

FINAL
BOXELDER CREEK
REGIONAL STORMWATER
MASTER PLAN

OCTOBER 2006



FINAL BOXELDER CREEK REGIONAL STORMWATER MASTER PLAN

TECHNICAL REPORT

OCTOBER 2006

Prepared for:



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Fort Collins, Colorado
&
The Boxelder Creek Regional Alliance

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Acronyms

ACE	Anderson Consulting Engineers
BCA	Benefit-Cost Analysis
CDOT	Colorado Department of Transportation
cfs	cubic feet per second
CLOMR	Conditional Letter of Map Revision
CWCB	Colorado Water Conservation Board
DFIRM	Digital Flood Insurance Rate Map
FAC	Financial Advisory Committee
FEMA	Federal Emergency Management Agency
FIA	Federal Insurance Administration
FIS	Flood Insurance Study
GIS	Geographic Information System
GMA	Growth Management Area
IGA	Inter-Governmental Agreement
LID	Local Improvement District
LOMA	Letter of Map Amendment
LOMR	Letter of Map Revision
NRCS	National Resource Conservation Service
PDM	Pre-disaster Mitigation
PID	Private Improvement District
RCBC	Reinforced Concrete Box Culverts
ROW	Right-of-Way
SCS	Soil Conservation Service
SEO	State Engineers Office
TAC	Technical Advisory Committee
USACE	United State Army Corps of Engineers
WSEL	Water Surface Elevation

Acknowledgements

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Lindsay Kilmenson
Kelly Gottschalk
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Kutak Rock
Stifel, Nicolaus & Co., Inc.
Stifel, Nicolaus & Co, Inc.

Executive Summary

Boxelder Creek is a natural creek which flows generally from north to south, draining an approximately 265 square mile watershed extending from southern Wyoming to its confluence with the Cache la Poudre River southeast of Fort Collins, Colorado. The lower portion of the watershed is highly urbanized, has a history of flooding and is impacted by numerous existing man-made structures (irrigation canals, culverts, etc.) The existing 100-year floodplain that was recently adopted by the Federal Emergency Management Agency (FEMA) impacts many existing residential and commercial properties and limits the ability for future development within what has become a highly desirable area.

Storm drainage problems have long plagued the Boxelder Creek watershed, particularly the developing area from just north of the Town of Wellington, Colorado to just south of Timnath, Colorado. Recently completed studies have suggested that damages from an infrequent flooding event would be severe and threaten both life and property. However, several stormwater mitigation alternatives that would reduce the threat of flood damage to existing homes and businesses and allow for the thoughtful and safe development of other vacant or agricultural properties have been identified.

The Boxelder Creek watershed and associated floodplain is unique in that it consists to a large degree of mostly undeveloped land (with the exception of Coal Creek within the Town of Wellington). This presents both an opportunity to implement flood and drainage mitigation projects prior to the area being developed and a constraint associated with the fact that most of the land is currently undeveloped and crosses jurisdictional borders. Further, it is not known how or when future development will occur and in what form it will take place. However, if flood hazard mitigation and drainage improvements are implemented in the near future, the basin and the area as a whole will benefit for years to come. All developing properties within the Basin will benefit “generally” while some properties (specifically those in the floodplain) will benefit “specially”.

Since the Boxelder Creek Watershed affects many property owners and several local governments, flood control mitigation should be developed through a cooperative effort among these affected interests. To that end, the Boxelder Creek Regional Alliance was formed to develop a regional solution that is more efficient and cost-effective to implement than the entities handling the flooding threat individually. The Regional Alliance consists of representatives from the following entities:

- Larimer County
- Town of Wellington
- City of Fort Collins
- Town of Timnath
- Town of Windsor
- The North Poudre Irrigation Company
- The Boxelder Sanitation District
- The New Cache la Poudre Irrigation Company
- A private property owner’s group
- Colorado Water Conservation Board (CWCB)

As part of the Regional Alliance, a Technical Advisory Committee (TAC) and Financial Advisory Committee (FAC) were established to oversee the technical and financial aspects respectively of a regional mitigation solution. Both the TAC and FAC were instrumental in the preparation of this Master Plan.

The Boxelder Creek Regional Drainage Master Plan was commissioned by the Regional Alliance in order to develop a regional strategy for mitigating the impacts associated with flooding within the Lower Boxelder Creek basin that impacts the communities of the Town of Wellington, the City of Fort Collins, the Town of Timnath and portions of Larimer County. The intent of the Regional Master Plan is to establish a cost-effective strategy for implementation that will benefit the local community both now and into the future. Several alternatives were developed and a Recommended Plan to minimize flooding extents was formulated. The Implementation Strategy developed includes mechanisms for funding the Recommended Plan.

Figure ES-1 provides a schematic overview of the Boxelder Creek Study Area and referenced flooding sources. **Figure ES-2** provides an overview of the Boxelder Creek floodplains and overall Study Area.

ES.1 Project Purpose and Need

The intent of this Regional Master Drainage Plan is to reduce the overall flood risk to residents within the Study Area. The primary goals of the Alliance for this study and project are:

1. To identify and size a system of improvements which will achieve the greatest defined economic benefit per dollar of cost based on the revised 100-year floodplain extents.
2. Identify potential funding mechanisms for the selected project.
3. Protect public welfare and property.

In order to meet all of the project goals, alternatives analysis and economic evaluations were conducted to aid in the selection of a “Recommended Plan”. This report details the selection of the “Recommended Plan” based on the above project goals.

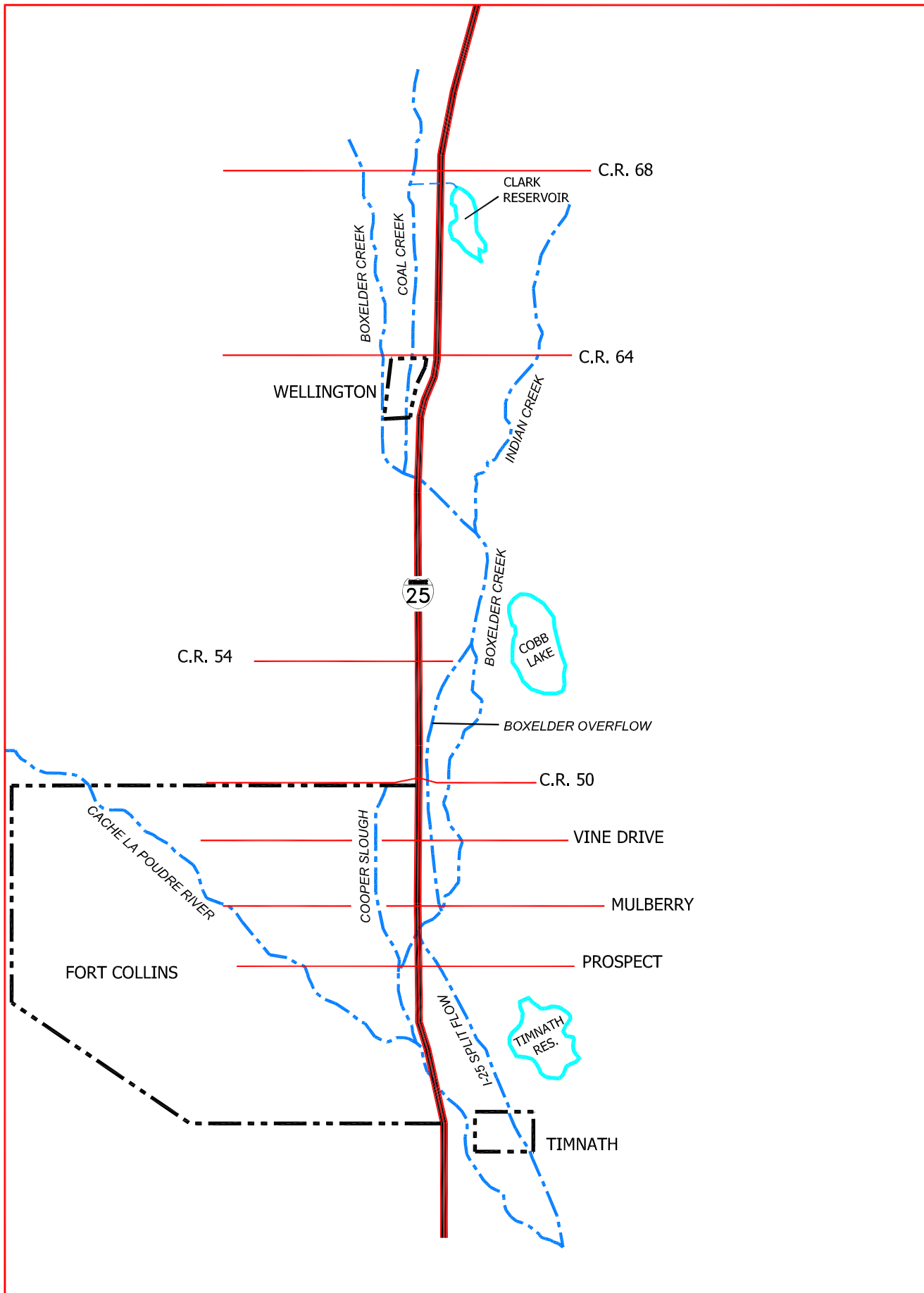


FIGURE ES-1
BOXELDER CREEK STUDY AREA
SCHEMATIC

ES-2
Northern Half

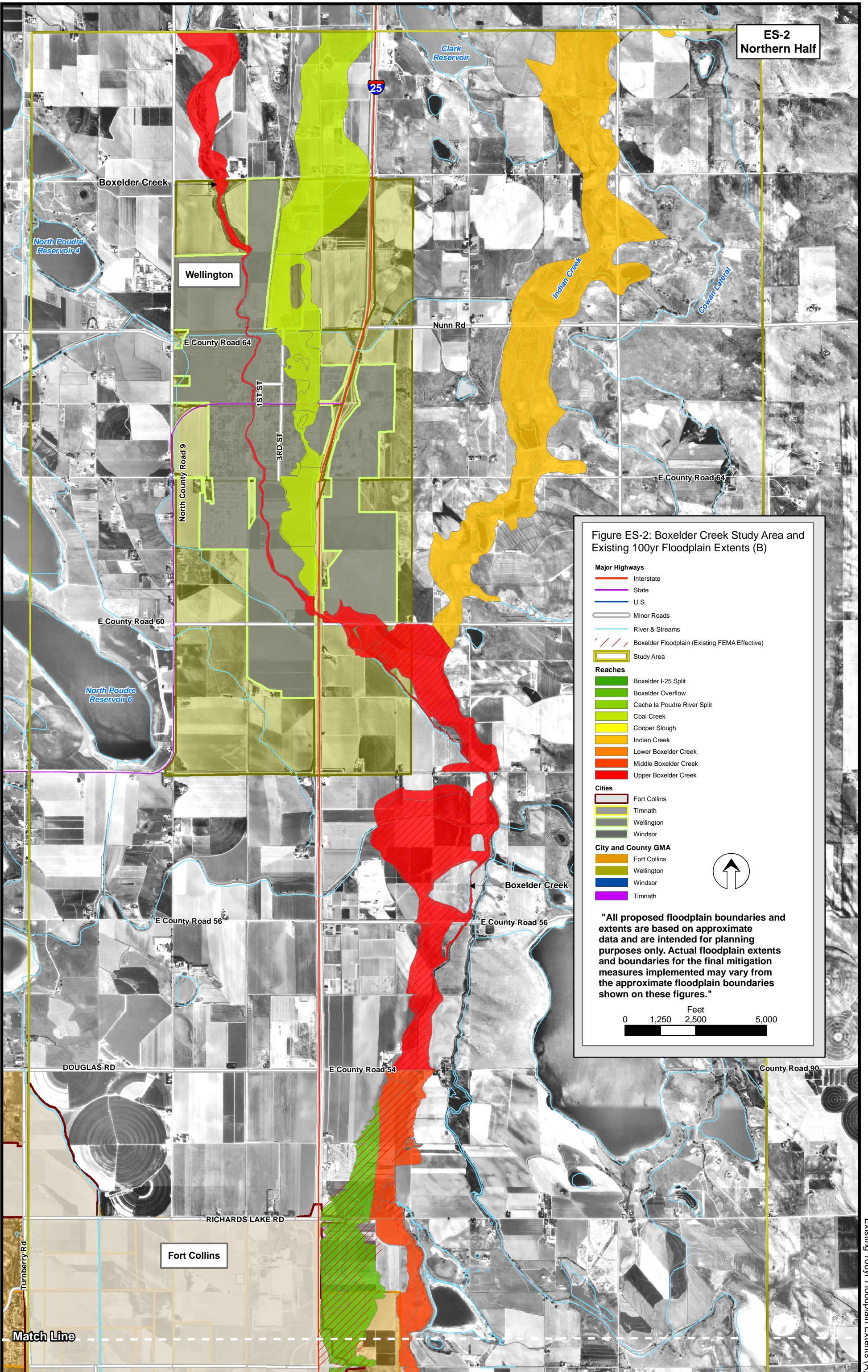


Figure ES-2: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (B)

- Major Highways**
- Interstate
 - State
 - U.S.
 - Minor Roads
 - River & Streams
 - Boxelder Floodplain (Existing FEMA Effective)
 - Study Area
- Reaches**
- Boxelder I-25 Split
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
- Fort Collins
 - Timnath
 - Wellington
 - Windsor
- City and County GMA**
- Fort Collins
 - Wellington
 - Windsor
 - Timnath

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

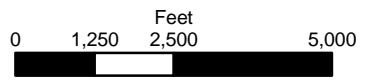


Figure ES-2: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (A)

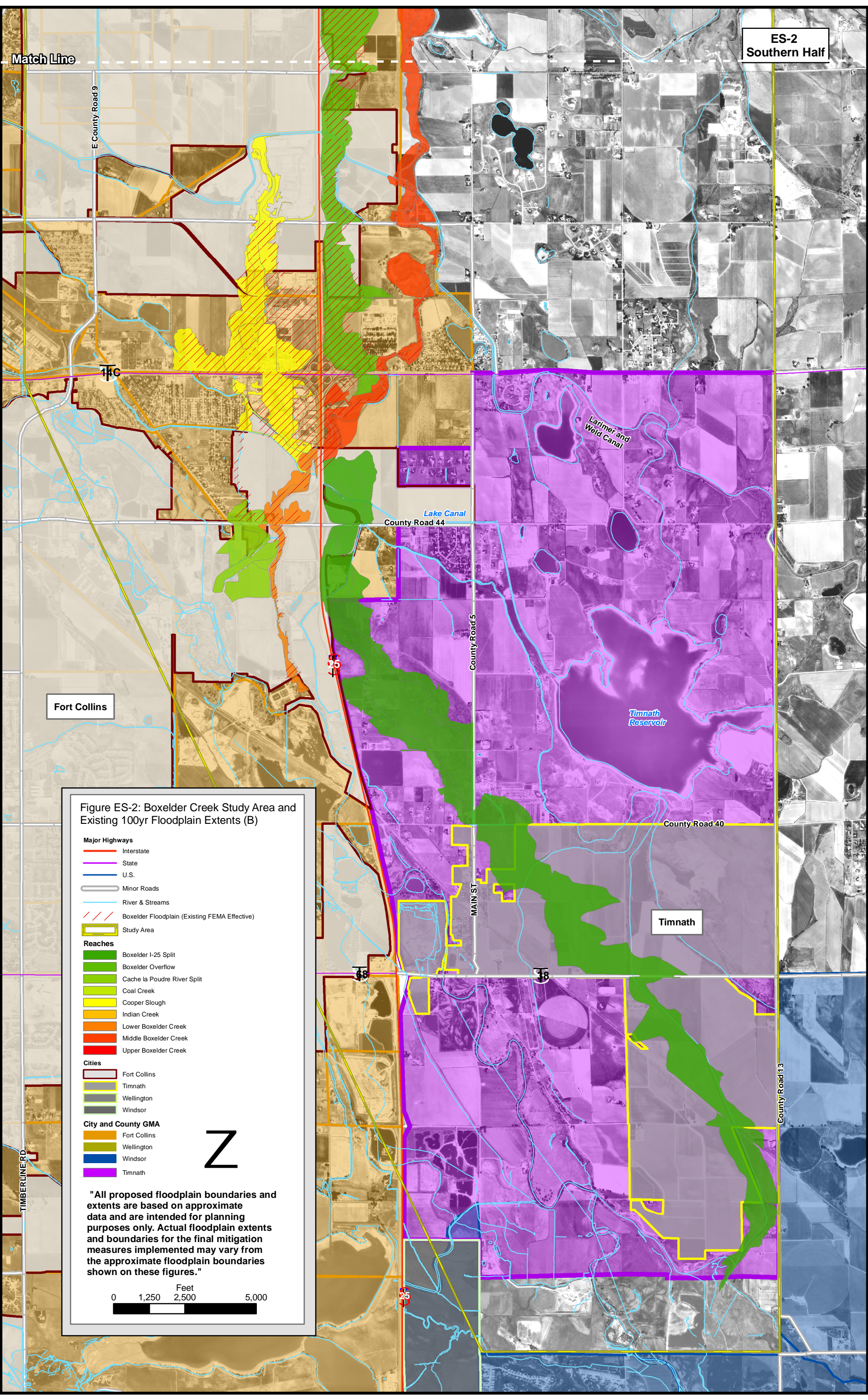
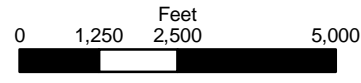


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"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."



ES.2 Summary of Existing Damages and Consequences

The Boxelder Creek 100-year floodplain impacts approximately 4,900 acres of land within the Study Area. While average floodplain velocities and depths are low (depths less than 3 feet and velocities less than 2.5 feet per second), the hazard associated with the flooding is estimated to be high due to the numerous split flows and diversions which occur within the basin. Flow paths are not well defined and the existing channel system and cross culverts are not capable of conveying large quantities of runoff. Numerous roads would overtop during the 100-year frequency flooding event. Due to the numerous split flows and diversions that occur, the potential for overtopping frequently used roads and the probability of the existing conveyance system to become blocked, there is the potential for loss of life and/or bodily injury during an extreme runoff event within the Study Area. **Table ES-1** summarizes the estimated damages during a 100-year frequency flooding event.

Major floods have occurred within the Boxelder Basin in 1909, 1922, 1930, 1937, 1947, 1963, 1967 and 1969. In 1947, the *Fort Collins Coloradoan* included a headline that read “Violent Rainstorm Floods Large Area; Crop Losses Heavy”. As much as five (5) inches of rain fell northwest of Wellington, washing out bridges and flooding crops. Nearly 1,000 acres of grain, alfalfa and corn crops were damaged. Heavy rains caused Boxelder Creek to overflow its banks again in 1967 and resulted in the death of a mother and her three daughters. The woman and her daughters drove into the flooded creek where it passed over a county road southwest of Wellington. Floods that summer destroyed county bridges seven times. On June 5, 1967, the headlines in the *Coloradoan* read “Another Auto Plunges into Boxelder”.

There are several existing flood control structures north of the Town of Wellington that were constructed by the Natural Resources Conservation Service (NRCS) in the 1960’s. Although the existing NRCS flood retarding structures located north of the project area have resulted in a significant reduction in the flooding hazard within downstream areas, significant growth and urbanization has increased the potential for flooding damages and the potential for injury and/or loss of life. Recent studies and reports have concluded that the potential for flooding within the urbanized areas of the Boxelder Creek watershed during an infrequent (100-year frequency) rainfall event is high.

There are several critical structures within the 100-year floodplain boundary including two schools in Wellington (Eyestone Elementary School and Wellington Junior High School) and two gas stations and liquid propane storage facility within the study area near the City of Fort Collins. Numerous business and commercial facilities within Larimer County, the City of Fort Collins and the Town of Wellington would be impacted. Access to an electrical substation would be cut off. Over 18 detention ponds and irrigation storage reservoirs, 4 irrigation canals and 30 roads are predicted to overtop and likely be damaged during the 100-year flood event within the Study Area. Most roads would overtop by approximately 1 to 2 feet. In addition, there are numerous sanitary sewers, electrical lines, water transmission lines and other infrastructure that could be impacted and/or damaged.

In addition to significant property damage and potential for injury and loss of life, the Boxelder Creek floodplain within the Study Area significantly impacts expected development opportunities. Much of this floodplain is in already developed or planned development areas.

However, the Boxelder Overflow and I-25 split occur within prime development areas along the I-25 corridor that are currently undeveloped. The existing FEMA regulatory floodplain significantly limits the uses of these lands.

Table ES-1: Estimated Existing Damages Summary			
Reach/Entity	Estimated Present Worth of Damages	Structures Impacted During the 100-year Flood	No. of Roads Overtopped⁴
<i>By Jurisdiction</i>			
Larimer County/City of Fort Collins	\$76.9 million	400	24
Town of Wellington	\$29.5 million	220	4
Town of Timnath	\$3.4 million	50	5
TOTAL	\$109.8 million	670	33

ES.3 Alternatives Assessment

Several alternatives to meet the objectives of this Master Plan were developed and evaluated. Five (5) alternatives were evaluated as part of this Master Plan and included both non-structural and structural components. Costs and benefits have been estimated for each of these alternatives and the alternatives were evaluated for benefit/cost and utilizing an alternatives evaluation matrix. The alternatives evaluated included the following:

- Alternative 1 – Non-jurisdictional Alternative
- Alternative 2 – Non-regional Conveyance Alternative
- Alternative 3 – Regional Storage Alternative
- Alternative 4 – Upstream Regional Storage to Minimize Downstream Splits/Diversions
- Alternative 5—Optimized Regional Storage and Conveyance

A brief description of each alternative is provided below.

Alternative 1

Under this alternative, there are no regional or other community funded projects considered and each individual property owner is assumed to be responsible for handling floodplain issues and drainage problems. This is a highly unlikely scenario as there are existing Stormwater Utilities and other funding associated with the majority of the areas impacted and, as such, some municipal involvement is inevitable. However, for comparison purposes, this alternative was evaluated to compare benefits versus cost.

Under this alternative, each individual property owner could encroach onto the 100-year floodplain extents but would not be able to encroach into the defined floodway. Land values associated with areas within the flood fringe and floodway are therefore significantly different. In addition, as the floodplain cuts across most of the developable land, the entire parcel value could be reduced as a result. Engineering fees would be required as each parcel would need to get approval from FEMA via a Letter of Map Amendment (LOMA) or a Letter of Map Revision (LOMR). Engineering and permitting fees associated with preparing such documentation is

estimated to be on the order of \$10,000 to \$25,000 per parcel. In addition, fill for each parcel would be required to raise proposed structures above the estimated 100-year flooding event. In most cases, 1-3 feet of fill would be required and an additional cost would be incurred as a result of encroaching into the floodplain. For existing structures in the floodplain, it was assumed that approximately 330 structures would require floodproofing at an estimated cost of \$15,000 per structure.

- **Total Estimated Implementation Cost:** \$41.9 million (does not include costs for road or other local improvements)
- **Total Floodplain Area Removed:** 0
- **Structures Removed from 100-year Flood Extents:** 0

Alternative 2

This alternative assumes that each jurisdiction would independently develop mitigation alternatives that impact primarily only areas within that jurisdiction. Currently and prior to formation of the Regional Alliance, this was the direction that most of the affected parties were considering. In general, this alternative includes only channelization and diversion components and no regional detention is specified. The project components of this alternative have been previously evaluated in other reports prepared for the respective communities and private interests.

It should be noted that this alternative, since it does not include any regional features, would not remove a substantial amount of floodplain or reduce the flooding hazards between the Town of Wellington and the I-25 crossing of Boxelder Creek.

The key project components consist of the following:

1. Undetained overflow diversion of Coal Creek (Town of Wellington).
2. Channel and conveyance improvements between County Road 58 and Highway 14 (new Boxelder Creek Overflow Channel for approximately 5,000 cfs).
3. Prospect Road Improvements/Lake Canal-Alternative E (City of Fort Collins).
4. Diversion of Boxelder I-25 split flow for approximately 4,200 cfs (Private owners).
5. Timnath Diversion Channel-Alternative 2 for approximately 4,200 cfs (Town of Timnath).

Under this alternative, it is assumed that local drainage channels will be required within the Town of Wellington to handle local runoff generated within the basin below the diversion to Clark Reservoir.

The undetained diversion of Coal Creek into Boxelder Creek could increase the flooding and/or erosion potential in Boxelder Creek. This impact was not studied in detail as part of the Master Plan, however, it is an impact that should be considered in the final decision making process.

Note: The potential widening of the I-25 corridor could provide an opportunity for construction of an adjacent Boxelder Creek Overflow channel from County Road 52 to Highway 14 and to accommodate a diversion channel for the Boxelder Creek I-25 split flow to the proposed Timnath diversion channel.

- **Total Estimated Implementation Cost:** approximately \$58.3 million
- **Total Floodplain Area Removed:** approximately 1,750 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 219

Alternative 3

This alternative is a basin-wide regional alternative that was evaluated by the City of Fort Collins as part of the Boxelder/Cooper Slough Master Planning effort; however, this alternative was not selected as the preferred alternative by the City of Fort Collins (as this is a more costly Regional Project that benefits many properties outside of the City of Fort Collins jurisdictional limits). The alternative utilizes regional detention to capture and attenuate storm runoff within both the Boxelder and Cooper Slough basins. The major project components in this alternative include the following:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 990 acre-feet of storage).
3. Roadway crossing improvements along major drainage corridors (3,000 to 3,500 cfs design conveyance capacity).
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements.
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (for approximately 3,000 cfs conveyance capacity).
6. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** approximately \$36.2 million
- **Total Floodplain Area Removed:** approximately 2,670 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 306

Alternative 4

This alternative includes the components included in Alternative 3 and adds storage at either Upper or lower Gray Lakes or at a new detention facility upstream of County Road 50 (Mussetter Alternative D). This alternative would further reduce discharges in Boxelder Creek from County Road 50 downstream through the City of Fort Collins, making conveyance improvements in this reach smaller.

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 990 acre-feet of storage).
3. Roadway crossing improvements along major drainage corridors (1,100 to 3,000 cfs design conveyance capacity).
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements (reduced design conveyance capacity).
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (for approximately 3,000 cfs conveyance capacity).
6. New detention storage at County Road 50 (optimized to minimize peak discharge at I-25 box culverts to approximately 1,800 cfs; 1,580 acre-feet of storage required).
7. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** approximately \$41.9 million
- **Floodplain Area Removed:** approximately 2,880 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 330

Alternative 5

Alternative 5 includes optimizing the upstream storage to minimize the need for diversions below the I-25 culvert crossing. The I-25 culverts with all four (4) cells open have a maximum capacity of approximately 3,600 cfs (based on previous hydraulic modeling). In this alternative, it is assumed that some flow (approximately 500 cfs) would be diverted below the I-25 box culverts through Timnath. Therefore, upstream storage has been optimized to: 1) eliminate the Boxelder overflow and spills into Copper Slough and 2) minimize the total peak discharge at the I-25 box culverts to approximately 4,100 cfs.

Two (2) scenarios for optimizing storage were evaluated: The first at the County Road 50 storage area and the second at the Edson Reservoir site.

Based on updating the available hydrologic model for the watershed, the following components are included in Alternative 5:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Roadway crossing improvements along major drainage corridors of Boxelder Creek (for total peak discharge of 3,800 to 6,300 cfs).
3. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements.

4. Improvement of Boxelder Creek from County Road 50 to County Road 54 (total design conveyance capacity of approximately 6,200 cfs).
5. New detention storage at County Road 50 (approximately 635 acre-feet).
6. Diversion of Boxelder I-25 split flow (assumed design conveyance capacity of approximately 500 cfs) (Private owners).
7. Timnath Diversion Channel (assumed design conveyance capacity of approximately 500 cfs (Town of Timnath).
8. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** \$38.9 million
- **Total Floodplain Area Removed:** approximately 2,400 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 305

Alternative 5A includes optimizing storage at Edson Reservoir and includes the following components:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 660 acre-feet of storage).
3. Roadway crossing improvements along major drainage corridors of Boxelder Creek (for total peak discharge of 3,600 cfs to 4,100 cfs). Prospect Road/Lake Canal Improvements.
4. Improvement of Boxelder Creek from County Road 50 to County Road 54 (total design conveyance capacity of approximately 3,600 cfs).
5. Diversion of Boxelder I-25 split flow (assumed design conveyance capacity of approximately 500 cfs) (Private owners).
6. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements.
7. Timnath Diversion Channel (assumed design conveyance capacity of approximately 500 cfs (Town of Timnath).
8. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** \$35.6 million
- **Total Floodplain Area Removed:** approximately 2,500 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 310

ES.4 Recommended Alternative

The alternatives were evaluated for benefit, cost and the overall effectiveness of being implemented. A summary of the benefits, costs and evaluation scores are summarized in **Table ES-2**.

Parameter	Alternative 1 – No Action	Alternative 2 – Non-regional Conveyance	Alternative 3 – Regional Storage	Alternative 4-Maximize Regional Storage	Alternative 5 – Optimize Storage and Conveyance	Alternative 5A – Optimize Storage and Conveyance
Total Land Removed from Floodplain (acres)	0	1,750	2,670	2,770	2,490	2,535
Structures Removed from Floodplain	0	219	306	330	306	306
Agricultural Land removed from Floodplain (acres)	0	1,020	1,410	1,530	1,410	1,410
Roadways Removed from Flooding	0	33	33	33	33	33
Benefits						
<i>Estimated Local Benefits</i>	\$24 million	\$40 million	\$53 million	\$54 million	\$52 million	\$52 million
<i>Estimated Regional Benefits</i>	\$0 million	\$18 million	\$26 million	\$27 million	\$26 million	\$26 million
Total Benefits	\$24 million	\$58 million	\$79 million	\$81 million	\$78 million	\$78 million
Implementation Costs	\$42 million	\$58 million	\$36 million	\$42 million	\$39 million	\$36 million
Evaluation Matrix Score	2.3	2.1	3.3	3.2	3.4	3.9
Benefit/Cost Ratio	0.6	0.9	2.1	1.8	1.9	2.1
Cost per acre removed from floodplain	N/A	\$33,400	\$14,600	\$16,100	\$16,700	\$15,100

Based on the evaluations undertaken and numerous discussions with the TAC and FAC, the preferred alternatives for the Boxelder Creek Regional Plan were reduced to Alternative 5A and Alternative 3. Alternative 3 requires additional storage upstream, however, it reduces the need for a diversion for the I-25 split flow (the peak discharges are reduced sufficiently to eliminate the split flow entirely). However, due to timing of the Timnath diversion channel and the desire to develop properties below the I-25 split flow, Alternative 5A represents an optimized solution of storage and conveyance. Both regional alternatives have a benefit/cost ratio greater of approximately 2.0 and a total implementation cost of approximately \$36 million.

Further evaluations were conducted to determine the overall impact of constructing specific components of Alternative 3 and 5A, specifically, the upstream storage and its impacts on downstream areas. Based on these evaluations, it was determined that the largest regional benefit was a direct result of both the Coal Creek diversion to Clark Reservoir and the proposed Edson Reservoir. Further, it was concluded that the Middle Boxelder Creek Improvements and I-25 split flow diversion (in the case of Alternative 5A) have direct Regional Benefits, as they reduce the potential flooding in other areas as well as locally. The Middle Boxelder Creek Improvements would eliminate the Boxelder Overflow floodplain and significantly reduce the potential for overflows into the Cooper Slough Basin. The I-25 Split Flow Diversion Channel (if

required) would allow for the I-25 box culverts to be opened without adversely impacting areas downstream.

The TAC therefore recommended that Alternative 3 be considered for further implementation. The improvements would be made in three (3) phases and include Regional contributions in combination with other locally funded project components. **Figure ES-3** provides a graphic representation of the proposed project improvements and resulting approximate floodplain extents with the improvements as constructed.

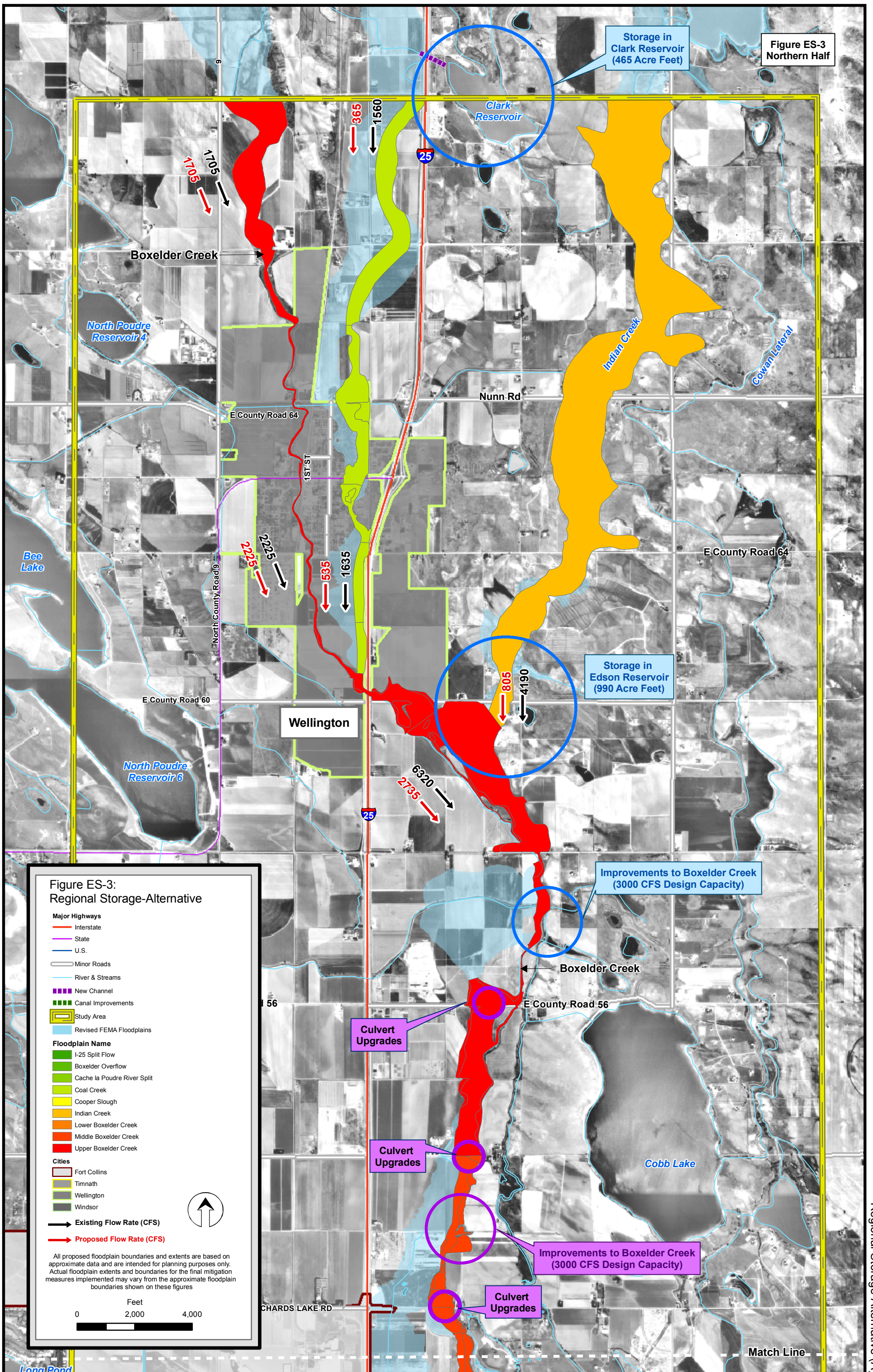
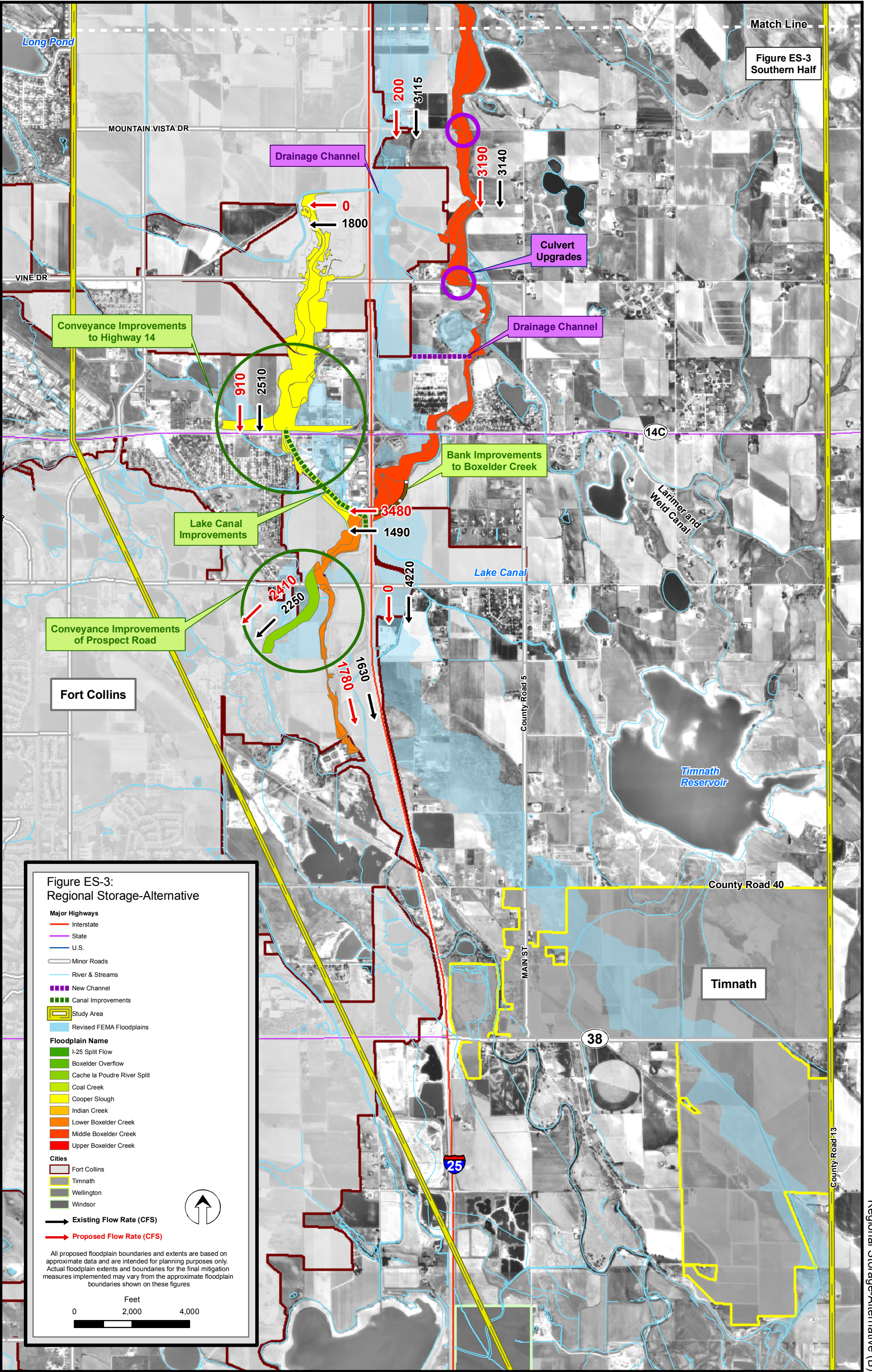


Figure ES-3: Regional Storage-Alternative (A)

Match Line
Figure ES-3
Southern Half



**Figure ES-3:
Regional Storage-Alternative**

Major Highways

- Interstate
- State
- U.S.
- Minor Roads
- River & Streams
- New Channel
- Canal Improvements
- Study Area
- Revised FEMA Floodplains

Floodplain Name

- I-25 Split Flow
- Boxelder Overflow
- Cache la Poudre River Split
- Coal Creek
- Cooper Slough
- Indian Creek
- Lower Boxelder Creek
- Middle Boxelder Creek
- Upper Boxelder Creek

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

Existing Flow Rate (CFS)

Proposed Flow Rate (CFS)

All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures

Feet
0 2,000 4,000

Figure ES-3:
Regional Storage-Alternative (B)

ES.5 Summary of Recommended Alternative

The Recommended Alternative is proposed to be funded through both Regional Contributions (Phase I) and Local Contributions (Phase 2 and 3). The Alliance proposes to form a Storm Drainage Authority (the “Authority”) pursuant to Colorado law, providing for intergovernmental contracting ability. The Authority will be responsible for implementing the Regional Improvements (Phase I) highlighted below. It is anticipated that a CWCB low-interest loan will be obtained for construction of the facilities and will be paid back through monthly fees and charges as well as a system of development fees raised by the Authority from properties located within the Boxelder Creek Drainage Basin. Grants will also be pursued to offset some of the costs associated with the project.

It is expected that an Inter-Governmental Agreement (IGA) among the City of Fort Collins, Town of Wellington and Unincorporated areas of Larimer County will be required in order to form the Authority.

The recommended alternative for the Boxelder Creek Regional Drainage Improvement Project consists of the following project phases and components:

Regional Improvements, Phase I: Edson Reservoir, Coal Creek Diversion to Clark Reservoir, Middle Boxelder Improvements (2007-2010)

Depending on the preliminary design of available upstream storage at the proposed Edson Reservoir site, additional storage and/or diversion of the I-25 split flow channel may be required.

- **Diversion of Coal Creek to Clark Reservoir (approximately 465 acre-feet design capacity) (Implementation Period: 2007-2010)**
 - Improvement of the North Poudre Canal to capture and convey Coal Creek flood flows into Clark Reservoir (approximately 1,560 cfs design capacity)
 - Culvert crossings associated with the North Poudre Canal at I-25 (design capacity approximately 1,560 cfs)
 - Dredging of Clark Reservoir (approximately 532,400 cubic yards to provide for approximately 465 acre-feet of flood storage within the top 3 feet of the existing reservoir)
 - Associated land acquisition and right-of-way (approximately 28.3 acres)
 - Spillway and outlet works improvements to Clark Reservoir to ensure adequate flood storage
 - Agreement associated with flood storage reserve capacity within the reservoir
 - Constructed and funded through the Boxelder Regional Alliance (potential for FEMA PDM grants and CWCB Low-interest loans)

- ✓ **Estimated Construction Cost: \$6.2 million**
- ✓ **Regional Benefits:** Reduces peak discharges downstream (approximately 90% in Coal Creek; 5-10% in Boxelder Creek) via attenuation in Clark Reservoir

- ✓ **Local Benefits:** Reduces floodplain extents by approximately 150-215 acres; minimizes flooding potential and damages for approximately 180 structures (including 2 schools, community center, residential and commercial structures)

➤ **Construction of Edson Reservoir (approximately 660 to 990 acre-feet design capacity) (Implementation Period: 2008-2010)**

- Construction of an earthen embankment and ungated outlet to impound approximately 660 to 990 acre-feet of storage on Indian Creek just upstream of County Road 60
- Associated land acquisition and right-of-way (approximately 90 to 131 acres)
- Depending on the final available storage volume at the Edson site, a diversion at the Boxelder I-25 split flow may be required (maximum discharge of 700-1,000 cfs)
- Constructed and funded through the Boxelder Regional Alliance (potential for NRCS grants and CWCB Low-interest loans)

- ✓ **Estimated Construction Cost: \$4.1 to \$6.1 million** (\$5.1 million assumed for cost estimating purposes)
- ✓ **Regional Benefits:** Significantly reduces peak discharges downstream (approximately 40-60%) via attenuation in Edson Reservoir; minimizes size of required downstream conveyance improvements; reduces floodplain extents and potential for downstream split flows
- ✓ **Local Benefits:** Minimizes flooding potential and damages to approximately 165 existing structures within Larimer County and Fort Collins (in conjunction with other improvements)

➤ **Middle Boxelder Creek Stream Improvements (approximately 3,600 to 4,100 cfs design capacity) (Implementation Period: 2008-2010)**

- Improvements to Middle Boxelder Creek from County Road 54 to County Road 52 (3,600 to 4,100 cfs design capacity)
- Construction of two (2) storm drainage channels to direct flow to Boxelder Creek
- Constructed and funded through the Boxelder Regional Alliance (potential grants from USFWS, USEPA, Parks and Trails Districts)

- ✓ **Estimated Construction Cost: \$1.1 million**
- ✓ **Regional Benefits:** Potential trail and recreational opportunities
- ✓ **Local Benefits:** Reduces potential for overflow and split flows adjacent to I-25 and impacting Cooper Slough; removes approximately 535 acres of the Boxelder Overflow (in conjunction with upstream detention)

➤ **Construction of a siphon/wasteway structure along the Larimer and Weld Canal at Boxelder Creek (Implementation Period: 2009-2010)**

- Siphon (design capacity equal to the decreed capacity of the Larimer and Weld Canal) or wasteway structure (3,600 cfs design capacity)

- Constructed and funded through the Boxelder Regional Alliance

- ✓ **Estimated Construction Cost: \$1.3 million**
- ✓ **Regional Benefits:** : Reduces overtopping potential of the Larimer and Weld Canal and diversion of floodwater to Cooper Slough
- ✓ **Local Benefits:** Minimal

Total funding requirement for the Phase I Regional Improvements is approximately \$13.7 million (depending on the final design of Edson Reservoir and available storage; other sites including the CR50 Storage Site may be evaluated during preliminary design).

- **Construction of the I-25 Split Flow Diversion Channel (ties into the Timnath Diversion channel) for between 700 and 1,000 cfs capacity (Regional Alliance along with Private Developers)**

Depending on the amount of detention storage available at the Edson site, a partial diversion of Boxelder Creek overflows at the I-25 split may be required. Design discharges will be significantly reduced as a result of the Regional Improvements implemented. Private interests will only be responsible for that portion of the diversion channel that directly impacts individual property interests.

- 50 to 150-wide footprint including a diversion channel and a regional trail incorporated onto a bench of the channel
- Approximately 6,800 feet long (from Boxelder Creek to County Road 42E)
- Overflow structure on the right bank of Boxelder Creek upstream of I-25 crossing
- Compound channel section with 700-1,000 cfs design capacity channel utilized to minimize the footprint for future conditions (assuming Regional storage is constructed)
- Associated land acquisition and right-of-way (approximately 10 acres)
- Flume and siphon crossing at Cache la Poudre Reservoir Inlet Ditch (CLPRID)
- Flume and siphon crossing at Lake Canal
- Seven 8' high by 10' wide culvert (or similar conveyance bridge) crossing at Prospect Road
- Constructed by the Boxelder Regional Alliance (if required) based on the final design of Edson Reservoir.

- ✓ **Estimated Construction Cost: \$0 to \$1.6 million** (assumed to be \$1 million for cost estimating purposes)
- ✓ **Regional Benefits:** Trail system; provides open space; protects County Road 42E, CLPRID and Lake Canal
- ✓ **Local Benefits:** Removes approximately 300 acres from floodplain, minimizes flooding potential to approximately 8 existing structures

Other Non-Regional Improvements, Phase II: Prospect Street Improvements and Cache la Poudre Overflow (2007-2009)

The following improvements are required such that the existing box culvert plugs at the I-25 crossing can be removed. Costs for these improvements may be partially funded by the City of Fort Collins. The Regional Improvements will significantly reduce the design flows within the Cooper Slough Basin that contribute to the flooding potential within Boxelder Creek downstream of Prospect Road. However, flows will increase as a result of increasing the conveyance capacity of the I-25 box culverts (i.e. removing the plugs).

➤ **Improvements to Prospect Road West of I-25 (approximately 4,500 cfs design capacity)**

- Improvement of Boxelder Creek from just upstream of I-25 to just downstream of Prospect Road (4,500 cfs design capacity)
- Culvert/bridge crossing of Prospect Road (4,500 cfs design capacity)
- Associated land acquisition and right-of-way (approximately 1.5 acres)
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$3.9 million**
- ✓ **Regional Benefits:** Allows for removal of the Boxelder Creek I-25 culvert plugs (reduces potential for split flow downstream of I-25 crossing of Boxelder Creek)
- ✓ **Local Benefits:** Minimizes flooding potential and damages to existing structures and facilities; minimize overtopping potential of Prospect Road; minimizes overtopping potential of the CLPRID and Lake Canal; removes approximately 15 acres from the existing floodplain

➤ **Cache la Poudre Overflow (approximately 2,500 cfs design capacity)**

- Construction of a side-flow spillway structure on Boxelder Creek, just downstream of Prospect Road (2,530 cfs design capacity)
- Construction of an outfall channel and swale to convey flows to an existing oxbow of the Poudre River (2,530 cfs design capacity)
- Associated land acquisition and right-of-way (approximately 20.1 acres)
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$2.2 million**
- ✓ **Regional Benefits:** Allows for removal of the Boxelder Creek I-25 culvert plugs (reduces potential for split flow downstream of I-25 crossing of Boxelder Creek); potential recreational opportunities
- ✓ **Local Benefits:** Minimizes flooding potential and damages to existing structures and facilities; removes approximately 80 acres from floodplain; minimize overtopping potential of Prospect Road; minimizes overtopping potential of the CLPRID and Lake Canal

Total funding requirement for Phase II is approximately \$6.1 million.

Other Local Improvements, Phase III: Middle Boxelder Creek Road Crossing Improvements and Cooper Slough/Mulberry Street and Lake Canal Improvements (2010-2020)

Phase III of the Proposed Improvements will consist of increasing the conveyance capacity at County Road crossings and providing improvements to within the Cooper Slough Basin at Mulberry Street and the Lake Canal. Costs for these improvements may be born from the Regional Funding mechanism and may be partially funded through agreements with Private Developers. The Regional Improvements will significantly reduce the design flows within the Cooper Slough Basin that contributes to the flooding potential within Boxelder Creek downstream of Prospect Road.

➤ **Boxelder Creek Road Crossing Improvements (Larimer County and Private Developers)**

These improvements will be implemented as roadways and development progresses north towards Wellington. Design discharges will be significantly reduced as a result of the Regional Improvements implemented.

- Installation of culvert/bridge crossings on Boxelder Creek at County Road 58, County Road 56, County Road 54 (Douglas Road), County Road 52, County Road 50 (Mountain Vista Road), County Road 48 (Vine Drive) and State Highway 14 (Mulberry Street) (3,600 to 4,100 cfs design capacity)
- Constructed and funded as development and roadway improvements progresses

- ✓ **Estimated Construction Cost: \$8.4 million**
- ✓ **Regional Benefits:** Minimizes potential for road overtopping and erosion; potential recreational opportunities
- ✓ **Local Benefits:** Reduces potential for overflow and split flows

➤ **Cooper Slough/Mulberry Street and Lake Canal Improvements (City of Fort Collins and Private Developers)**

These improvements will be implemented and coordinated with the City of Fort Collins as development progresses. Design discharges will be significantly reduced as a result of the Regional Improvements implemented.

- Construction of a side-flow spillway structure on the Lake Canal, just upstream of State Highway 14 along with an outfall channel from Lake Canal to the crossing at State Highway 14 (910 cfs design capacity).
- Improvement of the Lake Canal from the confluence with Copper Slough to Boxelder Creek Minor bank improvements to the Cache la Poudre Reservoir Inlet Ditch (CLPRID).
- Improvements to Cooper Slough from State Highway 14 to its termination in the Lake Canal (910 cfs design capacity).
- Local drainage improvements at Mulberry Street including upgrading culvert crossings for Cooper Slough
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$3.6 million**
- ✓ **Regional Benefits:** Minimal
- ✓ **Local Benefits:** Reduces floodplain extents and potential for damages to approximately 90 residential and commercial structures; removes approximately 130 acres from floodplain

Total funding requirement for Phase III is approximately \$12.0 million.

Total Regional Project Costs are estimated to be \$13.7 million. Total Project costs are estimated to be approximately \$32.8 million.

In addition, to the above Regional Improvements, the Town of Timnath is moving forward with a local diversion project that will provide conveyance for the entire existing condition FEMA 100-year regulatory flow discharge (approximately 2,800 cfs). With the above Regional Improvements, the I-25 split flow will be reduced from between 0 to approximately 1,000 cfs (depending on available storage within Edson Reservoir). As such, the size of the Timnath Diversion Channel could be significantly reduced or eliminated. However, timing of the Regional project has prompted the Town of Timnath to progress with the design and construction of a diversion channel to accommodate the FEMA regulatory flow rates. If timing allows, Timnath may elect to contribute to the Regional project. The current plans for the Timnath Diversion channel include the following:

- 150-wide footprint including a diversion channel and a regional trail incorporated onto a bench of the channel
- Approximately 7,920 feet long (from County Road 42E to confluence with the Cache la Poudre River via Oxbow Lake)
- Associated land acquisition and right-of-way (approximately 42.5 acres)
- Flume and siphon crossing at Unnamed Ditch
- Seven 8' high by 10' wide culvert crossing at County Road 40
- Constructed and funded by the Town of Timnath and Private Developer interests.

- ✓ **Estimated Construction Cost: \$0 to \$5.7 million** (not included in Regional funding strategies)
- ✓ **Regional Benefits:** Trail system; provides open space
- ✓ **Local Benefits:** Removes approximately 760 acres from floodplain; minimizes flooding potential to approximately 45 existing structures

ES.6 Funding Strategy and Evaluations

The elements of the Boxelder Creek Regional Financing Strategy encompass the following key objectives:

1. **Benefits.** The benefits of a regional storm drainage plan and construction program would be many, and would include both local and regional benefits greater than the costs incurred (i.e. benefit/cost ratio greater than 1).
2. **Equitable Distribution of Costs.** It is most equitable to distribute costs of regional planning and improvements over a large area through recurring fees and charges imposed by a regional Storm Drainage Authority along with one-time system development fees imposed when a property is annexed or developed.
3. **Choice of Entity.** The vehicle that is recommended is a Storm Drainage Authority formed by an Intergovernmental Agreement among Larimer County, the Town of Wellington, the City of Fort Collins and any other jurisdictional entities that would like to participate. The Storm Drainage Authority would have the power to impose fees and charges throughout the Boxelder Creek Drainage Basin and to borrow money secured through bonds and loans to finance the proposed project.
4. **Role of Other Local Governments.** Colorado law provides that governmental entities may contract to provide to provide together, or through a mutually created entity, any function, service or facility which each of the governmental entities is lawfully authorized to provide. Governmental entities are specifically authorized to form drainage facilities and entities. If the decision is made to proceed through formation of an authority, it is anticipated that Larimer County, the Town of Wellington, the City of Fort Collins and possibly others will enter into an Intergovernmental Agreement governing the formation, duties and governance of the Storm Drainage Authority.

The financial analysis for the Boxelder Creek Drainage Improvement Project(s) paralleled the engineering efforts and has drawn from the results of the Plan and Strategy Implementation recommended by the TAC and FAC. As part of this effort, a grant and low interest loan search was performed and the results of potential external funding sources have been incorporated into the financial analysis as the best case scenario. An estimated range of fees that will be needed to fund the regional facilities is included in **Table ES-3**. Scenario 1 illustrates the projected fees required to pay for annual debt service to construct required capital facilities from 2007 to 2010 if all parcels currently in the Boxelder Creek floodplain are assessed the fees. The fees are shown first without the benefit of any grants or developer contributions (worst case scenario) and then with potential external funding (best case scenario). Scenario 2 provides the same best and worst case annual fee assessments but is based on only the fees being assessed on parcels actually removed from the flood plain. It is anticipated that the funding sources will be derived from

some combination from two groups of fee payers: One consisting of all owners of properties within the basin and the other consisting of owners or properties which will be removed from the floodplain through construction of the proposed improvements.

It is envisioned that the final funding allocations will be based on a combination of monthly fees per parcel and one-time development fees for all parcels within the basin. However, a reasonable rate (based on the evaluations undertaken) appears to be in the range of \$4 to \$10 per month for residential parcels and one-time development fees (for properties removed from the floodplain) of between \$1,300 to \$2,500 per acre. The final funding strategy for the Regional Improvements will be developed as part of establishing the Regional Drainage Authority.

Table ES-3: Economic Impacts of Fee Assessments for Regional Facilities per Year				
Scenario 1: Fees Assessed on All Parcels Currently in Flood Plain Only				
	Without Grants		With Grants	
	Number	Annual Fee	Number	Annual Fee
Per Acre	4,960	\$213.91	4,960	\$96.77
Per Parcel	809	\$1,311.50	809	\$593.33
Per Structure	693	\$1,531.02	693	\$692.64
Per \$ Assessed Valuation	\$124,516,961	\$0.009	\$124,516,961	\$0.004
Scenario 2: Fees Assessed Based On All Parcels in the Boxelder Basin				
	Without Grants		With Grants	
	Number	Annual Fee	Number	Annual Fee
Per Acre	5,290	\$200.57	5,290	\$90.74
Per Parcel	6,210	\$170.85	6,210	\$77.29
Per Structure	3,810	\$278.48	3,810	\$125.98
Per \$ Assessed Valuation	\$135,419,370	\$0.008	\$135,419,370	\$0.004

ES.7 Implementation and Funding Strategy

The objective of the funding strategy is to outline a strategy to fund the items in the list of Boxelder Creek Regional Drainage Improvement Projects (the “Regional Improvements”). The funding strategy assumes that purely local improvements would be constructed by individual property owners or small groups of property owners who would benefit from the local improvement.

Types of Benefit - The Technical Advisory Committee and the Financial Advisory Committee have identified various benefits from the Regional Improvements. All property in the Basin would benefit from the increased capacity to handle storm run-off, the decrease in both size and number of structures necessary to contain and route water, including decreased road crossings, and the increased level of public safety during flooding. Property located wholly or partly in the floodplain would have other potential benefits, including increases in property values attributable to rezoning and development and a decreased or eliminated need to pay flood insurance premiums.

Properties which Benefit Generally (Out of Floodplain)--General benefit is the benefit that is received generally by **all** properties contributing runoff to Boxelder Creek due to the reduction in improvements and services needed in the event of a flood. The Authority would identify the level of basin wide fees needed to provide a level of service consistent with the storm water master plan. If this amount is determined to be \$4 per month per average sized residence, then the Authority would assess \$4 per month to owners of average sized residences everywhere in the geographic area which is tributary to Boxelder Creek, regardless of jurisdiction.

<i>Proposed Fee</i>	<i>Improved Properties</i>	<i>Developing Properties</i>
Where assessed:	The Basin Tributary to Boxelder Creek	The Basin Tributary to Boxelder Creek
Type of Payment:	SWU Monthly Fee	System Development Fee
Basis of payment:	Acreage/Impervious	Acreage/Impervious
Requirements for Formation:	Intergovernmental Agreement	Intergovernmental Agreement

Properties which Benefit Specially (Being Removed from Floodplain)--Special benefit is the benefit that accrues only to **certain** properties by virtue of their removal from the floodplain. Such properties would pay a greater amount per acre because they have a greater benefit. In part, this will be paid through a floodplain removal fee paid by existing homeowners being removed from the floodplain. Properties developing after construction of the improvements will be asked to pay a one-time equity buy-in fee as a fair contribution or “reimbursement” to the Authority for their share of the capital investment in flood control facilities.

<i>Proposed Fee</i>	<i>Improved Properties</i>	<i>Developing Properties</i>
Where assessed:	In the current FEMA Floodplain	In the current FEMA Floodplain
Type of Payment:	Floodplain Removal Fee	Equity Buy-in Fee
Basis of payment:	Acreage	Acreage
Requirements for Formation:	Formal Public Election for owners of affected property	Intergovernmental Agreement

Sources of Revenue – The Financial Advisory Committee has sought to identify the most appropriate fees, charges or other sources of revenue to equitably distribute the costs of the

Regional Improvements. Under Colorado law, there are three forms of impositions or charges that can be used to pay for the Regional Improvements. First, there are fees for services which are imposed as a way of paying the cost of providing a specific service. Second, there are property taxes, which require a vote under TABOR. Third, there are assessments which are imposed on the basis of a specific benefit conferred on the property assessed. It is anticipated that the Regional Improvements will be funded primarily through fees for services. It is not anticipated that there will be any reliance on taxes or assessments to fund the Regional Improvements.

Two types of fees would be imposed throughout the Basin. The first would be a recurring monthly service charge to pay the cost of providing the service on an ongoing basis. The second would be a one-time fee, called a system development fee, that is imposed when a property is developed or annexed. It is expected that both types of fees would be used to pay the costs of the Regional Improvements.

Recommended Entity - A Regional Storm Drainage Authority (the “Authority”), operating as an enterprise for purposes of TABOR, is currently envisioned as the primary vehicle for funding the proposed Regional Improvements. The Authority would borrow money through the issuance of tax-exempt revenue bonds or notes to pay the costs of the Regional Improvements. Debt service on these obligations would be paid by the Authority from the service charges and system development fees, after payment of operation and maintenance expenses of the facilities operated by the Authority.

The Authority would be formed under an Inter-governmental Agreement (IGA) among participating governmental jurisdictions with land in the Basin. Pursuant to Colorado law, governmental entities may contract to perform together anything that could be done by each entity individually. Governmental entities are expressly authorized to contract to form a drainage authority. A drainage authority formed pursuant to such an agreement would have the authority, among others, to develop drainage facilities, to acquire, construct, manage, maintain or operate drainage facilities, to acquire or dispose of property used for drainage purposes, to condemn property, to incur debt and to impose rates and fees. The Authority would have a board of directors consisting of representatives appointed by the governing bodies of each of the sponsor governments. Under this plan the entire community within the Basin could pay for the proposed Regional Improvements on an equitable and fair basis. The terms of the IGA would define the structure and governance of the Authority. The Authority would act as a regional storm water utility service enterprise, and it would levy fees to provide regional storm water management and flood control services.

It is envisioned that it will take 3-5 years to implement the recommended alternative. The following steps are required prior to complete implementation of the recommended strategy:

1. Completion and adoption (by all affected jurisdictions) of this Master Plan. (December, 2006)
2. Completion of conceptual design and evaluations (including surveying and detailed hydrologic/hydraulic analysis) for the Recommended Alternative. (April, 2007)

3. Completion of a feasibility study and approval by CWCB for low-interest loan application. (May, 2007)
4. Preparation of a Conditional Letter of Map Revision (CLOMR) or Conditional Physical Map Revision (PMR) request and approval by FEMA. (July, 2007)
5. Completion and adoption of the recommend Financing Plan (November, 2007)
6. Completion and adoption (by all affected jurisdictions) of the Inter-governmental Agreement. (November, 2007)
7. Formation of the financing entity and Drainage Authority. (March, 2008)
8. Preliminary design of the Recommended Alternative. (July, 2008)
9. Final design and preparation of bid documents. (November, 2008)
10. Environmental and dam safety permitting associated with the Recommended Alternative. (May, 2009)
11. Selection of contractor. (June, 2009)
12. Construction. (July, 2009-October, 2010)
13. As-built documentation. (November, 2010)
14. Preparation of a Physical Map Revision (PMR) request and approval by FEMA. (April, 2011)
15. Revision to the FEMA regulatory floodplain maps. (October, 2011)

1.0 Introduction and Background

Boxelder Creek is a natural creek which flows generally from north to south, draining an approximately 265 square mile watershed extending from southern Wyoming to its confluence with the Cache la Poudre River southeast of Fort Collins, Colorado. The lower portion of the watershed is highly urbanized, has a history of flooding and is impacted by numerous existing man-made structures (irrigation canals, culverts, etc.). The existing 100-year floodplain that was recently adopted by the Federal Emergency Management Agency (FEMA) impacts many existing residential and commercial properties and limits the ability for future development within what has become a highly desirable area.

1.1 Project Purpose and Need

Storm drainage problems have long plagued the Boxelder Creek watershed, particularly the developing area from just north of the Town of Wellington, Colorado to just south of Timnath, Colorado. Recently completed studies have suggested that damages from an infrequent flooding event would be severe and threaten both life and property. However, several stormwater mitigation alternatives that would reduce the threat of flood damage to existing homes and businesses and allow for the thoughtful and safe development of other vacant or agricultural properties have been identified.

The Boxelder Creek watershed and associated floodplain is unique in that it consists to a large degree of mostly undeveloped land (with the exception of Coal Creek within the Town of Wellington). This presents both an opportunity to implement flood and drainage mitigation projects prior to the area being developed and a constraint associated with the fact that most of the land is currently undeveloped.

Since the Boxelder Creek Watershed affects many property owners and several local governments, flood control mitigation should be developed through a cooperative effort among these affected interests. To that end, the Boxelder Creek Regional Alliance was formed to develop a regional solution that is more efficient and cost-effective to implement than the entities handling the flooding threat individually. The Regional Alliance consists of representatives from the following entities:

- Larimer County
- Town of Wellington
- City of Fort Collins
- Town of Timnath
- Town of Windsor
- The North Poudre Irrigation Company
- The Boxelder Sanitation District
- The New Cache la Poudre Irrigation Company
- A private property owner's group

- Colorado Water Conservation Board (CWCB)

The Boxelder Creek Regional Drainage Master Plan was commissioned by the Regional Alliance in order to develop a regional strategy for mitigating the impacts associated with flooding within the Lower Boxelder Creek basin that impacts the communities of the Town of Wellington, the City of Fort Collins, the Town of Timnath and portions of Larimer County. The intent of the Regional Master Plan is to establish a cost-effective strategy for implementation that will benefit the local community both now and into the future. Several alternatives have been identified in order to minimize flooding extents and mechanisms for funding the alternatives have also been considered. Engineering models and tools have been utilized to estimate the benefits and costs associated with drainage improvement alternatives.

1.2 Goals of Boxelder Creek Regional Alliance

The intent of this study is to reduce the overall flood risk to residents within the Study Area. The primary goals of the Alliance for this study and project are:

1. To identify and size a system of improvements which will achieve the greatest defined economic benefit per dollar of cost based on the revised 100-year floodplain extents.
2. Identify potential funding mechanisms for the selected project.
3. Protect public welfare and property.

In order to meet all of the project goals, alternatives analysis and economic evaluations were conducted to aid in the selection of a “Recommended Plan”. This report details the selection of the “Recommended Plan” based on the above project goals.

The alternatives evaluated are intended to minimize the flooding extents from the entire Boxelder Creek Watershed; however, some of the alternatives inadvertently address local flooding concerns as well.

1.3 Study Area

The study area for this project includes the floodplain for Boxelder Creek from just north of the Growth Management Area (GMA) of the Town of Wellington, Colorado at Larimer County Road 68, south to the floodplain and split flow confluence with the Cache la Poudre River south of the Town of Timnath, Colorado. The study area includes the projected flow path of flood overflows which split from the historic Boxelder Creek channel at its crossing at Interstate 25 about 1/3 mile north of East Prospect Street, Fort Collins, Colorado (see **Figure 1-1**).

The study area was also subdivided into several reaches and zones for purposes of evaluating the alternatives. These study reaches and zones include the following:

- **Upper Study Area**—from County Road 68 to County Road 54 including the following flow path reaches:
 - Upper Boxelder Creek
 - Coal Creek
 - Indian Creek

- **Middle Study Area**—from County Road 54 to the natural Boxelder Creek channel crossing of I-25 including the following flow path reaches:
 - Middle Boxelder Creek
 - Boxelder Creek Overflow
- **Lower Study Area**—from the natural Boxelder Creek channel crossing of I-25 to the confluence with the Cache la Poudre River including the following flow path reaches:
 - Lower Boxelder Creek (including overflow to the Cache la Poudre River)
 - Cooper Slough (and flow splits)
 - Boxelder I-25 Split Flow Path through Timnath (Timnath Overflow)

Above County Road 68, there are several existing flood control reservoirs constructed by the United States Soil Conservation Service (SCS) (now the Natural Resources Conservation Service) in the 1960's. These reservoirs perform well at protecting downstream areas during more frequent rainfall-runoff events, however, due to the vast urban development below these reservoirs and the limited conveyance capacity of the existing channel, the potential for significant flooding exists.

Figure 1-1 Northern Half

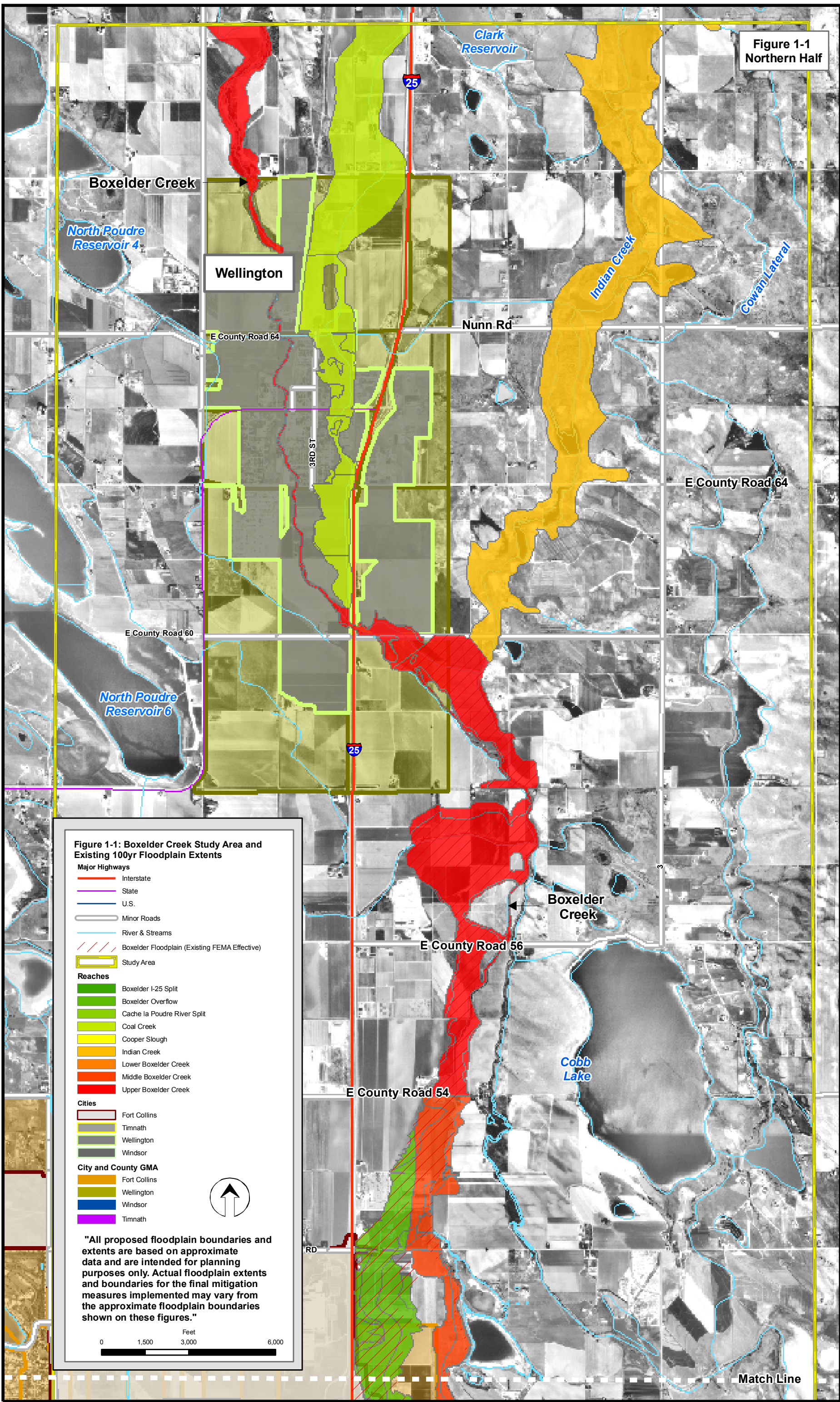


Figure 1-1: Boxelder Creek Study Area and Existing 100yr Floodplain Extents

- Major Highways**
- Interstate
 - State
 - U.S.
 - Minor Roads
 - River & Streams
 - Boxelder Floodplain (Existing FEMA Effective)
 - Study Area
- Reaches**
- Boxelder I-25 Split
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
- Fort Collins
 - Timnath
 - Wellington
 - Windsor
- City and County GMA**
- Fort Collins
 - Wellington
 - Windsor
 - Timnath

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

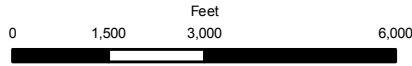


Figure 1-1: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (A)

Match Line

Figure 1-1
Southern Half

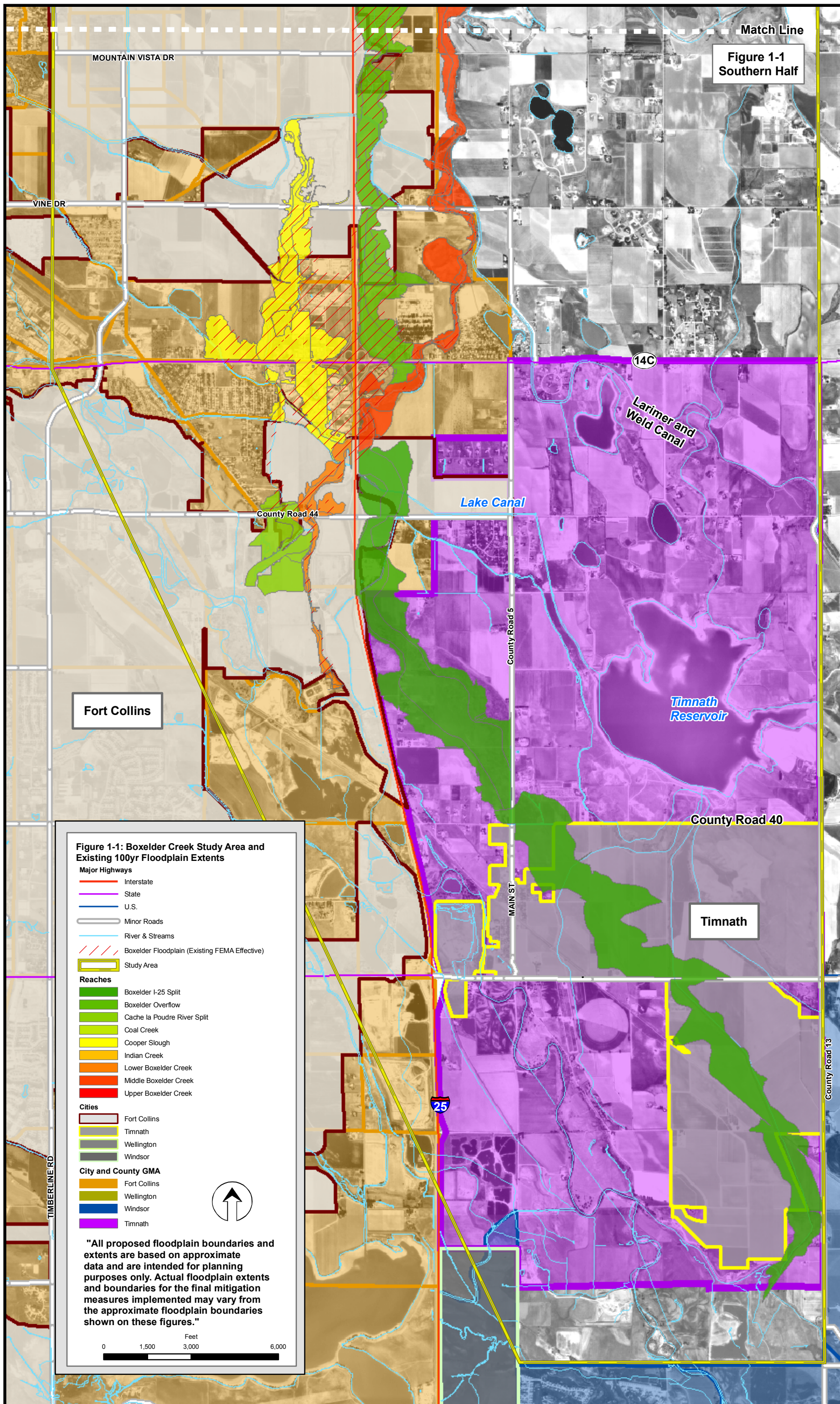


Figure 1-1: Boxelder Creek Study Area and Existing 100yr Floodplain Extents

Major Highways

- Interstate
- State
- U.S.
- Minor Roads
- River & Streams
- Boxelder Floodplain (Existing FEMA Effective)
- Study Area

Reaches

- Boxelder I-25 Split
- Boxelder Overflow
- Cache la Poudre River Split
- Coal Creek
- Cooper Slough
- Indian Creek
- Lower Boxelder Creek
- Middle Boxelder Creek
- Upper Boxelder Creek

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

City and County GMA

- Fort Collins
- Wellington
- Windsor
- Timnath

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."



Figure 1-1: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (A)

Table 1-1 provides a summary of the reach and the floodplain zone within the reach.

Table 1-1: Study Reaches and Associated Flooding Zones	
Reach	Flood Zone
Upper Boxelder Creek	Upper: Zone A; Lower: Zone AE
Coal Creek	Upper: Zone A; Lower: Zone AE
Indian Creek	Zone A
Middle Boxelder Creek	Zone AE with floodway
Boxelder Creek Overflow	Zone AE with floodway
Cooper Slough and splits	Zone AE with floodway
Lower Boxelder Creek	Zone AE with floodway
Boxelder I-25 Split Flow through Timnath	Upper: Zone AE; Lower: Zone A
Cache la Poudre Overflow	Zone AE with floodway

Figure 1-2 shows the different floodplain zones within the Study Area.

1.4 Scope of Report

The Scope of Work undertaken as part of this study included the following tasks or phases of work:

- Phase I: Data Collection
- Phase II: Data Analysis
- Phase III: Economic Analysis
- Phase IV: Compilation of Draft Master Plan
- Phase V: Public Outreach

1.5 Public Outreach

Several avenues of public outreach and community involvement were undertaken as part of developing this Regional Drainage Master Plan. These efforts included:

- Information newsletters and mailings to residents within the Study Area
- Invitation to the public to attend regular Alliance meetings
- Informational flyers
- Newspaper articles and press releases
- Public Open House (March 7, 2006)
- Work sessions with Town Board, City Council and County Commissioner representatives

A summary of the public outreach undertaken as part of the development of this Master Plan is presented in **Appendix G**.

Figure 1-2
Northern Half

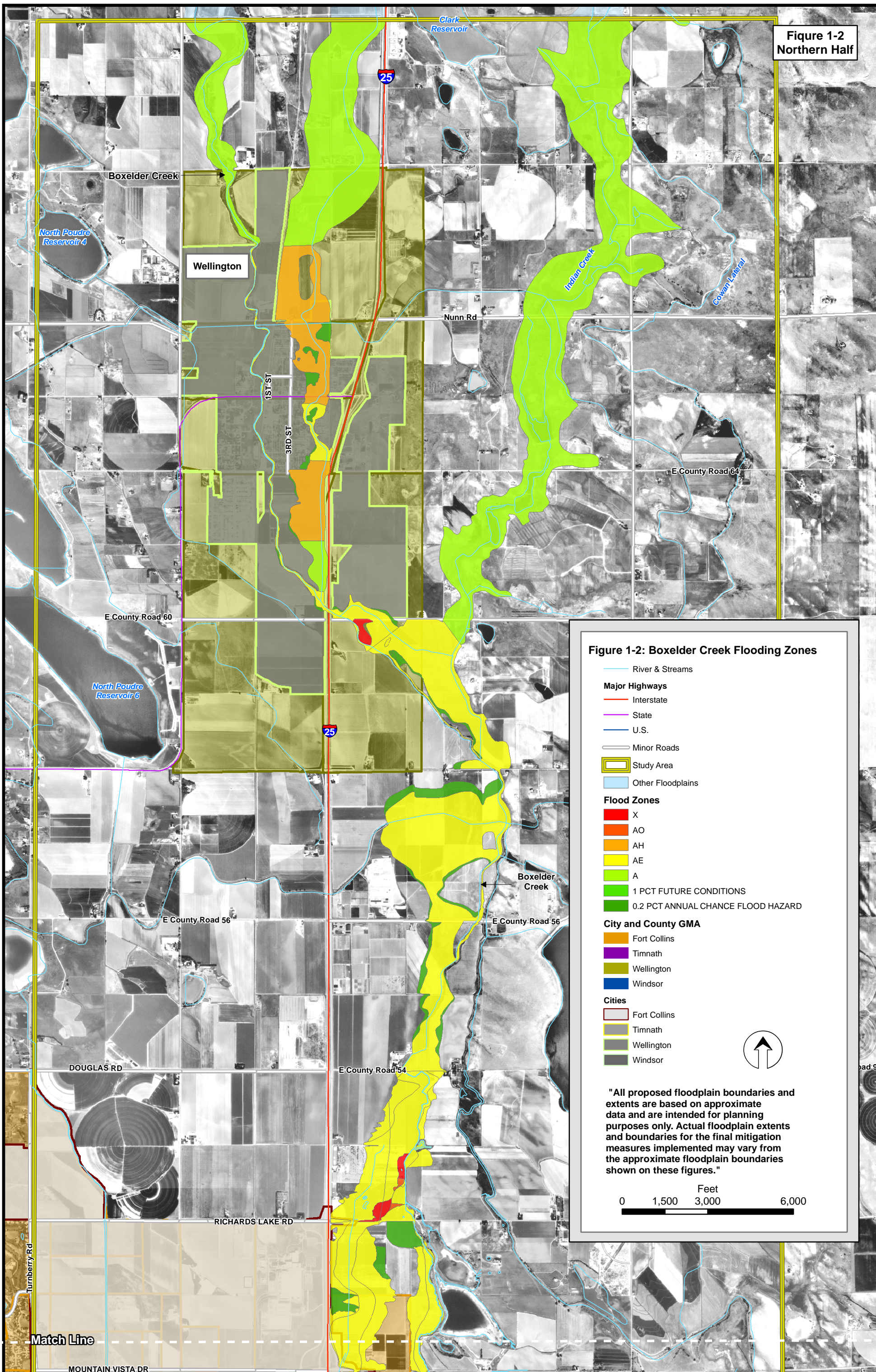


Figure 1-2: Boxelder Creek Flooding Zones (A)

Figure 1-2
Southern Half

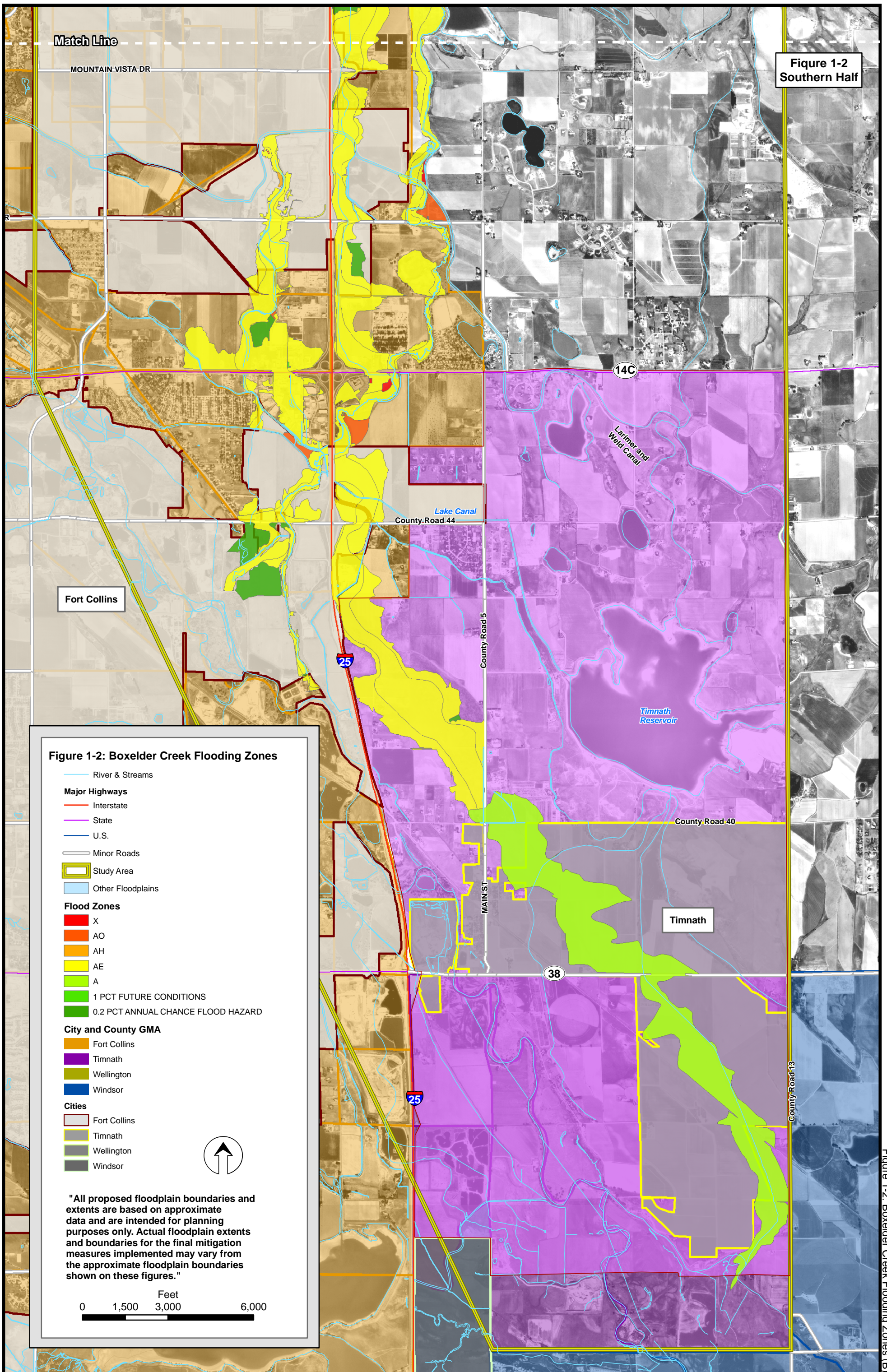


Figure 1-2: Boxelder Creek Flooding Zones

- River & Streams
- Major Highways**
 - Interstate
 - State
 - U.S.
- Minor Roads
- Study Area
- Other Floodplains
- Flood Zones**
 - X
 - AO
 - AH
 - AE
 - A
 - 1 PCT FUTURE CONDITIONS
 - 0.2 PCT ANNUAL CHANCE FLOOD HAZARD
- City and County GMA**
 - Fort Collins
 - Timnath
 - Wellington
 - Windsor
- Cities**
 - Fort Collins
 - Timnath
 - Wellington
 - Windsor

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

0 1,500 3,000 6,000 Feet

Figure 1-2: Boxelder Creek Flooding Zones (B)

2.0 Review of Existing Studies

2.1 Summary of Existing Studies

There are several recent and relevant reports that were reviewed as part of preparation of this Regional Master Drainage Plan. A summary of the studies reviewed is provided below.

1981 Cooper Slough/Boxelder Creek Master Drainageway Planning Study (Simons, Li and Associates, August 1981)

This study was performed in the early 1980's prior to much of the development within the Boxelder Creek corridor. The study evaluated the hydrology/hydraulics and floodplain for Boxelder/Cooper Slough from County Road 50 to the confluence with the Poudre River.

The study identified the split from Boxelder Creek at I-25 to Timnath based on a peak 100-year design discharge of approximately 2,330 cubic feet per second (cfs). However, peak discharges in this study are approximately 30 to 65 percent less than the current approved hydrology utilized by FEMA for the most recent floodplain mapping.

Estimated damages were computed as approximately \$4.1 million during 100-year frequency event within the study area (1981 dollars). Average annual damages were estimated at approximately \$899,280. Mitigation alternatives were estimated at \$4.7 to \$5.5 million in 1981 dollars. The preferred mitigation alternative was a combination of channelization and detention with a benefit-cost ratio of between 2.02 to 2.65.

Coal Creek Floodplain Feasibility Study, Wellington, Colorado (Nolte and EDRC, January 2001)

This study evaluated alternatives for mitigating flooding of Coal Creek through the Town of Wellington. Five (5) alternatives were considered. Alternative 5, Undetained Diversion to Boxelder Creek was selected as the preferred alternative. The estimated cost is approximately \$3.2 million. No damage reductions or floodplain extents were computed as part of this study.

Boxelder Creek Floodplain Analysis through the Town of Wellington (Sear Brown, August 2003)

This evaluation consisted of a floodplain study only. The objective of the study was to update floodplain extents based on increased peak discharges as determined in the City of Fort Collins revised Boxelder Creek/Cooper Slough Basin Master Drainage Plan (ACE, 2002-2004). The revised floodplains are based on peak discharges that have increased 50 to 100 percent. Peak 100-year water surface elevation (WSEL) increased by 0.32 feet on average with a maximum rise of 1.14 feet. The floodplain was extended 150 feet on average with a maximum extension of 1,164 feet.

City of Fort Collins Boxelder Creek/Cooper Slough Basin Master Drainage Plan (Anderson Consulting Engineers, 2002-2004)

This study undertaken by the City of Fort Collins was very comprehensive in nature and consists of several volumes. The study evaluated the hydrology/hydraulics and floodplain for Boxelder/Cooper Slough from County Road 54 to the confluence with the Poudre River and includes several split flow areas. The hydrology of the basin was evaluated based on revised

rainfall values utilized by the City of Fort Collins. Based on these revised precipitation values in addition to reevaluating the hydraulics and floodplain extents (i.e., several areas of split flows and diversions are documented), peak discharges increased significantly over previous studies.

Damages were estimated to be approximately \$62.44 million in damages (present worth assuming 50-year period). 134 structures were estimated as being damaged during the 100-year design event.

Several alternatives for mitigation were evaluated as part of the study including some regional alternatives. Alternative E (which consists primarily of conveyance improvements) was selected as the Preferred Alternative. However, Alternative C which is a regional solution was a close second. Alternative C was also evaluated as part of this study as it is a regional alternative.

Town of Timnath Master Drainage Plan (Ayres Associates, June 2005)

This study identified that the major storm drainage problem within the Town of Timnath GMA is related to the Boxelder Creek overflow floodplain. Floodwaters impact five (5) insurable structures and approximately 760 acres of recently annexed developable land between County Road 5 and the Greeley No. 2 Canal. In addition, five (5) major roadways would be overtopped. Estimated damages during the 100-year frequency event are unknown. “The overtopping flows have the potential to not only damage infrastructure but to be a major safety hazard to motorists caught in unexpectedly deep and swift floodwaters.” Mitigation measures were evaluated that would reduce flood impacts from Boxelder Creek as well as discharges from the Timnath Reservoir and other local drainage basins that impact the Town GMA. Alternative 2 consists of a diversion channel to the Poudre River and is the preferred alternative. Alternative 3 is a regional approach that eliminates overflow and utilizes some of the same storage concepts as in the City of Fort Collins Master Plan. Construction cost estimates were prepared as part of this study, however, no damage estimates were undertaken.

Preliminary FEMA Flood Insurance Study (FIS) and Digital Flood Insurance Rate Map (DFIRM) Updates (September 2005)

This study was used to present the existing condition floodplains that impact the Lower Boxelder Basin within the Study Area. The floodplains that are presented in the Preliminary FEMA DFIRM are based on revised floodplain mapping studies prepared by the City of Fort Collins. These floodplain extents and resulting damages were used as the baseline for comparison purposes when evaluating mitigation alternatives. However, the floodplains within the Town of Timnath, the Town of Wellington and portions of Larimer County above Count Road 52 are based on older studies that utilize lower 100-year frequency precipitation depths. As a result, there are discrepancies in the peak discharges utilized to determine the FEMA regulatory floodplains in these areas. For example, the peak 100-year FEMA discharge for the I-25 split flow is approximately 4,200 cfs just below the I-25 crossing of Boxelder Creek. However, the peak discharge of the I-25 split flow through the Town of Timnath is approximately 2,800 cfs.

Feasibility Study for Alternatives to Mitigate Flooding Effects on Boxelder Creek (Mussetter Engineering, Inc., November 2005)

This study was commissioned by local developers who are directly impacted by the Boxelder Creek I-25 Split Flow. The study evaluated several alternatives for minimizing the extents of the I-25 split flow area by conveyance, storage and a combination of both. Several new

storage/diversion concepts were identified in this report and have been included as part of the Regional Master Plan evaluations. Construction cost estimates were developed utilizing similar unit rates to the City of Fort Collins Master Plan, however, no damage reduction estimates were provided. A comparison of peak discharge reduction by unit of cost was developed.

2.2 Data Sources

Several data sources were available for use in the development of this Master Plan. These data sources included the following:

- Larimer County Geographic Information System (GIS) tax assessor’s database
- FEMA DFIRM database
- Hydrologic and hydraulic models associated with the City of Fort Collins Drainage Master Plan

To the extent possible, existing data was utilized for this study. No new hydraulic information was generated as part of this study and, as such, the extent of the floodplains associated with the various proposed alternatives has been estimated.

Note: The Larimer County GIS-based Tax Assessor’s data (parcel boundaries) does not match the available floodplain mapping and ortho aerial photography used as the base map for the evaluations. As such, individual parcel data may not be entirely accurate. However, it is believed that the average parcel information (structure values, land values, etc) is adequate for planning purposes and in preparing this Regional Master Plan.

2.3 Hydrology Summary

The existing conditions hydrology was determined from the UD-SWM model adopted by FEMA for the revised floodplain as shown on the Preliminary DFIRM dated September 2005. This hydrologic model was developed by Anderson Consulting Engineer’s on behalf of the City of Fort Collins and includes the entire Boxelder Creek watershed below the existing SCS Flood Control Dams located north of County Road 68. Hydrologic models were also available for several of the proposed alternatives. Where required, the models were modified to reflect the proposed changes associated with the various alternative scenarios.

Table 2-1 provides a summary of the peak discharges for various frequency events at key design points within the Study Area.

Table 2-1: Existing Conditions Hydrology Summary				
Design point	100-year event	50-year event	10-year event	2-year event
Coal Creek at County Road 64 (DP333)	1,635 cfs			
Boxelder Cr below Indian Cr (DP115)	6,320 cfs			
Boxelder Cr at County Road 50 (DP101)	3,140 cfs	2,580 cfs	880 cfs	210 cfs
Boxelder Creek at Lake Canal (DP563)	3,585 cfs	2,050 cfs	785 cfs	190 cfs
Boxelder Overflow at L&W Canal (DP99)	3,115 cfs			
Boxelder I-25 Split Flow (DP927)	4,220 cfs			
Cooper Slough at State Highway 14 (DP936)	2,510 cfs	740 cfs	40 cfs	15 cfs

A further summary of the existing conditions hydrology (including hydrographs at selected Design Points) is included in **Appendix B**.

2.4 Hydraulics Summary

The hydraulics of the Boxelder Creek, Cooper Slough and overflow/split flow paths were estimated utilizing the United States Army Corps of Engineer’s (USACE) HEC-RAS computer program. Hydraulics for the reaches below County Road 54 were determined based on the evaluations undertaken for the City of Fort Collins as part of the Cooper Slough/Boxelder Creek Master Plan. A summary of the average flow depths and velocities estimated for the 100-year frequency event is provided in **Table 2-2**.

Table 2-2: Existing Conditions Hydraulic Summary (100-year event)		
Reach	Average Depth (feet)	Average Velocity (fps)
Boxelder Creek (below L&W Canal)		
Channel	8.6	6.5
Left	2.7	2.3
Right	2.8	2.3
Boxelder Creek (above L&W Canal)		
Channel	7.6	6.3
Left	1.3	2.0
Right	1.8	2.1
Poudre River Split		
Channel	2.2	3.1
Left	1.1	1.8
Right	0.8	1.2
Boxelder Split Flow		
Channel	2.35	2.85
Left	1.0	1.4
Right	1.0	1.7
Boxelder Overflow (below L&W Canal)		
Channel	2.65	3.2
Left	1.1	1.8
Right	1.1	2.2
Boxelder Overflow (above L&W Canal)		
Channel	2.6	4.2
Left	1.1	2.2
Right	1.2	2.4

A further summary of the hydraulics utilized in preparation of this Master Plan is provided in **Appendix B**.

There are several areas of split flow that occur within the Middle and Lower Study reaches created as a result of minimal conveyance within the existing channel. The Boxelder Overflow occurs just below County Road 54 where the existing Boxelder Creek channel becomes constrained and the floodplain widens significantly. The Boxelder Overflow also impacts the Cooper Slough Basin via diversions through existing cross culverts and irrigation canals under I-

25. The I-25 Split Flow occurs where the Boxelder Creek channel crosses I-25 via two (2) reinforced concrete box culverts (RCBC). There are four (4) existing box culverts at this location, however, due to downstream conveyance constraints, two (2) of the cells are blocked. When runoff exceeds the capacity of the box culverts, flow is diverted south along I-25 through to the Town of Timnath, eventually reaching the Cache la Poudre River just north of the Town of Windsor GMA.

2.5 Summary of Existing Damages and Consequences

The Boxelder Creek 100-year floodplain impacts nearly 4,900 acres of land within the Study Area and while average floodplain velocities and depths are low (depths less than 3 feet and velocities less than 2.5 feet per second), the hazard associated with the flooding is estimated to be high due to the numerous split flows and diversions which occur within the basin. Flow paths are not well defined and the existing channel system and cross culverts are not capable of conveying large quantities of runoff. Numerous roads would overtop during the 100-year design flooding event. Due to the numerous split flows and diversions that occur, the potential for overtopping frequently used roads and the probability of the existing conveyance system to become blocked, there is the potential for loss of life and/or bodily injury during an extreme runoff event within the Study Area.

Major floods have occurred within the Boxelder Basin in 1909, 1922, 1930, 1937, 1947, 1963, 1967 and 1969. In 1947, the *Fort Collins Coloradoan* included a headline that read “Violent Rainstorm Floods Large Area; Crop Losses Heavy”. As much as five (5) inches of rain fell northwest of Wellington, washing out bridges and flooding crops. Nearly 1,000 acres of grain, alfalfa and corn crops were damaged. Heavy rains caused Boxelder Creek to overflow its banks again in 1967 and resulted in the death of a mother and her three daughters. The woman and her daughters drove into the flooded creek where it passed over a county road southwest of Wellington. Floods that summer destroyed county bridges seven times. On June 5, 1967, the headlines in the *Coloradoan* read “Another Auto Plunges into Boxelder”.

Although the existing National Resource Conservation Service (NRCS) flood retarding structures located north of the project area have resulted in a significant reduction in the flooding hazard within downstream areas, significant growth and urbanization has increased the potential for flooding damages and the potential for injury and/or loss of life. Recent studies and reports have concluded that the potential for flooding within the urbanized areas of the Boxelder Creek watershed during an infrequent (100-year frequency) rainfall event is high.

In 1988, the Colorado Department of Transportation (CDOT) installed four (4) culverts at the I-25 crossing of Boxelder Creek (downstream of Mulberry Street and upstream of Prospect Road). However, two (2) of the culverts were temporarily plugged based on the estimated downstream capacity of the existing channel. These plugs remain and will not be removed by CDOT until either the downstream capacity is increased or the upstream peak discharge is reduced.

In 1997, the Spring Creek flood prompted the City of Fort Collins to re-evaluate their design rainfall standards. Subsequently, new rainfall depths were adopted and were utilized in the 2004 City Master Plan for Boxelder Creek.

There are several critical structures within the 100-year floodplain boundary including two schools in Wellington (Eyestone Elementary School and Wellington Junior High School) and

two gas stations and liquid propane storage facility within the study area near the City of Fort Collins. Numerous business and commercial facilities within the City of Fort Collins and the Town of Wellington would be impacted. Access to an electrical substation would be cut off. Over 18 detention ponds and irrigation storage reservoirs, 4 irrigation canals and 30 roads are predicted to overtop and likely be damaged during the 100-year flood event within the Study Area. Most roads would overtop by approximately 1 to 2 feet. In addition, there are numerous sanitary sewers, electrical lines, water transmission lines and other infrastructure that could be impacted and/or damaged.

In addition to significant property damage and potential for injury and loss of life, the Boxelder Creek floodplain within the Study Area significantly impacts expected development opportunities. Much of this floodplain is in already developed or planned development areas. However, the Boxelder Overflow and I-25 split occur within prime development areas along the I-25 corridor. The existing floodplain significantly limits the uses of these lands.

The aerial extent of the revised 100-year frequency floodplain is provided in **Table 2-3**.

Table 2-3: Existing Floodplain Extents	
Reach/Entity	Area within 100-year Floodplain (acres)
<i>By Jurisdiction</i>	
Larimer County	3,884
City of Fort Collins	478
Town of Wellington	215
Town of Timnath	383
Town of Windsor	0
<i>By Reach</i>	
Upper Boxelder Creek	844
Coal Creek	630
Indian Creek	920
Middle Boxelder Creek	453
Boxelder Creek Overflow	536
Cooper Slough and splits	331
Lower Boxelder Creek	74
Boxelder Split Flow through Timnath	1,062
Cache la Poudre Overflow	27
TOTAL FLOODPLAIN IN STUDY AREA	4,960

Several of the existing documents reviewed as part of this study included estimates of damages during the 100-year event. **Table 2-4** provides a summary of the reported damages during the 100-year frequency flooding event.

Table 2-4: Reported Existing Damages Summary			
Reach/Entity	Estimated Present Worth of Damages	Structures Impacted During the 100-year Flood	No. of Roads Overtopped⁴
<i>By Jurisdiction</i>			
Larimer County/City of Fort Collins ¹	\$62.4 million	134	24
Town of Wellington ²	\$7 million	180	4
Town of Timnath ³	\$3.7 million	5	5
TOTAL	\$73.1 million	319	33

¹From *City of Fort Collins Boxelder/Cooper Slough Master Plan*, (Anderson Consulting Engineers, 2002-2004). Part of the damages estimated in this Master Plan occur within Larimer County (up to County Road 54). Dollars are represented in present worth based on a 50-year period.

²From *Coal Creek Floodplain Feasibility Study, Wellington, Colorado* (Nolte, January 2001)

³From *Town of Timnath Master Drainage Plan* (Ayres Associates, June 2005)

⁴Estimated from available reports and floodplain maps.

3.0 Alternative Assessments

3.1 Overall Approach

Alternatives were evaluated using the hydrologic and hydraulic models developed by Anderson Consulting Engineers (ACE) for the City of Fort Collins. Larimer County's GIS database was utilized to assist in property assessment values and zoning information. Potential land use values were estimated from various sources.

The general approach to the alternatives evaluation is as follows:

1. The 100-year floodplain extents for the existing condition and the various alternative scenarios were determined based on the existing hydrologic/hydraulic models available that were prepared as part of previous studies. These floodplains are approximate only and are intended for planning purposes only. Actual floodplain extents will require the preparation of a detailed hydraulic model and FEMA Conditional Letter of Map Revision (CLOMR) application.
2. Existing damages were estimated based on published reports and, utilizing the Larimer County GIS database, the aerial extent of the revised 100-year floodplain. Damages to structures and contents were based on published Federal Insurance Administration (FIA) depth-damage curves using average floodplain depths. Indirect damages (agricultural losses, emergency services, clean-up costs, etc.). A spreadsheet model was utilized to estimate damages based on the structure type, County assessed value and the appropriate factor.
3. Residual damages associated with the evaluated alternatives were estimated based on the revised approximate floodplain extents and flooding depths utilizing the same spreadsheet model as indicated above.
4. Benefits were estimated based on the aerial extent of land removed from the floodplain. Factors for regional benefits were utilized to estimate the regional benefit components.
5. Construction costs for the alternatives were based on information from previous studies and these costs were formatted for consistency.
6. Due to the inherent uncertainties associated with estimating the floodplain extents, damages, benefits and costs, the benefit-cost ratios were evaluated utilizing a probabilistic approach incorporated into the spreadsheet model. (see Section 4.1.4) Crystal Ball, a software package that performs Monte Carlo simulations based on probabilistic ranges for parameter values was utilized for this analysis. A Monte Carlo simulation randomly generates values for uncertain variables over and over to simulate a model.

The data has been summarized in several spreadsheets included in **Appendix C**.

3.1.1 GIS Data Sources

The Larimer County GIS based tax assessor's database was utilized to obtain parcel information and structure values. This information utilized in the evaluations included the following:

- Parcel Number (Table ACCOUNT, Field Name PARCELNB)
- Number of Buildings (Table ACCOUNT, Field Name BLDGS)
- Gross Land Area (Table ACCOUNT, Field Name LANDGROSSACRES)
- Actual Total Value (Table ACCOUNT, Field Name ACTUALVAL)
- Assessed Parcel Value (Table ACCOUNT, Field Name ASSESSEDVAL)
- Structure/Improvement Value (Table IMPROVEMENT, Field Name IMPACTUALVAL)
- Property Type (Table IMPROVEMENT, Field Name PROPTYPE)

The Table OWNER was also utilized to obtain mailing addresses for all parcels potentially impacted by the existing floodplain.

The GIS data was utilized to determine the following information for the existing conditions and the alternatives that were evaluated. This information was also separated by jurisdiction and stream reach:

- Total acreage in the floodplain (acres)
- Total parcel acreage impacted by the floodplain (acres)
- Total acreage in the regulatory floodway (acres)
- No. of parcels within the floodplain
- No. of structures within the floodplain (Note: This was manually checked using aerial photographs as building footprint data was not available for the majority of the Study Area)
- No. of structures based on different structure type (mobile home, commercial, single-level residential, single-level residential with basement, two-story residential and two-story residential with basement)
- Percentage of floodplain under various land use (agricultural, residential, commercial/industrial, and other use)
- Assessed land value within the floodplain (\$)
- Assessed structure value in the floodplain (\$)

Some of the data utilized in the evaluations was estimated manually. These included the following:

- No. of roads overtopped or adversely impacted
- No. of utilities/infrastructure adversely impacted

3.1.2 Damage Assessments

The general procedure for estimating the damages for each flood event is described below:

- The assessed value of the structure and contents and the market value for each structure in the floodplain was estimated by overlying the 100-year floodplain various alternatives on

the City’s GIS database and tabulating the data as discussed in the previous section. The current market value of improvements was estimated by applying a factor of 1.09 to the assessed structure and contents values.

- The average depth of the floodplain was assumed to range between 1-3 feet based on hydraulic information available. The FIA depth-damage data was utilized based on this range of flooding depths for the various types of structures determined from the GIS database.
- Flood damages were estimated by multiplying the percent damage as determined by the depth-damage curves by the adjusted market assessed value.
- Costs associated with emergency services, traffic delays, clean-up costs, agricultural losses and environmental losses, and infrastructure losses were based on factors applied to the estimated structural and contents damages.

Average annual damages were estimated based on the following equation:

$$D_{aa} = (0.015xD_{100}) + (0.045xD_{50}) + (0.09xD_{10}) + (0.20xD_5) + (0.40xD_2)$$

Where D_{aa} is the average annual damage in dollars and D_i is the damage in dollars associated with the i-th return period event.

As floodplain extents for the 2-year through 50-year frequency events was not determined, the damages for these events were estimated based on ratios determined in the City of Fort Collins Master Plan. These ratios were utilized to estimate percentages of damages (based on the 100-year frequency event) for the lesser frequency (more probable) events for use in estimating average annual damages.

The average annual damages were converted to a present worth value assuming a standard 50-year project life and an annual inflation rate of 5 percent. The following equation was utilized to estimate the present worth of flood damages based on the above assumptions:

$$D_{pw} = [((1+i)^n - 1)/i(1+i)^n] \times D_{aa}$$

Where D_{pw} is the present worth of damages in dollars, D_{aa} is the average annual value of damages in dollars, i is the interest rate in decimal percent and n is the project life.

Table 3-1: Estimated Existing Damages Summary				
Reach/Entity	Present Worth of Damages	Structures Impacted During the 100-year Flood	Agricultural Land in Floodplain (acres)	No. of Roads Overtopped
Larimer County	\$59.0 million	290	1,920	9
City of Fort Collins	\$17.9 million	110	300	18
Town of Wellington	\$29.5 million	220	70	8
Town of Timnath	\$3.4 million	50	300	4
TOTAL	\$109.8 million	670	2,590	39

3.1.3 Benefit-Cost Evaluations

To the extent possible, the FEMA Benefit-Cost Analysis (BCA) approach was utilized in order to determine benefits and costs, however, the FEMA BCA approach does not allow for consideration of increased land value and tax base to be considered as benefits. The FEMA BCA guidance documents indicate that “the possible impact of a mitigation project on local or regional employment or on overall economic output or economic activity should not be counted”. **Table 3-2** lists the Categories of Avoided Damages (Benefits) that can be considered utilizing the FEMA BCA approach.

Table 3-2: FEMA Approved Categories of Avoided Damages (Benefits)		
Category	Subcategory	Considered in Master Plan
Avoided Physical Damages		
	Buildings	Yes
	Contents	Yes
	Infrastructure	Yes
	Landscaping	No
	Site Contamination	No
	Vehicles	No
	Equipment	No
Avoided Loss-of-Function Costs		
	Displacement costs	Yes
	Loss of rental income	Yes
	Loss of business income	Yes
	Lost wages	Yes
	Disruption time for residents	Yes
	Loss of public services	Yes
	Loss of utility service	Yes
	Road/bridge closures	Yes
Avoided Casualties		
	Deaths	No
	Injuries	No
	Illnesses	No
Avoided Emergency Management Costs		
	Emergency operations costs	Yes
	Evacuation/rescue costs	Yes
	Security costs	No
	Protective measures costs	No
	Debris removal/clean-up costs	Yes
	Other management costs	Yes

As a result of the preliminary funding mechanisms that have been considered to implement the selected mitigation strategy, this Master Plan considered both Local and Regional Benefits as part of the evaluations. Local or Special Benefits are defined as those benefits which accrue to certain properties within the floodplain as a result of implementing a mitigation measure. The local benefits are quantified to include both a reduction in flooding damages along with a net

increase in land value as a result of being removed from the floodplain. Regional or General Benefits are defined as those benefits that affect all properties within the Study Area equally.

The following benefits were considered and quantified in the evaluations undertaken as part of this study:

- **Local (Special) Benefits**
 - Decreased property damages
 - Decreased agricultural losses
 - Increased land value associated with removal from the floodplain extents

- **Regional (General) Benefits**
 - Increased access and traffic efficiency
 - Decreased future construction costs
 - Protection to public health and welfare
 - Reduction in potential for injury and loss of life
 - Reduced clean-up/maintenance costs
 - Decrease in potential for utility interruption
 - Decrease in potential damages to infrastructure (water, sanitary sewer, gas, etc.)
 - Decrease in the potential for loss of water supply/water rights/delivery
 - Decrease in the potential for water quality and environmental damages
 - Increase in recreational opportunities (within trail corridors and open space)
 - Increased tax base potential associated with future development

Current FEMA BCA guidelines allow for the inclusion of displacement costs, lost business income, lost public services, lost rental income, relocation costs and loss of time related income associated with road closures. To the extent possible, FEMA unit rates for these costs have been included in the evaluations. However, FEMA BCA guidelines do not normally allow for potential of loss of life or injury under “ordinary” flooding conditions. FEMA does allow for damages associated with potential for loss of life or injury to be included in some situations that involve flash flood situations and/or dam and levee failure. Further, FEMA suggests that significant technical expertise and judgment be provided when determining damages associated with the potential for loss of life or significant injury (no other guidelines are provided).

In the case of Boxelder Creek, historic flood related vehicle casualties have occurred within the Study Area. In fact, FEMA recognizes that the majority of flooding deaths are vehicle related (FEMA BCA Training Materials, 2005). The Boxelder Creek has numerous split flow paths and potential for road overtopping that could breach roadway embankments and/or create a scour hole within the roadway. As such, the potential for loss of life or significant injury within the basin is high for events with a magnitude greater than a 50-year frequency event. However, due to the uncertain nature of quantifying loss of life or significant injury, these costs have not been included in the damage estimates. The benefit associated with minimizing the potential for loss

of life and/or significant injury has been considered qualitatively in the alternatives evaluation matrix (discussed further in Section 4.4).

Implementation costs were estimated from information prepared by others in the various studies and reports available. Unit rates were adopted for consistency and consistent contingencies and other associated costs were adopted for all of the components and alternatives evaluated. These included the following:

- Construction contingency (30% of total estimated construction costs)
- Legal fees (3% of estimated construction and land/right-of-way (ROW) acquisition costs)
- Management fees (5% of estimated construction, land/ROW and legal costs)
- Engineering/permitting fees (15% of construction costs including contingency)

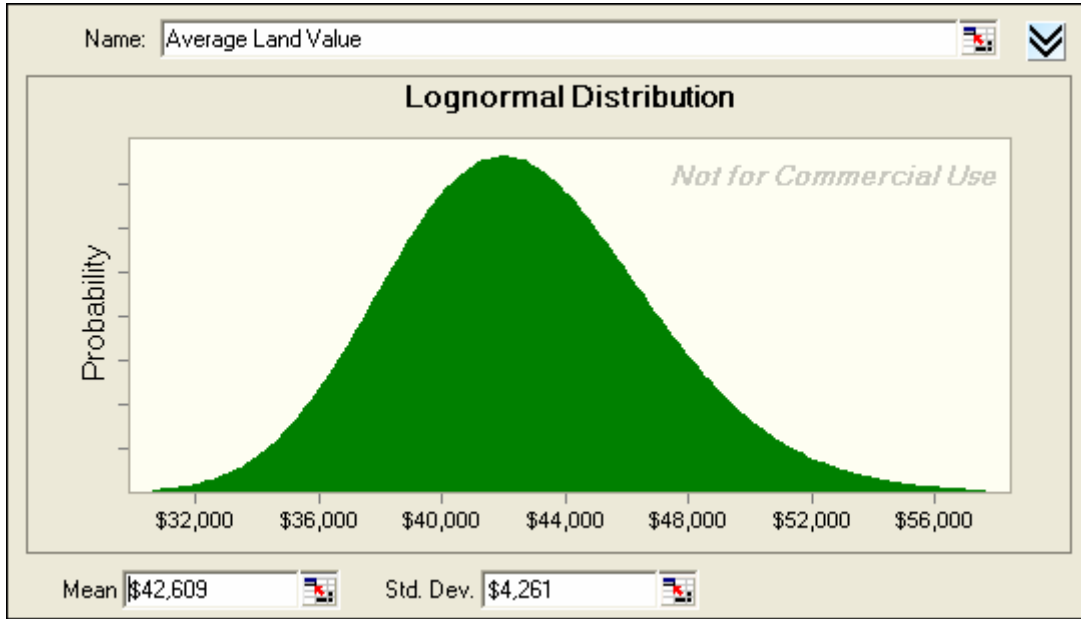
Construction costs were estimated based on estimated unit rates bounded by a high and low end estimate based on current construction trends and experience with recent similar construction projects.

3.1.4 Uncertainty Analysis

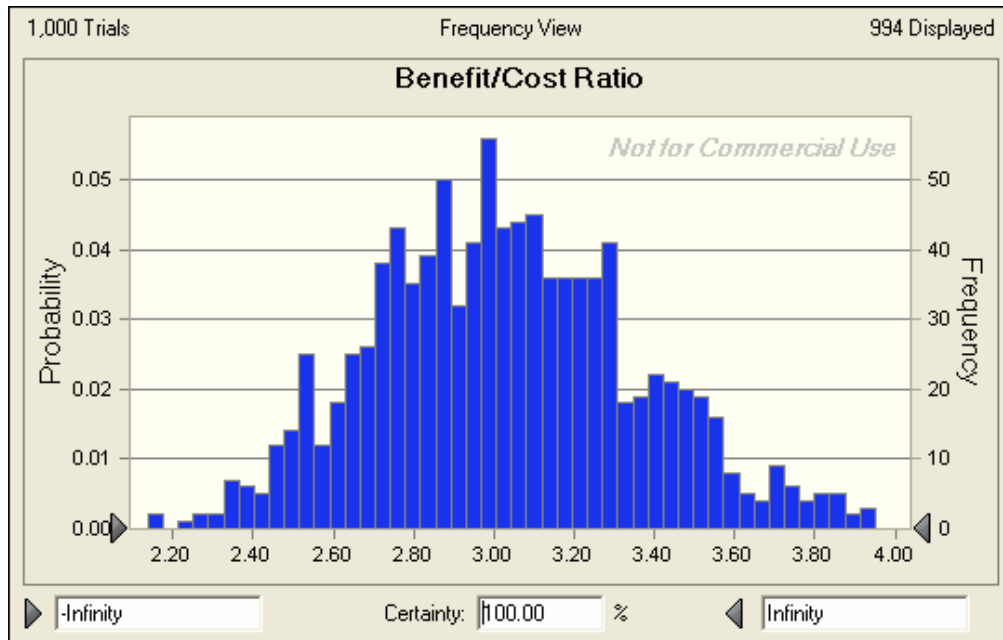
Due to the inherent uncertainties associated with estimating the floodplain extents, damages, benefits and costs, the benefit-cost ratios were evaluated utilizing a probabilistic approach incorporated into the spreadsheet model. (see Section 4.1.4) Crystal Ball, a software package that performs Monte Carlo simulations based on probabilistic ranges for parameter values was utilized for this analysis. A Monte Carlo simulation, randomly generates values for uncertain variables over and over to simulate a model.

For each uncertain variable (one that has a range of possible values the possible values with a probability distribution can be defined. The type of distribution that can be selected is based on the conditions surrounding that variable.

An example of a lognormal distribution assigned to the average land value is provided below.



A Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distributions for the uncertain variables and using those values for the cell. For example, an example of a Monte Carlo simulation on the BCA for a certain alternative is provided below. This is based on a set of variables for unit costs, increased lands values, etc. that the Alliance will define.



Defined forecasts can also be established for other variables such as the net increase in land value, percentage of environmental or infrastructure losses, etc. This type of analysis minimizes the uncertainties associated with unknown or not easily quantifiable parameters and greatly assists in the decision making process. For example, a decision may be based on a high estimate

for the construction cost and a low estimate of the benefits that still has an acceptable benefit-cost ratio.

3.1.5 Assumptions

The major assumptions utilized in the evaluations include the following:

1. Floodplain extents were estimated based upon available hydrologic/hydraulic information for the 100-year frequency event only. No new hydraulic modeling was performed as part of developing this Master Plan.
2. Structure and land values were adopted from the Larimer County Tax Assessor's GIS database
3. Contents value was estimated to be 30% of the total structure value (based on FEMA BCA guidelines).
4. Structural and contents damages were estimated from FIA depth-damage curves assuming an average floodplain depth of between 1 and 3 feet (based on hydraulic model data).
5. Percentage of damages for the 2-year through 50-year frequency events for all alternatives analyzed was based on information developed as part of the City of Fort Collins Master Plan (ACE, 2002-2004).
6. Environmental damages were estimated to be \$1,000 per acre of land within the floodplain.
7. Agricultural damages were estimated to be \$410 per acre of agricultural land within the floodplain.
8. Infrastructure damages were estimated to be \$50,000 per roadway overtopped and \$5,000 per utility impacted.
9. Emergency services costs were estimated to be 10% of the structural/contents and infrastructure damages.
10. Clean-up and maintenance costs were estimated to be 5% of total damages.
11. Average annual damages and present worth of damages were estimated utilizing a 7% inflation rate (based on FEMA BCA guidelines) and a 50-year assumed design life.
12. Construction contingency was assumed to be 30% of total estimated construction costs.
13. Legal fees were assumed to be 3% of estimated construction and land/ROW acquisition costs.
14. Management fees were assumed to be 5% of estimated construction, land/ROW and legal costs.
15. Engineering/permitting fees were assumed to be 15% of construction costs including contingency.
16. Future land values for areas removed from the floodplain were estimated to be \$15,000 per acre.
17. Increase in tax base potential was assumed to be 2.5% of the average land value.

18. Monthly rental costs associated with displacement and lost rental income are assumed to be \$1/square foot/month (based on FEMA BCA guidelines).
19. Disruption costs for lost wages are assumed to be \$21.16/hour (based on FEMA BCA guidelines).
20. Vehicle costs associated with road and traffic closures are assumed to be \$32.23/vehicle/hour of associated detour (based on FEMA BCA guidelines).
21. Loss of electric power is assumed to be \$188 per capita per day (based on FEMA BCA guidelines).
22. Loss of potable water supply is assumed to be \$403 per capita per day (based on FEMA BCA guidelines).
23. Loss of irrigation or non-potable water is assumed to be \$43 per capita per day (based on FEMA BCA guidelines).
24. Loss of wastewater service is assumed to be \$33.50 per capita per day (based on FEMA BCA guidelines).

3.2 Identified Project Components

There are several project components that were considered as part of developing alternatives for this Master Plan. These project components were identified in previous reports and through brainstorming sessions held by the Technical Advisory Committee (TAC) and Financial Advisory Committee (FAC) meetings. The project components that have been considered include the following:

3.2.1 No Action (Non-structural Solutions)

No action and non-structural solutions were evaluated during preparation of the Master Plan. No action would require that all property owner's who would like to develop their properties to import fill to raise the ground elevation to 1 foot above the adjacent 100-year frequency flooding depth. A Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) processed through FEMA would also be required for the property to be removed from the regulatory floodplain. County and local ordinances would not allow development to occur without this action. For existing structures, the no action alternative would do nothing to reduce the potential for flooding and subsequent damages to these structures. Existing structures within the 100-year floodplain extents will be required to purchase flood insurance.

Non-structural solutions (including zoning, floodplain regulation, etc.) are viable solutions, however, the majority of the property within the Boxelder Creek floodplain has enormous development and commercial value as it lies within the I-25 corridor.

3.2.2 Structural Solutions

Structural solutions which included conveyance, detention and a combination of both were also evaluated as part of this Master Plan. Structural solutions evaluated included the following:

Upper Study Area Storage

- Additional storage in existing SCS Reservoirs
- Diversion of flows in Coal Creek and storage in Clark Reservoir
- County Road 62 Storage
- New detention below Edson Reservoir

Middle Study Area Storage

- Additional storage in Cobb Lake (via diversion or pump station)
- Additional storage in Gray Reservoir
- New detention at County Road 50
- Dispersed Regional Storage
- Diversion and additional storage in Timnath Reservoir
- Diversion and additional storage in Kitchel Reservoir

Upper Study Area Diversion/Conveyance

- Un-detained diversion of Coal Creek

Middle Study Area Diversion/Conveyance

- Channel improvements to Boxelder at split

Lower Study Area Diversion/Conveyance

- Prospect Road Improvements
- Timnath Diversion to Poudre River
- Diversion channel North of Timnath
- Conveyance improvements at Prospect Road

Figure 3-1 provides a summary of the identified structural components considered.

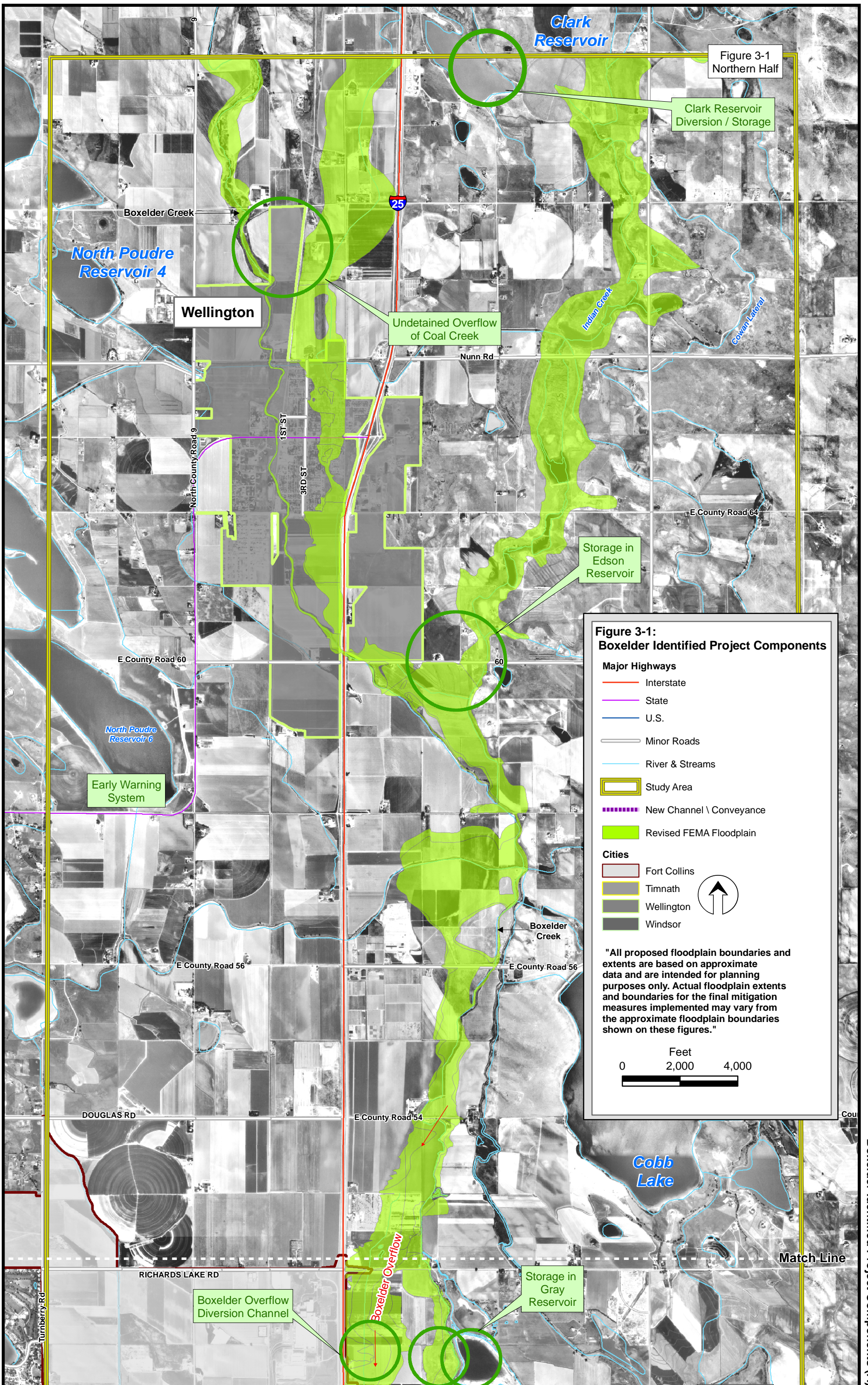


Figure 3-1
Northern Half

Clark Reservoir
Diversion / Storage

Wellington

Undetained Overflow
of Coal Creek

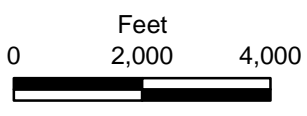
Storage in
Edson
Reservoir

Early Warning
System

**Figure 3-1:
Boxelder Identified Project Components**

- Major Highways**
- Interstate
 - State
 - U.S.
 - Minor Roads
- River & Streams
- ▭ Study Area
- ▬ New Channel \ Conveyance
- ▭ Revised FEMA Floodplain
- Cities**
- ▭ Fort Collins
 - ▭ Timnath
 - ▭ Wellington
 - ▭ Windsor

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

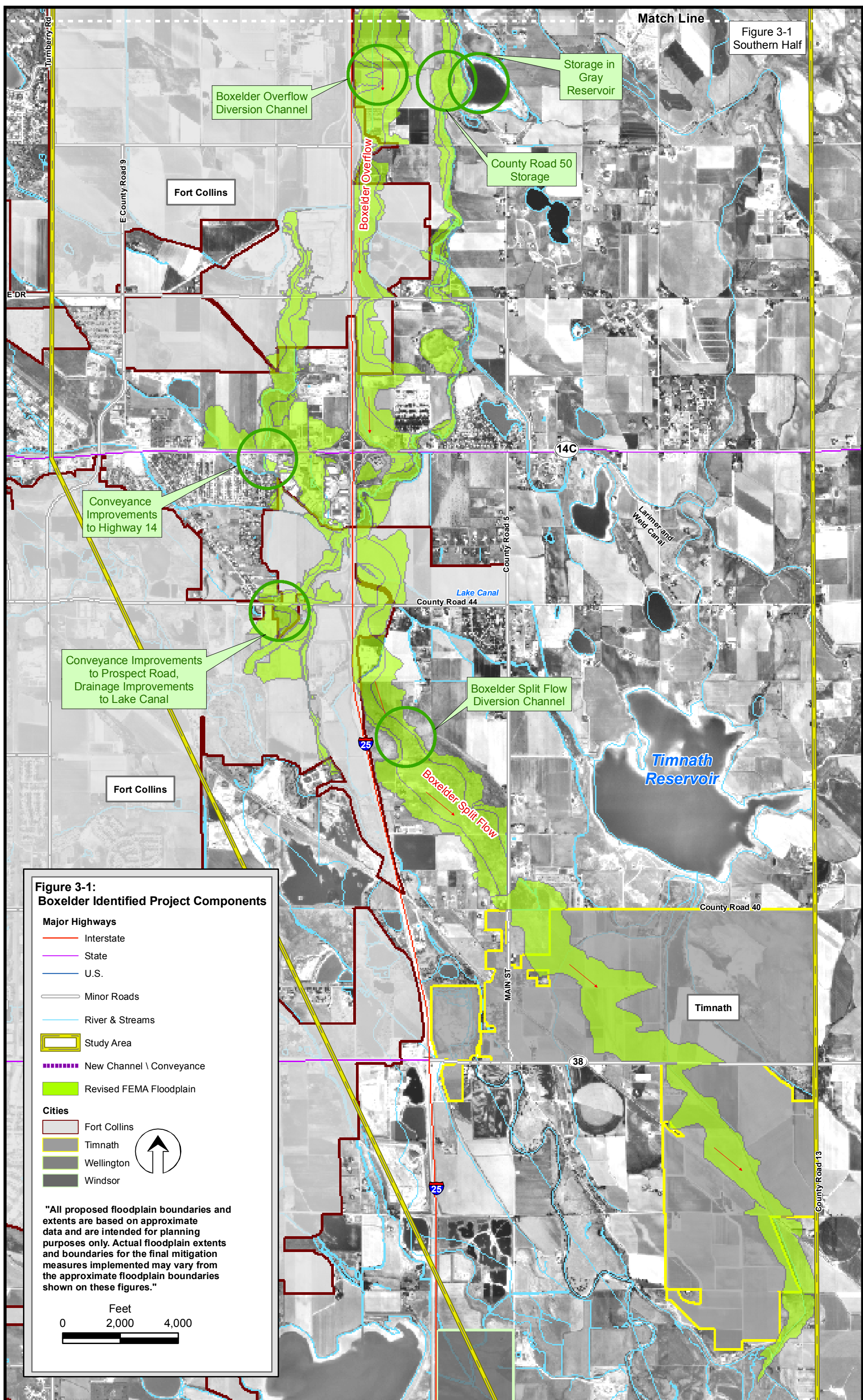


Match Line

Boxelder Overflow
Diversion Channel

Storage in
Gray
Reservoir

Figure 3-1
Southern Half



**Figure 3-1:
Boxelder Identified Project Components**

Major Highways

- Interstate
- State
- U.S.
- Minor Roads
- River & Streams
- Study Area
- New Channel \ Conveyance
- Revised FEMA Floodplain

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

Feet
0 2,000 4,000

Boxelder Identified Project Components (B)
Figure 3-1:

3.3 Description of Alternatives

Based on the above identified project components, five (5) alternatives have been evaluated as part of this Master Plan. Costs and benefits have been estimated for each of these alternatives utilizing the approach outlined in Section 2. A summary of the alternatives is provided below.

3.3.1 Alternative 1—Non-jurisdictional Alternative

Under this alternative, there are no regional or other community funded projects considered and each individual property owner is assumed to be responsible for handling floodplain issues and drainage problems. This is a highly unlikely scenario as there are existing Stormwater Utilities and other funding associated with the majority of the areas impacted and, as such, some municipal involvement is inevitable. However, for comparison purposes, this alternative was evaluated to compare benefits versus cost.

Under this alternative, each individual property owner could encroach onto the 100-year floodplain extents but would not be able to encroach into the defined floodway. Land values associated with areas within the flood fringe and floodway are therefore significantly different. In addition, as the floodplain cuts across most of the developable land, the entire parcel value could be reduced as a result. Engineering fees would be required as each parcel would need to get approval from FEMA via a Letter of Map Amendment (LOMA) or a Letter of Map Revision (LOMR). Engineering and permitting Fees associated with preparing such documentation is estimated to be on the order of \$10,000 to \$25,000 per parcel. In addition, fill for each parcel would be required to raise proposed structures above the estimated 100-year flooding event. In most cases, 1-3 feet of fill would be required and an additional cost would be incurred as a result of encroaching into the floodplain. For existing structures in the floodplain, it was assumed that approximately 330 structures would require floodproofing at an estimated cost of \$15,000 per structure.

- **Total Estimated Implementation Cost:** \$41.9 million (does not include costs for road or other local improvements)
- **Total Floodplain Area Removed:** 0
- **Structures Removed from 100-year Flood Extents:** 0

3.3.2 Alternative 2 – Non-regional Conveyance Alternative

This alternative assumes that each jurisdiction would independently develop mitigation alternatives that impact primarily only areas within that jurisdiction. Currently and prior to formation of the Regional Alliance, this was the direction that most of the affected parties were considering. In general, this alternative includes only channelization and diversion components and no regional detention is specified. The project components of this alternative have been previously evaluated in other reports prepared for the respective communities and private interests.

It should be noted that this alternative, since it does not include any regional features, would not remove a substantial amount of floodplain or reduce the flooding hazards between the Town of Wellington and the I-25 crossing of Boxelder Creek.

The key project components consist of the following:

1. Undetained overflow diversion of Coal Creek (Town of Wellington). **Estimated Cost: \$3.8 million** (\$3.2 million from Nolte study)
2. Channel and conveyance improvements between County Road 58 and Highway 14 (new Boxelder Creek Overflow Channel for approximately 5,000 cfs). **Estimated Cost: \$29.3 million**
3. Prospect Road Improvements/Lake Canal-Alternative E (City of Fort Collins) **Estimated Cost: \$14.8 million** (\$15.2 million from City of Fort Collins Master Plan)
4. Diversion of Boxelder I-25 split flow for approximately 4,200 cfs (Private owners) **Estimated Cost: \$4.7 million** (approximately \$4.32 million from Mussetter study)
5. Timnath Diversion Channel-Alternative 2 for approximately 4,200 cfs (Town of Timnath) **Estimated Cost: \$5.7 million** (approximately \$8.0 million from Ayres study)

Under this alternative, it is assumed that local drainage channels will be required within the Town of Wellington to handle local runoff generated within the basin below the diversion to Clark Reservoir.

The undetained diversion of Coal Creek into Boxelder Creek could increase the flooding and/or erosion potential in Boxelder Creek. This impact was not studied in detail as part of the Master Plan, however, it is an impact that should be considered in the final decision making process.

Note: The potential widening of the I-25 corridor could provide an opportunity for construction of an adjacent Boxelder Creek Overflow channel from County Road 52 to Highway 14 and to accommodate a diversion channel for the Boxelder Creek I-25 split flow to the proposed Timnath diversion channel.

- **Total Estimated Implementation Cost:** approximately \$58.3 million
- **Total Floodplain Area Removed:** approximately 1,750 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 219

Figure 3-2 Northern Half

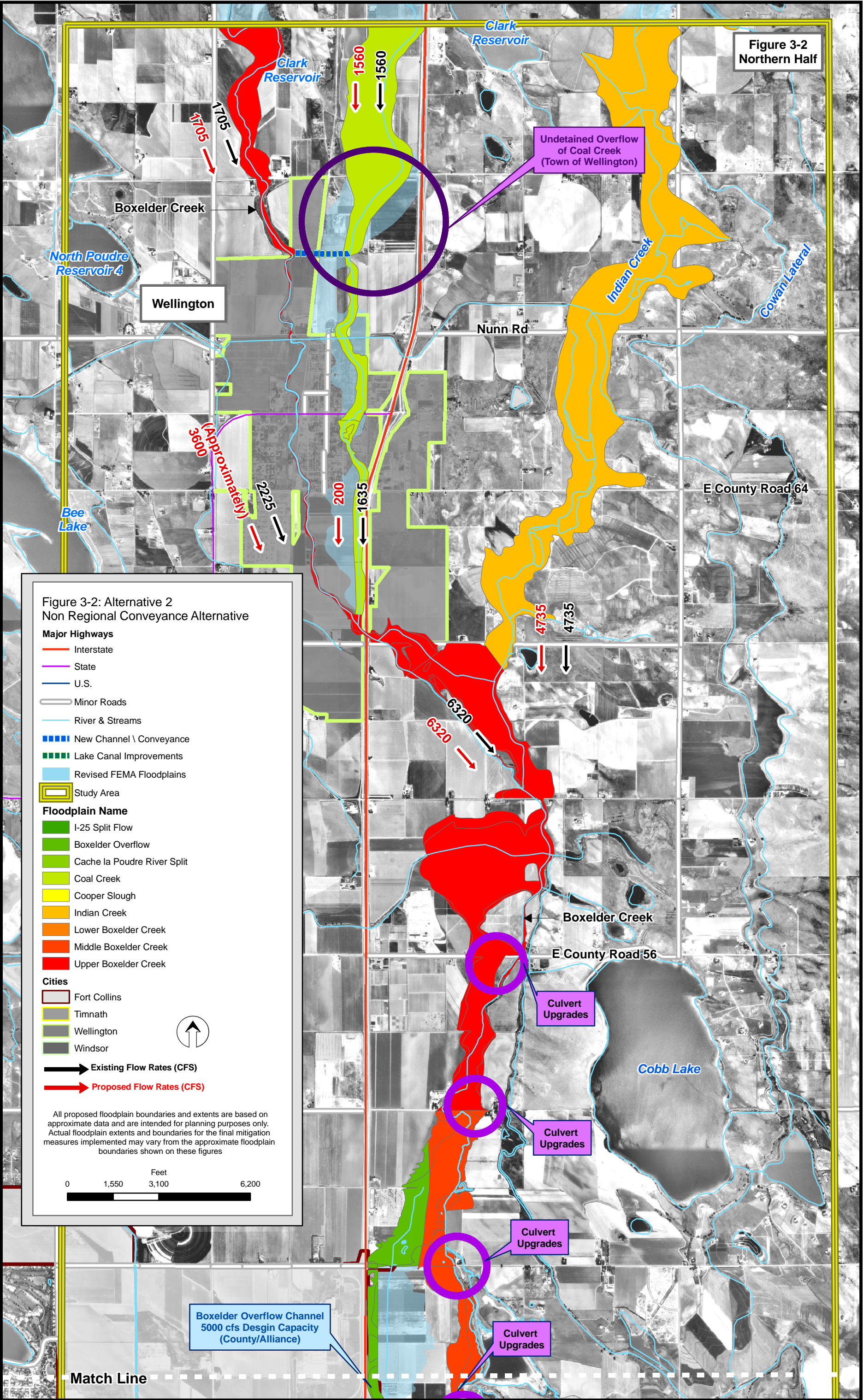
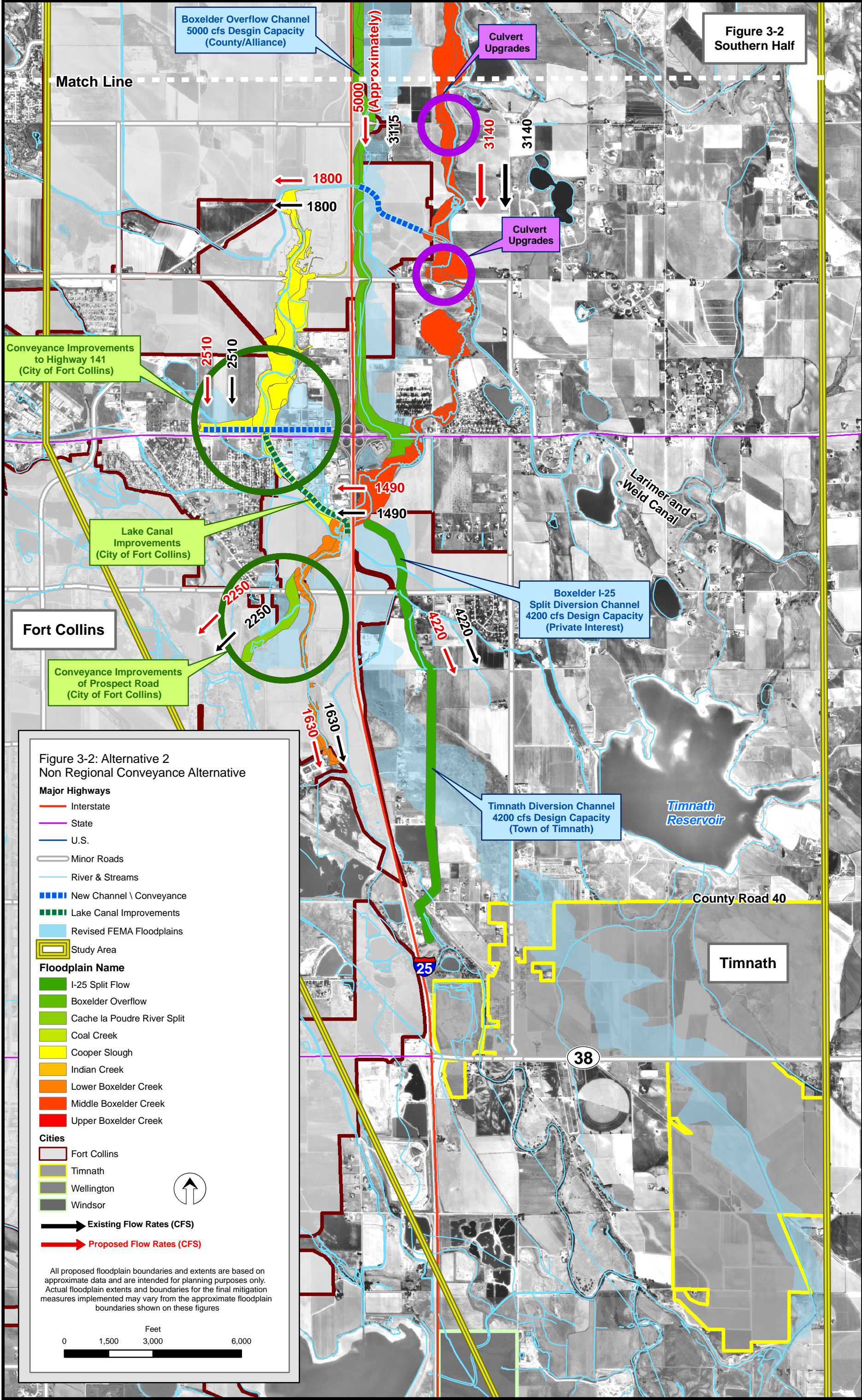


Figure 3-2: Alternative 2 Non Regional Conveyance Alternative (A)

Figure 3-2
Southern Half



**Figure 3-2: Alternative 2
Non Regional Conveyance Alternative**

Major Highways

- Interstate
- State
- U.S.
- Minor Roads

River & Streams

- New Channel \ Conveyance
- Lake Canal Improvements
- Revised FEMA Floodplains

Study Area

Floodplain Name

- I-25 Split Flow
- Boxelder Overflow
- Cache la Poudre River Split
- Coal Creek
- Cooper Slough
- Indian Creek
- Lower Boxelder Creek
- Middle Boxelder Creek
- Upper Boxelder Creek

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

Existing Flow Rates (CFS)

Proposed Flow Rates (CFS)

All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures

0 1,500 3,000 6,000 Feet

3.3.3 Alternative 3—Regional Storage Solution (City of Fort Collins Alternative C)

This alternative is a basin-wide regional alternative that was evaluated by the City of Fort Collins as part of the Boxelder/Cooper Slough Master Planning effort; however, this alternative was not selected as the preferred alternative by the City of Fort Collins (as this is a more costly Regional Project that benefits many properties outside of the City of Fort Collins jurisdictional limits). The alternative utilizes regional detention to capture and attenuate storm runoff within both the Boxelder and Cooper Slough basins. The major project components in this alternative include the following:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements. **Estimated Cost: \$6.2 million** (*\$9.1 million from City of Fort Collins Master Plan*)
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 990 acre-feet of storage). **Estimated Cost: \$5.1 million** (*\$4.3 million from City of Fort Collins Master Plan*)
3. Roadway crossing improvements along major drainage corridors (3,000 to 3,500 cfs design conveyance capacity). **Estimated Cost: \$8.4 million** (*\$7.5 million from City of Fort Collins Master Plan*)
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements. **Estimated Cost: \$14.3 million** (*\$14.1 million from City of Fort Collins Master Plan*)
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (for approximately 3,000 cfs conveyance capacity). **Estimated Cost: \$2.2 million** (*\$2.3 million from City of Fort Collins Master Plan*).
6. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

This alternative does not include the following local flooding components that were included with the original Alternative C as identified in the City of Fort Collins Boxelder/Cooper Slough Master Plan:

- Enlargement of the existing regional detention pond located south of Anheuser Busch, north of the Larimer and Weld Canal. **Estimated Cost: \$1.5 million**
- Installation of a drainage outfall system for the business park located at the northwest corner of I-25 and State Highway 14 (C&S Railroad Detention Area). **Estimated Cost: \$4.7 million**
- Cooper Slough roadway improvements **Estimated Cost: \$3.6 million**
- Floodproofing existing structures inundated (no more than 3 feet) in a 100-year storm event. **Estimated Cost: \$1.0 million** (approximately)

The total estimate for the City of Fort Collins Alternative C was estimated to be \$48.1 million (including the local improvements). Without the local improvements, the cost is reduced by approximately \$10.8 million to \$37.3 million.

- **Total Estimated Implementation Cost:** approximately \$36.2 million
- **Total Floodplain Area Removed:** approximately 2,670 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 306

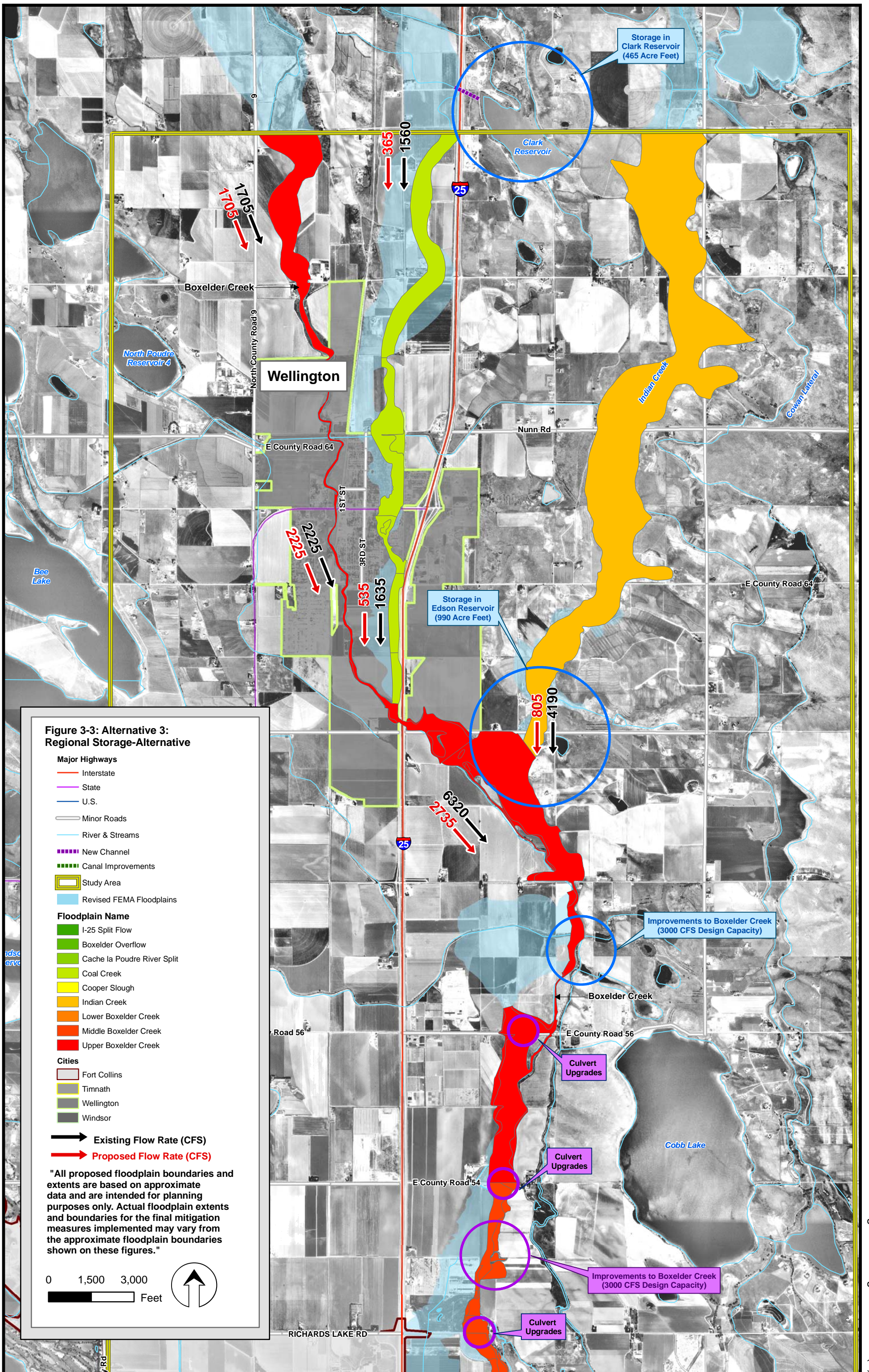


Figure 3-3: Alternative 3: Regional Storage-Alternative (A)

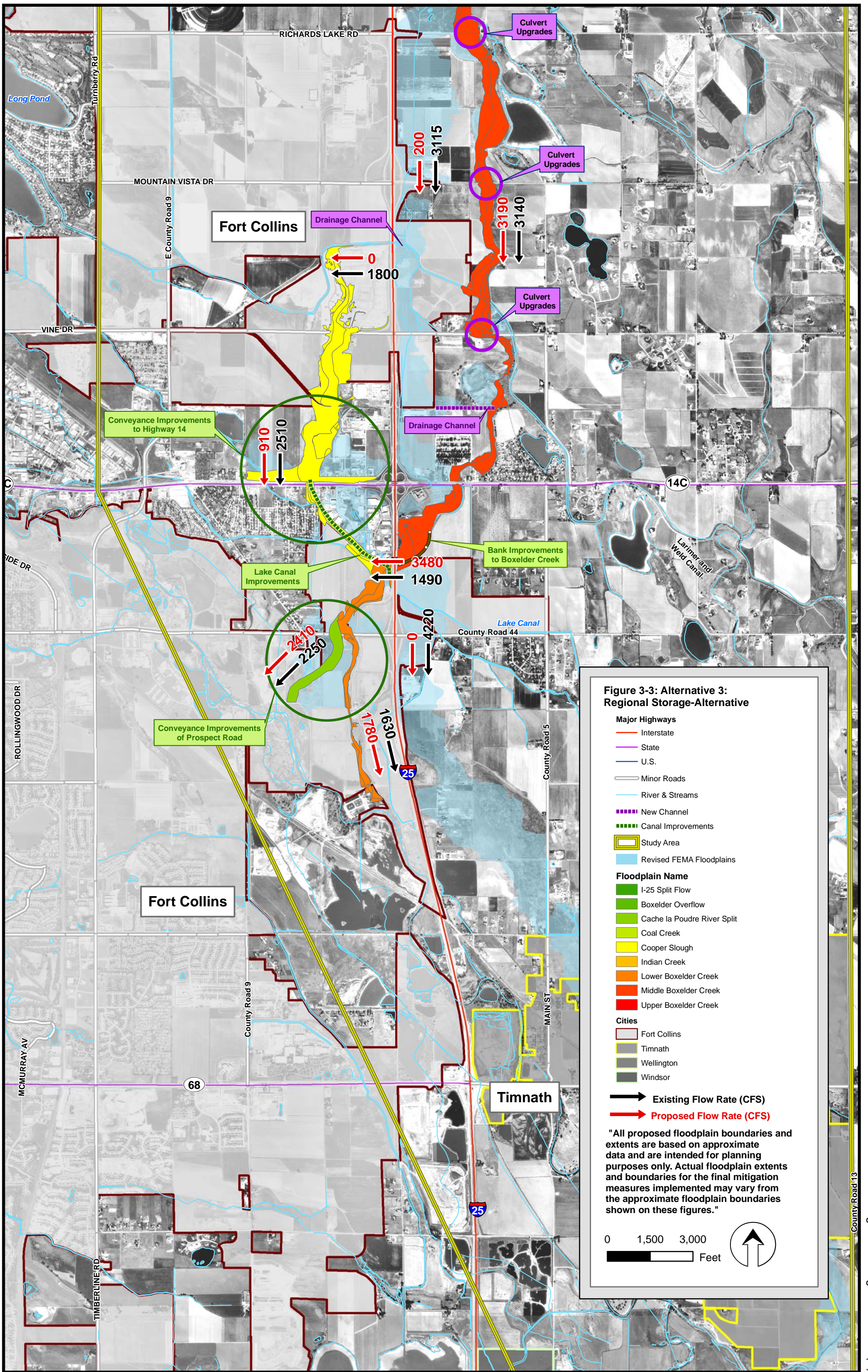
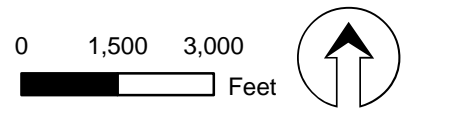


Figure 3-3: Alternative 3: Regional Storage-Alternative

- Major Highways**
 - Interstate
 - State
 - U.S.
 - Minor Roads
 - River & Streams
 - New Channel
 - Canal Improvements
 - Study Area
 - Revised FEMA Floodplains
- Floodplain Name**
 - I-25 Split Flow
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
 - Fort Collins
 - Timnath
 - Wellington
 - Windsor
- Flow Rates**
 - Existing Flow Rate (CFS)
 - Proposed Flow Rate (CFS)

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."



3.3.4 Alternative 4 – Upstream Regional Storage to Minimize Downstream Splits/Diversions

This alternative includes the components included in Alternative 3 and adds storage at either Upper or lower Gray Lakes or at a new detention facility upstream of County Road 50 (Mussetter Alternative D). This alternative would further reduce discharges in Boxelder Creek from County Road 50 downstream through the City of Fort Collins, making conveyance improvements in this reach smaller.

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements. **Estimated Cost: \$6.2 million**
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 990 acre-feet of storage). **Estimated Cost: \$5.1 million**
3. Roadway crossing improvements along major drainage corridors (1,100 to 3,000 cfs design conveyance capacity). **Estimated Cost: \$4.7 million**
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements (reduced design conveyance capacity). **Estimated Cost: \$10.1 million**
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (for approximately 3,000 cfs conveyance capacity). **Estimated Cost: \$1.6 million**
6. New detention storage at County Road 50 (optimized to minimize peak discharge at I-25 box culverts to approximately 1,800 cfs; 1,580 acre-feet of storage required). **Estimated Cost: \$14.1 million** (\$16.1 million from Mussetter report)
7. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

Storage at County Road 50 would further assist in minimizing peak discharges downstream within Boxelder Creek. This storage does not significantly impact the Boxelder Overflow or I-25 splits that have been previously mitigated to the extent possible. Further, the alternative does not impact the Cooper Slough reaches. However, this alternative would reduce the amount of conveyance improvements required downstream of the I-25 box culverts.

Storage at County Road 50 could be provided via the following:

- Diversion and storage within Upper or Lower Gray Reservoirs
- Storage in new detention areas within the floodplain above County Road 50
- Gates and a pump station to divert flow to Cobb Lake
- Dispersed storage within the reach below County Road 58 and County Road 50

- **Total Estimated Implementation Cost:** approximately \$41.9 million
- **Floodplain Area Removed:** approximately 2,880 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 330

Figure 3-4 Northern Half

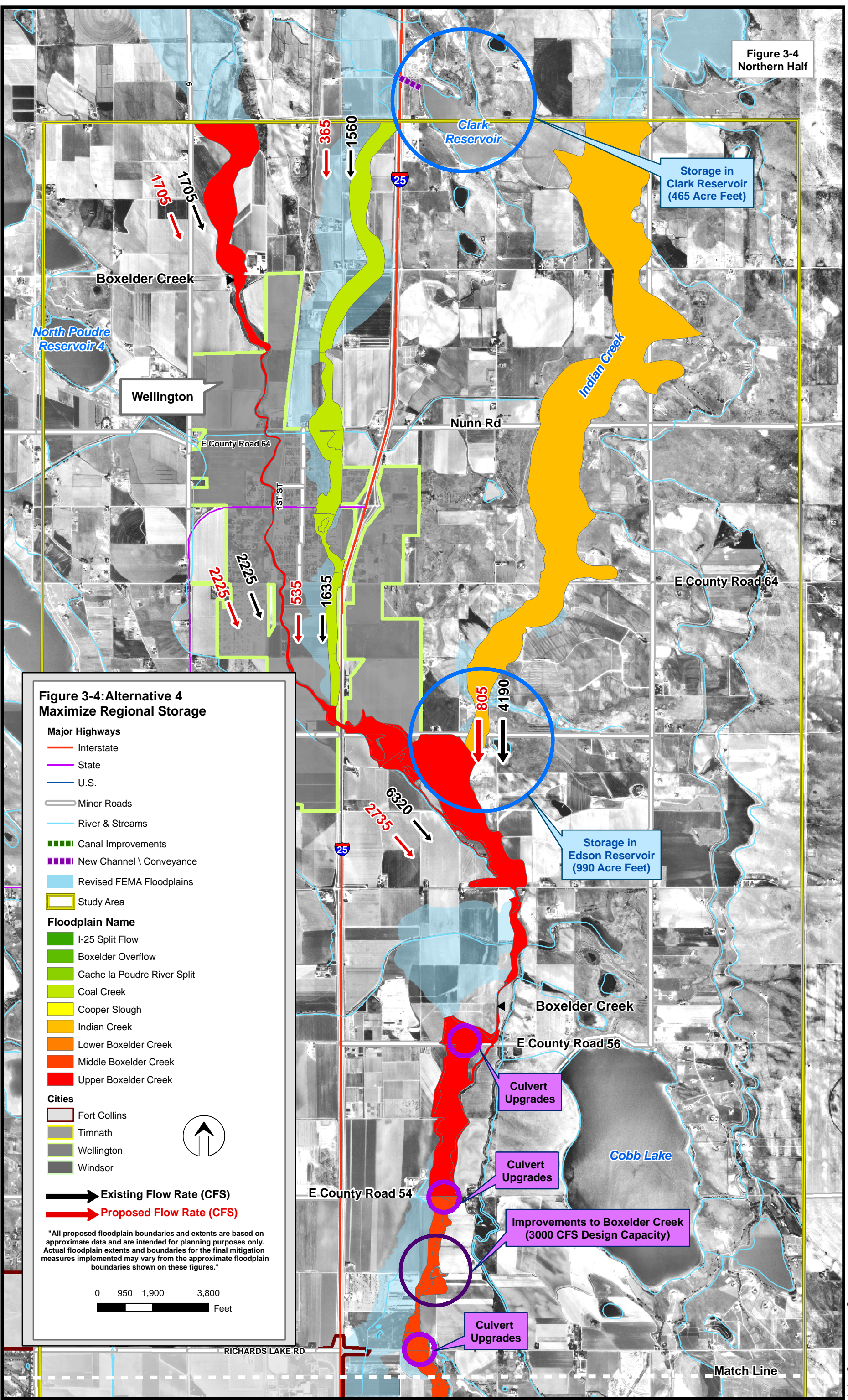


Figure 3-4: Alternative 4
Maximize Regional Storage

- Major Highways**
- Interstate
 - State
 - U.S.
 - Minor Roads
- River & Streams**
- Canal Improvements
 - New Channel \ Conveyance
- Revised FEMA Floodplains**
- Study Area
- Floodplain Name**
- I-25 Split Flow
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
- Fort Collins
 - Timnath
 - Wellington
 - Windsor

Existing Flow Rate (CFS)
Proposed Flow Rate (CFS)

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

0 950 1,900 3,800
Feet

Figure 3-4: Alternative 4
Maximize Regional Storage (A)

Figure 3-4 Southern Half

Match Line

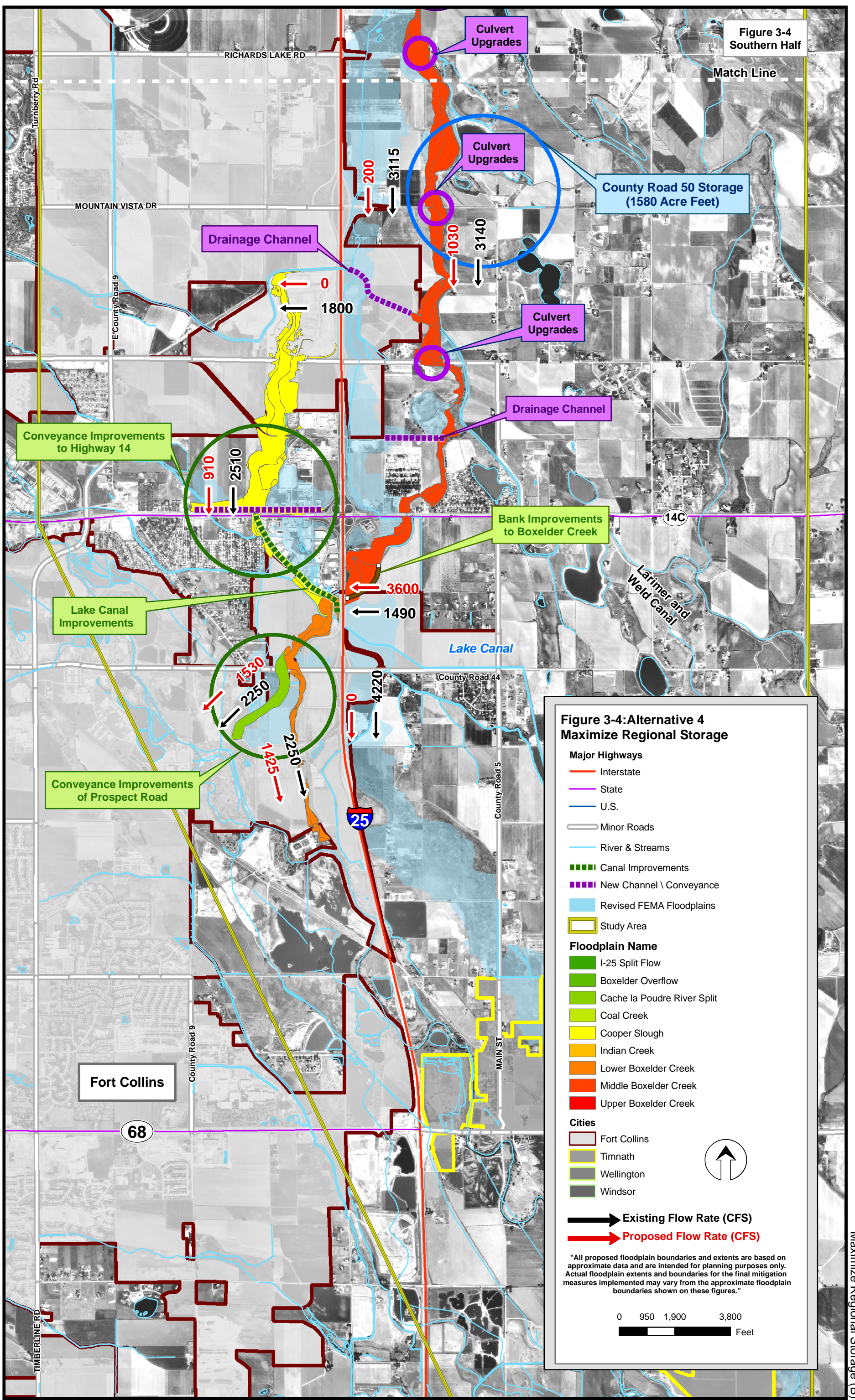


Figure 3-4: Alternative 4 Maximize Regional Storage

- Major Highways**
 - Interstate
 - State
 - U.S.
 - Minor Roads
 - River & Streams
 - Canal Improvements
 - New Channel \ Conveyance
 - Revised FEMA Floodplains
 - Study Area
- Floodplain Name**
 - I-25 Split Flow
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
 - Fort Collins
 - Timnath
 - Wellington
 - Windsor

Existing Flow Rate (CFS)
 Proposed Flow Rate (CFS)

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

0 950 1,900 3,800 Feet

Figure 3-4: Alternative 4 Maximize Regional Storage (B)

3.3.5 Alternative 5—Optimized Regional Storage and Conveyance

Alternative 5 includes optimizing the upstream storage to minimize the need for diversions below the I-25 culvert crossing. The I-25 culverts with all four (4) cells open have a maximum capacity of approximately 3,600 cfs (based on previous hydraulic modeling). In this alternative, it is assumed that some flow (approximately 500 cfs) would be diverted below the I-25 box culverts through Timnath. Therefore, upstream storage has been optimized to: 1) eliminate the Boxelder overflow and spills into Copper Slough and 2) minimize the total peak discharge at the I-25 box culverts to approximately 4,100 cfs.

Two (2) scenarios for optimizing storage were evaluated: The first at the County Road 50 storage area and the second at the Edson Reservoir site.

Based on updating the available hydrologic model for the watershed, the following components are included in Alternative 5:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements. **Estimated Cost: \$6.2 million**
2. Roadway crossing improvements along major drainage corridors of Boxelder Creek (for total peak discharge of 3,800 to 6,300 cfs). **Estimated Cost: \$9.6 million**
3. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements. **Estimated Cost: \$10.1 million**
4. Improvement of Boxelder Creek from County Road 50 to County Road 54 (total design conveyance capacity of approximately 6,200 cfs). **Estimated Cost: \$2.8 million**
5. New detention storage at County Road 50 (approximately 635 acre-feet) (Mussetter Alternative D). **Estimated Cost: \$5.8 million**
6. Diversion of Boxelder I-25 split flow (assumed design conveyance capacity of approximately 500 cfs) (Private owners) **Estimated Cost: \$2.0 million**
7. Timnath Diversion Channel (assumed design conveyance capacity of approximately 500 cfs (Town of Timnath) **Estimated Cost: \$2.3 million**
8. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** \$38.9 million
- **Total Floodplain Area Removed:** approximately 2,400 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 305

Alternative 5A which includes optimizing storage at Edson Reservoir includes the following:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements. **Estimated Cost: \$6.2 million**

2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 660 acre-feet of storage). **Estimated Cost: \$4.1 million**
3. Roadway crossing improvements along major drainage corridors of Boxelder Creek (for total peak discharge of 3,600 cfs to 4,100 cfs). **Estimated Cost: \$8.4 million**
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements. **Estimated Cost: \$10.1 million**
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (total design conveyance capacity of approximately 3,600 cfs). **Estimated Cost: \$2.4 million**
6. Diversion of Boxelder I-25 split flow (assumed design conveyance capacity of approximately 500 cfs) (Private owners) **Estimated Cost: \$2.0 million**
7. Timnath Diversion Channel (assumed design conveyance capacity of approximately 500 cfs (Town of Timnath) **Estimated Cost: \$2.3 million**
8. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- | |
|--|
| <ul style="list-style-type: none">• Total Estimated Implementation Cost: \$35.6 million• Total Floodplain Area Removed: approximately 2,500 acres• Structures Removed from 100-year Floodplain Extents: approximately 310 |
|--|

Figure 3-5
Northern Half

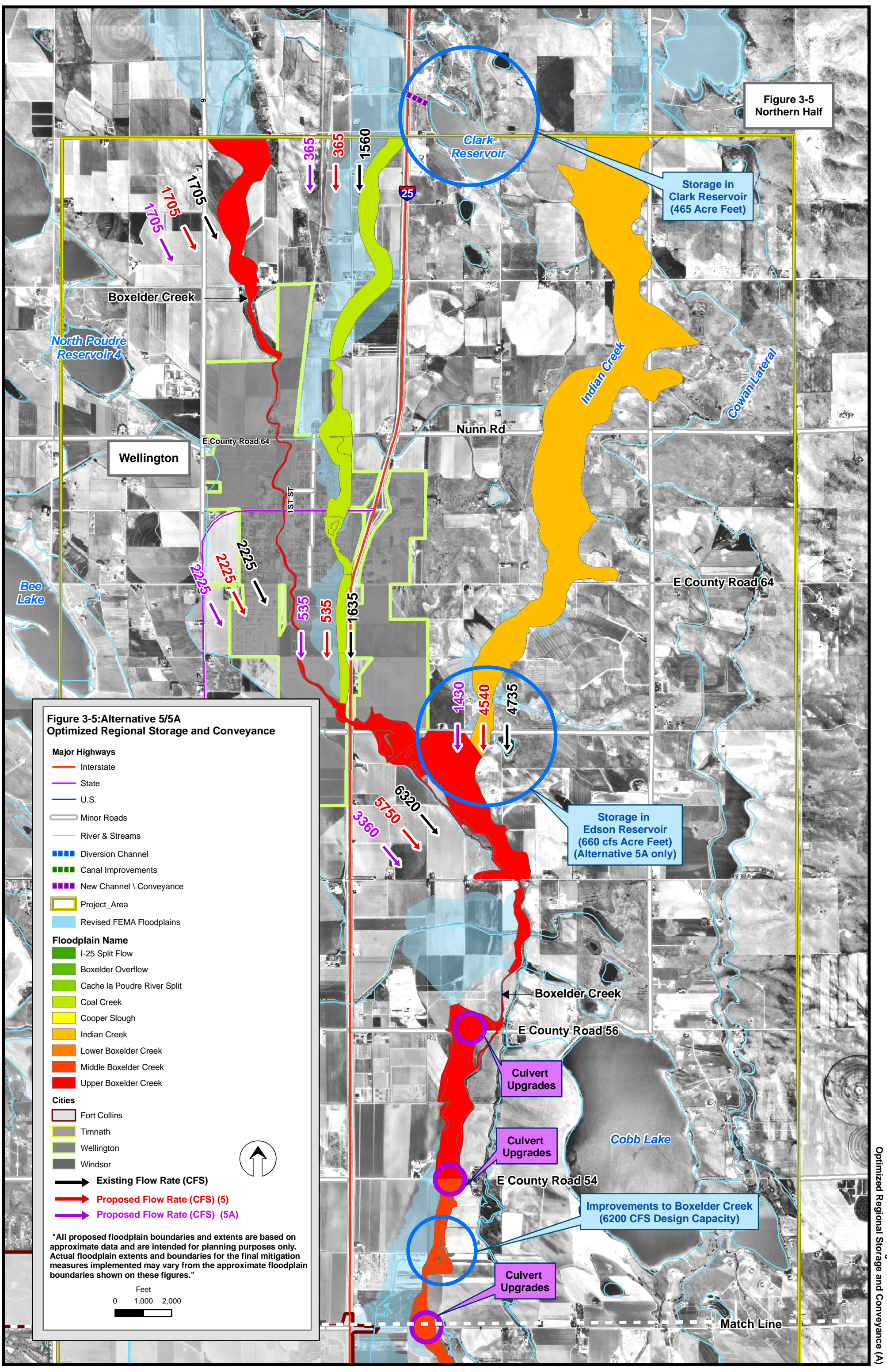


Figure 3-5: Alternative 5/5A
Optimized Regional Storage and Conveyance

- Major Highways**
- Interstate
 - State
 - U.S.
 - Minor Roads
- River & Streams**
- Diversion Channel
 - Canal Improvements
 - New Channel \ Conveyance
- Project Area**
- Revised FEMA Floodplains
- Floodplain Name**
- I-25 Split Flow
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
- Fort Collins
 - Timnath
 - Wellington
 - Windsor
- Flow Rates**
- Existing Flow Rate (CFS)
 - Proposed Flow Rate (CFS) (5)
 - Proposed Flow Rate (CFS) (5A)

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

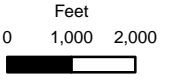


Figure 3-5: Alternative 5/5A
Optimized Regional Storage and Conveyance (A)

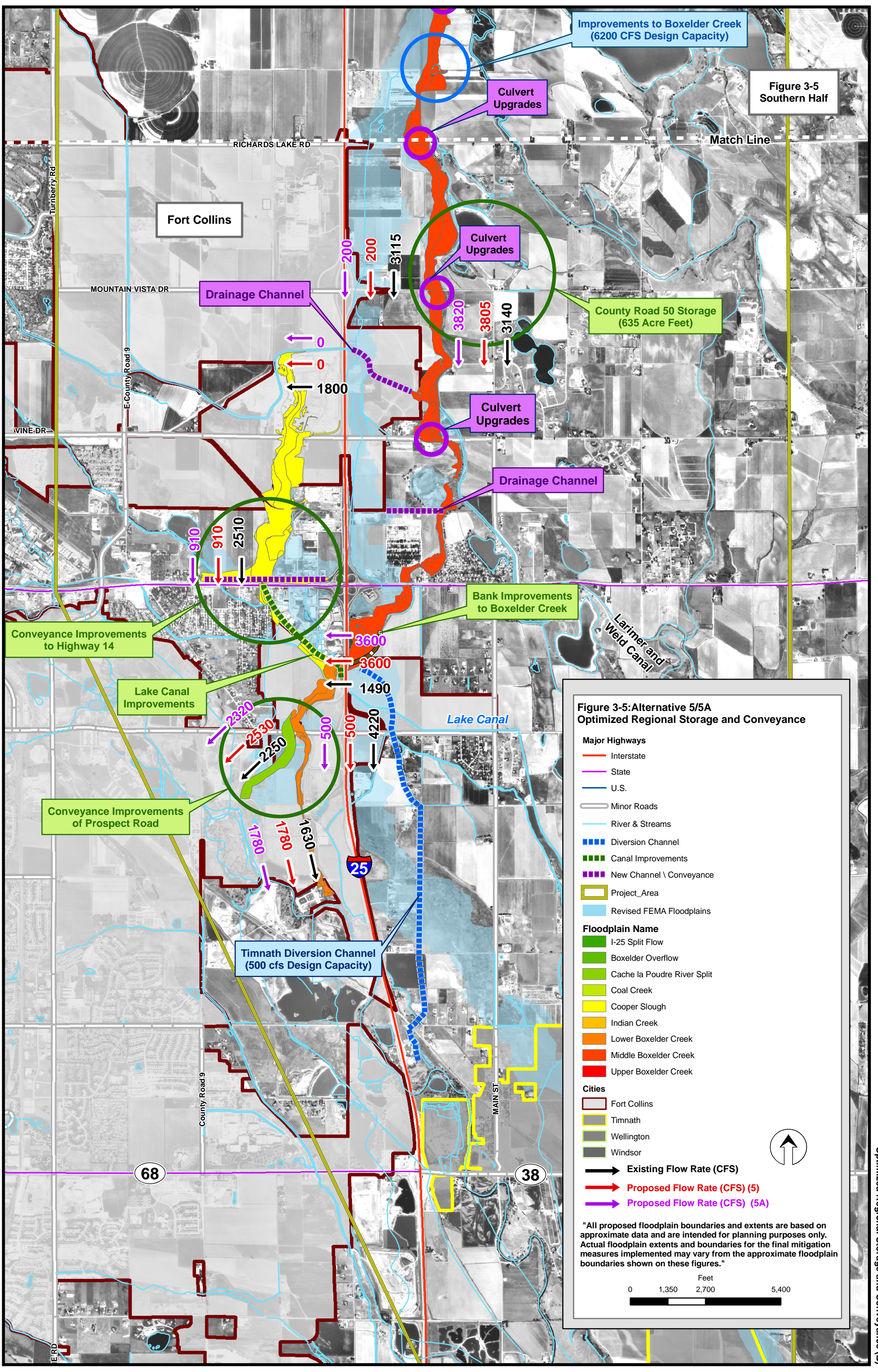


Figure 3-5 Southern Half

Figure 3-5: Alternative 5/5A Optimized Regional Storage and Conveyance

Major Highways

- Interstate
- State
- U.S.
- Minor Roads

River & Streams

- Diversion Channel
- Canal Improvements
- New Channel \ Conveyance

Project Area

- Revised FEMA Floodplains

Floodplain Name

- I-25 Split Flow
- Boxelder Overflow
- Cache la Poudre River Split
- Coal Creek
- Cooper Slough
- Indian Creek
- Lower Boxelder Creek
- Middle Boxelder Creek
- Upper Boxelder Creek

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

Flow Rates

- Existing Flow Rate (CFS)
- Proposed Flow Rate (CFS) (5)
- Proposed Flow Rate (CFS) (5A)

Scale

0 1,350 2,700 5,400 Feet

Disclaimer: "All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."

Figure 3-5: Alternative 5/5A Optimized Regional Storage and Conveyance (B)

3.4 Alternatives Evaluation

The following information was utilized to select a preferred alternative:

- Benefit-cost ratio
- Overall project cost
- Evaluation matrix

The evaluation matrix was developed so that other non-economic factors could be considered when selected a preferred alternative. Non-economic factors are difficult to quantify and to some degree are based on subjective judgment. As such, an evaluation matrix was utilized to define non-economic criteria and score these criteria based on weighting assigned to each criteria. The criteria, weighting and scoring was performed by members of the TAC independently and averaged. The criteria and weightings utilized in the matrix were:

- Feasibility of Implementation and Funding (25%)
- Public Safety (20%)
- Construction Risk (15%)
- Recreation and Environmental Opportunities (15%)
- Timing/Phasing (15%)
- Operation and Maintenance (10%)

The criteria were ranked on a scale of 1 to 5 with 5 being the most desirable for each alternative. The alternative with the highest score (along with an assessment of the overall costs and the benefit/cost ratio) should be considered as the most attractive for further consideration.

Table 3-3: Alternatives Summary

Parameter	Alternative 1 – No Action	Alternative 2 – Non-regional Conveyance	Alternative 3 – Regional Storage	Alternative 4-Maximize Regional Storage	Alternative 5 – Optimize Storage and Conveyance	Alternative 5A – Optimize Storage and Conveyance
Total Land Removed from Floodplain (acres)	0	1,750	2,670	2,770	2,490	2,535
Structures Removed from Floodplain	0	219	306	330	306	306
Agricultural Land removed from Floodplain (acres)	0	1,020	1,410	1,530	1,410	1,410
Roadways Removed from Flooding	0	33	33	33	33	33
Benefits						
<i>Estimated Local Benefits</i>	\$24 million	\$40 million	\$53 million	\$54 million	\$52 million	\$52 million
<i>Estimated Regional Benefits</i>	\$0 million	\$18 million	\$26 million	\$27 million	\$26 million	\$26 million
Total Benefits	\$24 million	\$58 million	\$79 million	\$81 million	\$78 million	\$78 million

Table 3-3: Alternatives Summary

Parameter	Alternative 1 – No Action	Alternative 2 – Non-regional Conveyance	Alternative 3 – Regional Storage	Alternative 4-Maximize Regional Storage	Alternative 5 – Optimize Storage and Conveyance	Alternative 5A – Optimize Storage and Conveyance
Implementation Costs	\$41.9million	\$58.3 million	\$36.2 million	\$41.9 million	\$38.9 million	\$35.6 million
Benefit/Cost Ratio	0.6	0.9	2.1	1.8	1.9	2.1
Cost per acre removed from floodplain	N/A	\$33,402	\$14,566	\$16,132	\$16,709	\$15,111

An alternatives evaluation matrix was assembled to assist the Alliance in the decision making process and selection of a preferred alternative. This matrix looked at non-quantifiable criteria in addition to overall implementation cost and estimated benefit/cost ratios. The non-quantifiable criteria include the following:

- Conceptual costs (25%)
- Feasibility of implementation (20%)
- Protection to public safety and welfare (20%)
- Construction risk (15%)
- Feasibility of funding (10%)
- Operation and maintenance (10%)

The weighting of the criteria and the scoring of the alternatives was performed in a workshop setting by members of the TAC. This information (along with the funding and economic evaluations) was utilized to assist in selecting a recommended alternative for implementation.

Table 3-4: Evaluation Matrix Summary

Parameter	Alternative 1 – No Jurisdiction Alternative	Alternative 2 – Non-regional Conveyance Alternative	Alternative 3 – Regional Storage Alternative	Alternative 4-Maximize Regional Storage	Alternative 5 – Optimize Storage and Conveyance	Alternative 5A – Optimize Storage and Conveyance
Estimated Implementation Costs	\$41.9 million	\$58.3 million	\$36.2 million	\$41.9 million	\$38.9 million	\$35.6 million
35-percent Confidence	\$38 million	\$56 million	\$35 million	\$40 million	\$37 million	\$34 million
65-percent Confidence	\$46 million	\$61 million	\$38 million	\$44 million	\$40 million	\$37 million
Estimated Benefits	\$24 million	\$58 million	\$79 million	\$81 million	\$78 million	\$78 million
35-percent Confidence	\$19 million	\$48 million	\$70 million	\$72 million	\$69 million	\$69 million
65-percent Confidence	\$25 million	\$61 million	\$85 million	\$87 million	\$83 million	\$84 million
Matrix Score	2.29	2.08	3.31	3.16	3.44	3.94
Rank	5	6	3	4	2	1
Benefit/Cost Ratio	0.6	0.9	2.1	1.8	1.9	2.1
35-percent Confidence	0.4	0.8	1.8	1.6	1.7	1.8
65-percent Confidence	1.6	1.0	2.3	2.0	2.1	2.3

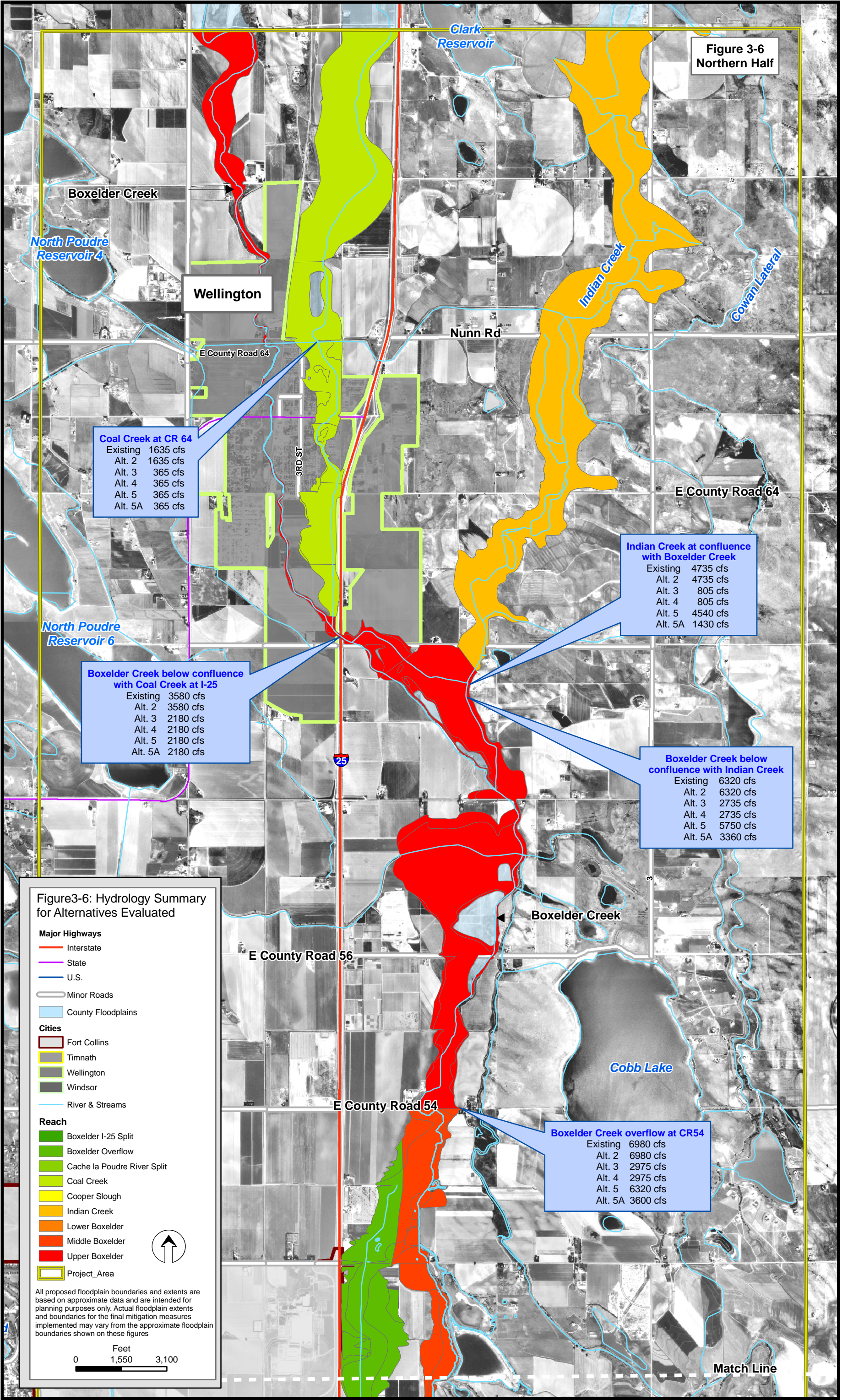
TABLE 3-5: ALTERNATIVES EVALUATION MATRIX

Alternative No.	Alternative ID	Scoring Criteria							Rank	Estimated Initial Capital Cost	Estimated Annual O&M Cost	Estimated Benefit/Cost Ratio
		Feasibility of Implementation & Funding	Public Safety	Construction Risk	Recreational & Environmental Opportunities	Timing/Phasing	Operation and Maintenance Issues	Total				
		25%	20%	15%	15%	15%	10%	100%				
* Scoring from 1 to 5 where 5 is the best option												
1	Non-jurisdictional Alternative	3.3	1.0	2.6	1.5	2.4	3.0	2.29	5	\$ 41,942,836	\$ -	0.56
2	Non-regional Conveyance Alternative	1.6	2.6	2.0	2.5	1.8	2.1	2.08	6	\$ 58,328,757	\$ 58,614	0.94
	Undetained diversion of Coal Creek (Wellington)									\$ 3,824,326		
	Boxelder Overflow Channel (Larimer County??) (5,000 cfs)									\$ 29,294,734		
	Fort Collins Alternative E (Fort Collins)									\$ 14,793,285		
	Boxelder I-25 Split (Private) (4,200 cfs)									\$ 4,706,816		
	Boxelder I-25 Split (Tinnath) (4,200 cfs)									\$ 5,709,596		
3	Regional Storage Alternative	3.9	3.5	3.0	2.6	3.0	3.5	3.31	3	\$ 36,147,970	\$ 37,694	2.08
	Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)									\$ 6,221,130		
	Edson Reservoir (990 ac-ft)									\$ 5,063,691		
	Middle Boxelder Creek Improvements (3,000 cfs)									\$ 2,189,555		
	Road Crossing Improvements (3,000 to 3,500 cfs)									\$ 8,412,128		
	Propect Road/Lake Canal Conveyance Improvements									\$ 14,261,466		
4	Maximized Regional Storage Alternative	2.9	4.0	3.0	3.1	3.0	2.8	3.16	4	\$ 41,893,256	\$ 41,480	1.84
	Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)									\$ 6,221,130		
	Edson Reservoir (990 ac-ft)									\$ 5,063,691		
	Middle Boxelder Creek Improvements (3,000 cfs)									\$ 1,644,234		
	CR50 Storage (1,580 ac-ft)									\$ 14,124,553		
	Road Crossing Improvements (1,110 to 3,000 cfs)									\$ 4,698,196		
	Propect Road/Lake Canal Conveyance Improvements									\$ 10,141,452		
5	Optimized Storage-Conveyance Alternative	3.1	4.0	3.1	4.0	3.4	2.9	3.44	2	\$ 38,877,501	\$ 40,149	1.90
	Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)									\$ 6,221,130		
	Middle Boxelder Creek Improvements (6,200 cfs)									\$ 2,790,968		
	CR50 Storage (635 acre-feet)									\$ 5,821,962		
	Road Crossing Improvements (3,800 to 6,300 cfs)									\$ 9,617,531		
	Propect Road/Lake Canal Conveyance Improvements									\$ 10,141,452		
	Boxelder I-25 Split Flow Diversion Channel (500 cfs)									\$ 2,000,223		
	Tinnath Diversion Channel (500 cfs)									\$ 2,284,235		
5A	Optimized Storage-Conveyance Alternative	4.3	4.0	3.4	4.3	3.6	3.9	3.94	1	\$ 35,578,782	\$ 36,161	2.09
	Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)									\$ 6,221,130		
	Edson Reservoir (660 ac-ft)									\$ 4,100,802		
	Middle Boxelder Creek Improvements 3,000 cfs)									\$ 2,401,362		
	Road Crossing Improvements (3,000 to 3,5000 cfs)									\$ 8,412,128		
	Propect Road/Lake Canal Conveyance Improvements									\$ 10,141,452		
	Boxelder I-25 Split Flow Diversion Channel (500 cfs)									\$ 2,017,673		
	Tinnath Diversion Channel (500 cfs)									\$ 2,284,235		
Criteria Score	Description of Scoring											
5	This option is the best at satisfying the criteria.											
4	This option is better than others at satisfying the criteria, but it is not the best.											
3	This option is average for satisfying the criteria.											
2	This option is worse than others at satisfying the criteria, but it is not the poorest.											
1	This option is the poorest at satisfying the criteria.											
Criteria	Description of Criteria											
Feasibility of Implementation & Funding	Relates to the overall feasibility of the alternative being implemented including obtaining the necessary funding.											
Public Safety	Relates to the ability of the alternative to protect public property and reduce flooding hazards.											
Construction Risk	An assessment of the overall construction risk associated with implementation of the project that could impact cost and timing.											
Recreational and Environmental Opportunities	The overall opportunities associated with the alternative to enhance recreation and the environment (water quality, wetlands, etc.)											
Timing/Phasing	The ability to phase the implementation of the project such that certain time-critical features can be implemented.											
Operation and Maintenance Issues	An assessment of the overall operation and maintenance constraints associated with the alternative.											

Table 3-6: Alternatives Hydrology Summary

Location	FEMA Existing Condition (cfs)	w/ Clark Reservoir Only (cfs)	w/ Edson Reservoir Only (660 a-f) (cfs)	Clark & Edson (cfs)	Clark, Edson, & I-25 Culverts (cfs)	Design Flow (cfs)
Coal Creek upstream of Wellington (CE 586)	1,650	174	1,650	174	174	175
Boxelder Creek at County Road 58 (CE 115)	6,322	6,027	4,650	3,586	3,586	3,600
Boxelder Creek at County Road 54 (CE 107)	6,978	6,698	4,985	3,906	3,906	3,910
Boxelder Creek at County Road 50 (CE 301)	2,905	2,838	2,597	2,464	2,464	3,930
Boxelder Creek Overflow at County Road 50 (CE 302)	4,054	3,777	2,370	1,463	1,463	Local
Boxelder Creek at L&W Canal (CE 95)	3,152	3,098	2,766	2735	2,735	3,880
Boxelder Creek Overflow at L&W Canal (CE 99)	3,450	3,146	1,898	1,149	1,149	Local
Boxelder Creek at County Road 48 (CE 96)	2,774	2,694	2,285	2,144	2,144	3,100
Boxelder Creek Overflow at County Road 48 (CE 97)	1,840	1,724	1,224	951	951	Local
Boxelder Creek at I-25 (CE 86)	5,685	5,397	4,398	3,884	3,884	3,890
I-25 Split Flow (CE 927)	4,216	3,931	2,941	2,440	669	700
Boxelder Creek at Prospect Road (CE 885)	4,000	3,816	3,120	2,746	4,516	4,520
Cooper Slough at Mulberry Street (CE 936)	2,511	2,332	1,653	1,285	1,284	1,290

Figure 3-6
Northern Half



Coal Creek at CR 64
 Existing 1635 cfs
 Alt. 2 1635 cfs
 Alt. 3 365 cfs
 Alt. 4 365 cfs
 Alt. 5 365 cfs
 Alt. 5A 365 cfs

Indian Creek at confluence with Boxelder Creek
 Existing 4735 cfs
 Alt. 2 4735 cfs
 Alt. 3 805 cfs
 Alt. 4 805 cfs
 Alt. 5 4540 cfs
 Alt. 5A 1430 cfs

Boxelder Creek below confluence with Coal Creek at I-25
 Existing 3580 cfs
 Alt. 2 3580 cfs
 Alt. 3 2180 cfs
 Alt. 4 2180 cfs
 Alt. 5 2180 cfs
 Alt. 5A 2180 cfs

Boxelder Creek below confluence with Indian Creek
 Existing 6320 cfs
 Alt. 2 6320 cfs
 Alt. 3 2735 cfs
 Alt. 4 2735 cfs
 Alt. 5 5750 cfs
 Alt. 5A 3360 cfs

Boxelder Creek overflow at CR54
 Existing 6980 cfs
 Alt. 2 6980 cfs
 Alt. 3 2975 cfs
 Alt. 4 2975 cfs
 Alt. 5 6320 cfs
 Alt. 5A 3600 cfs

Figure3-6: Hydrology Summary for Alternatives Evaluated

Major Highways
 Interstate
 State
 U.S.
 Minor Roads

County Floodplains

Cities
 Fort Collins
 Timnath
 Wellington
 Windsor

Reach
 Boxelder I-25 Split
 Boxelder Overflow
 Cache la Poudre River Split
 Coal Creek
 Cooper Slough
 Indian Creek
 Lower Boxelder
 Middle Boxelder
 Upper Boxelder
 Project Area

All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures

0 1,550 3,100 Feet

Figure3-6: Hydrology Summary for Alternatives Evaluated (A)

Match Line
Figure 3-6
Southern Half

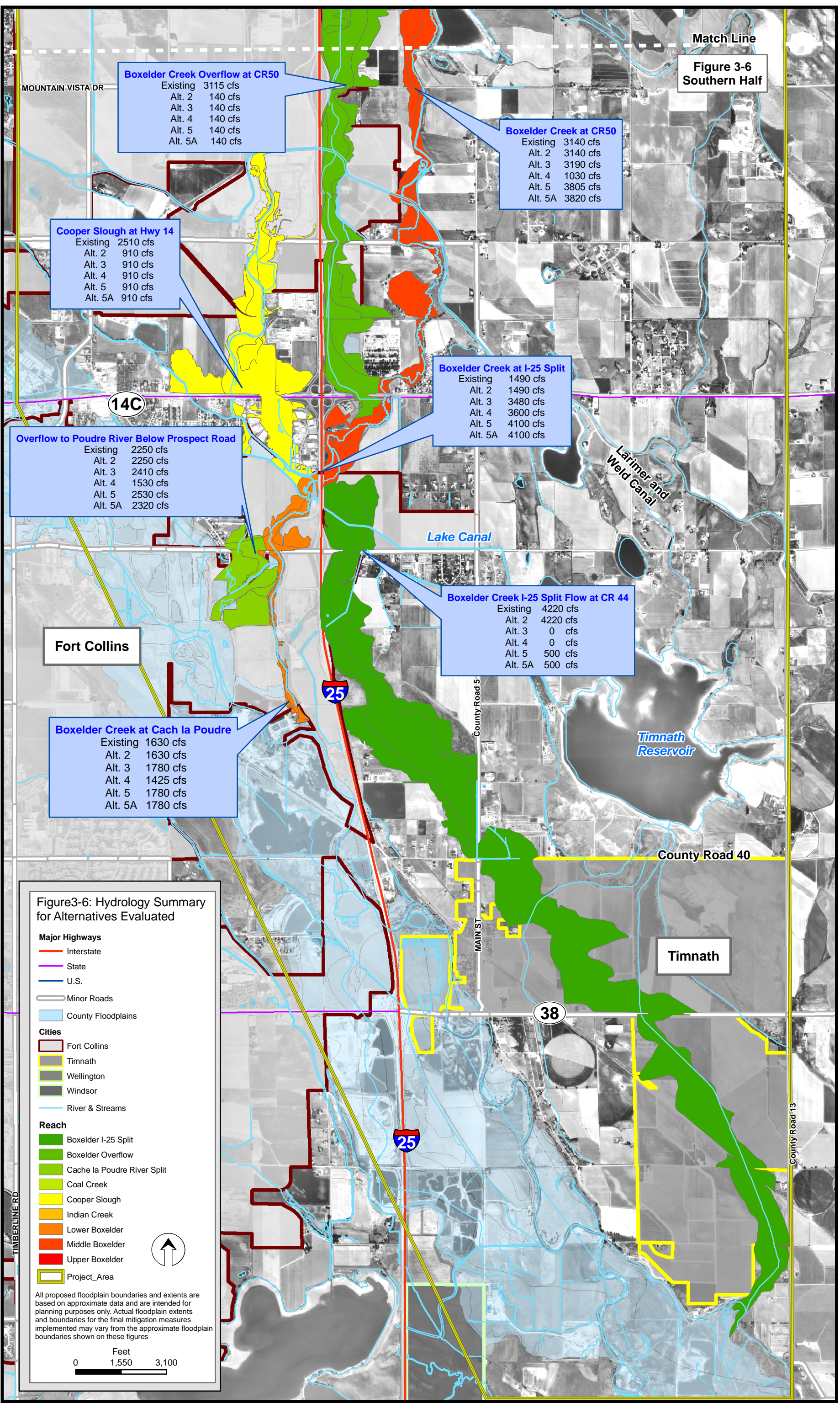
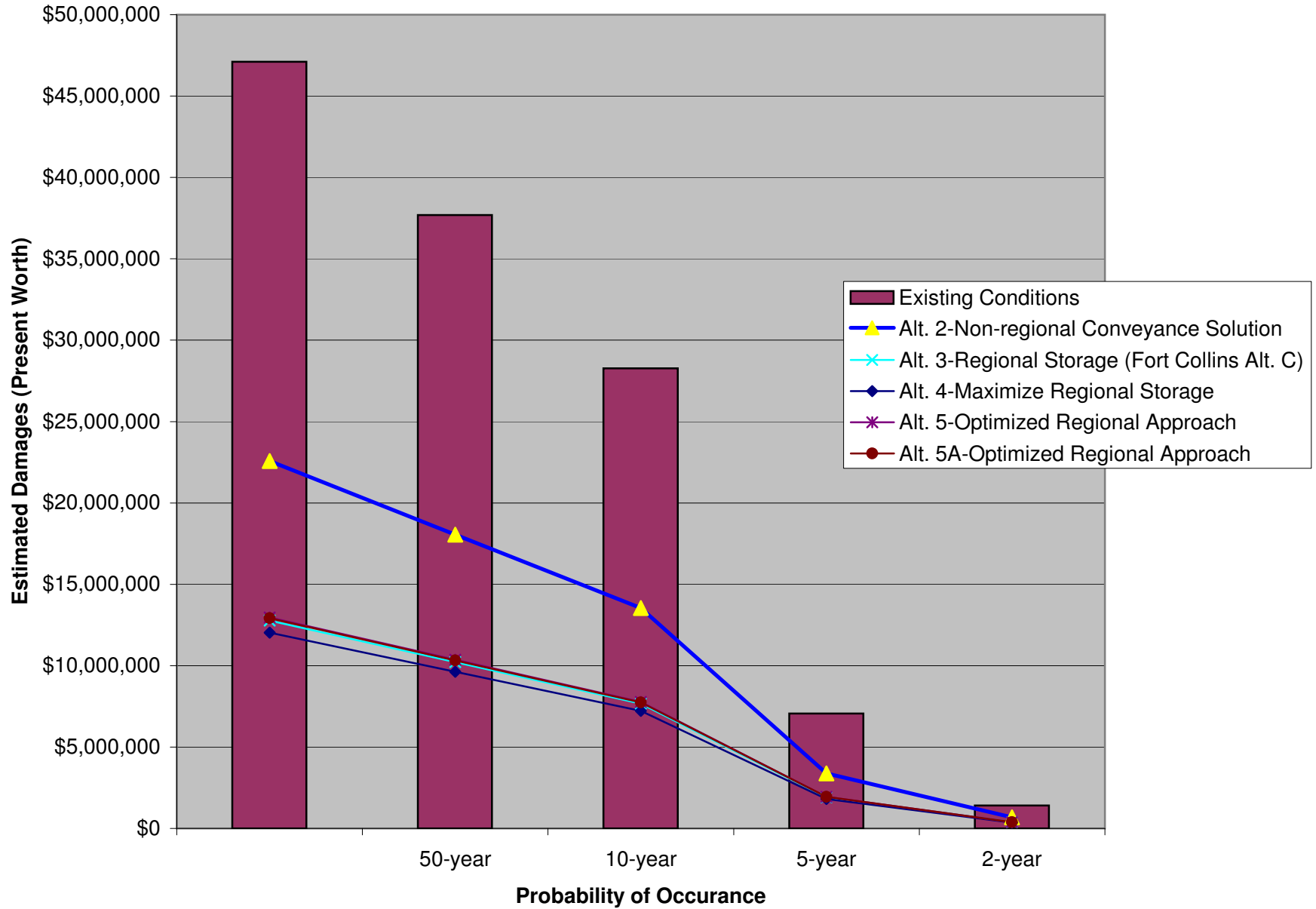
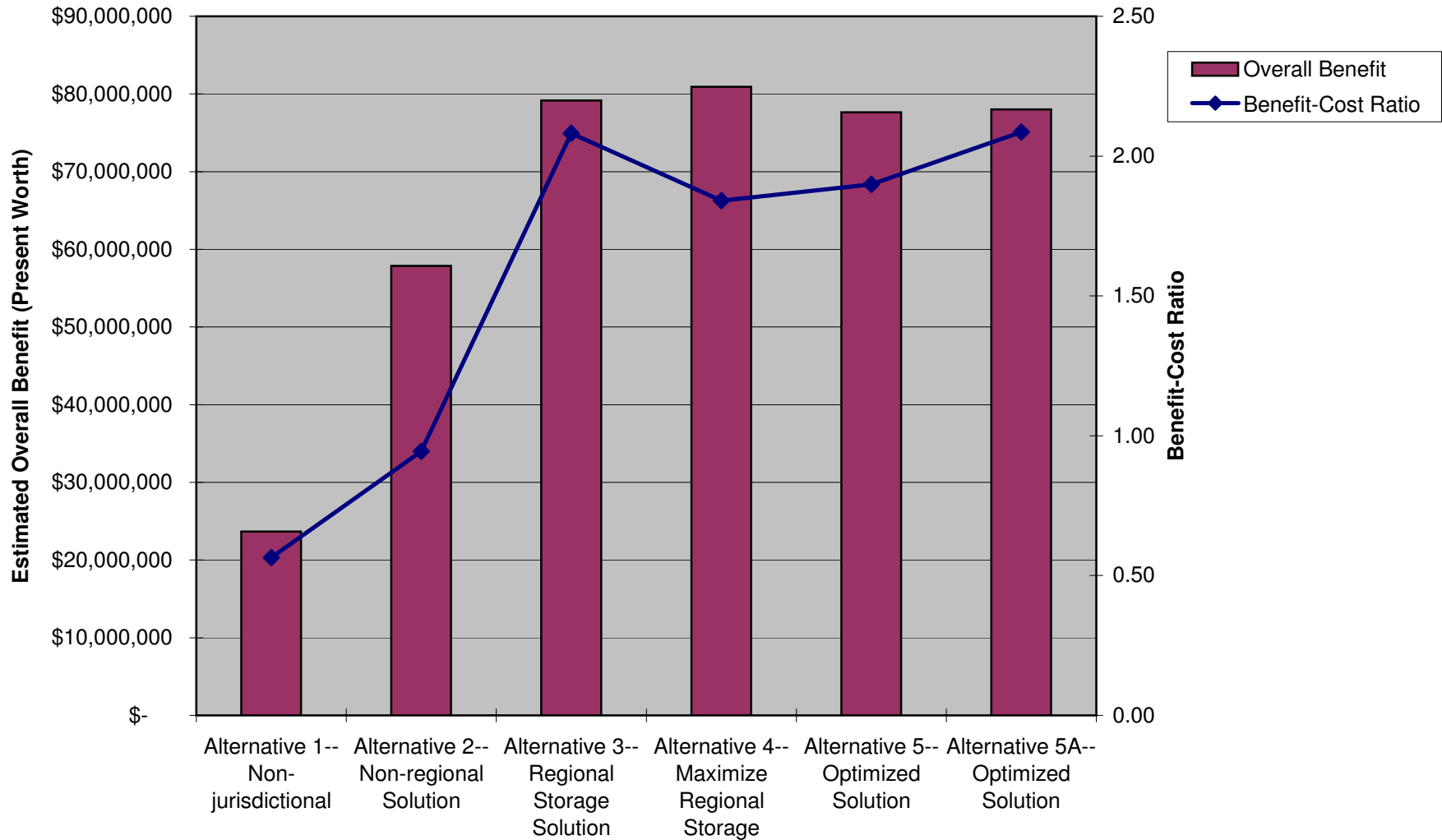


Figure 3-6: Hydrology Summary for Alternatives Evaluated (B)

**Figure 3-7
Damage-Frequency Estimates**



**Figure 3-8
Overall Benefit Estimates**



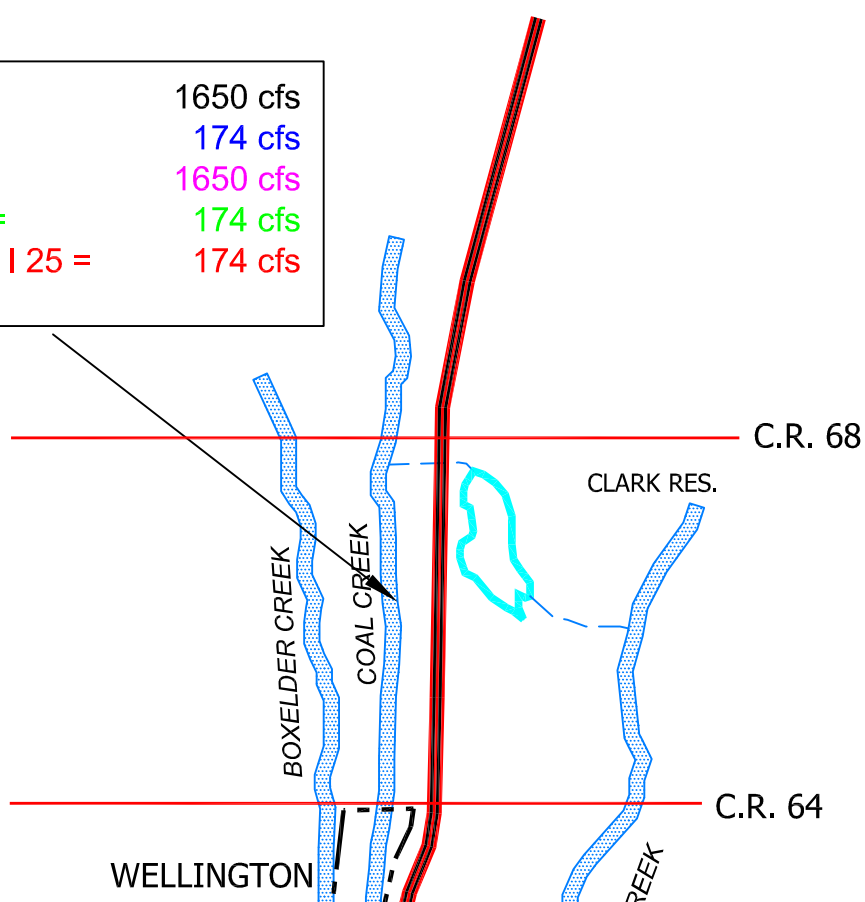
DRAFT

3.5 Recommended Alternative

Based on the evaluations undertaken and numerous discussions with the TAC and FAC, the preferred alternatives for the Boxelder Creek Regional Plan were reduced to Alternative 5A and Alternative 3. Alternative 3 requires additional storage upstream, however, it reduces the need for a diversion for the I-25 split flow (the peak discharges are reduced sufficiently to eliminate the split flow entirely). However, due to timing of the Timnath diversion channel and the desire to develop properties below the I-25 split flow, Alternative 5A represents an optimized solution of storage and conveyance. Both alternatives have a benefit/cost ratio greater than 2 and a total implementation cost of approximately \$36 million.

Further evaluations were conducted to determine the overall impact of constructing specific components of Alternative 3 and 5A, specifically, the upstream storage and its impacts on downstream areas. Based on these evaluations, it was determined that the largest regional benefit was a direct result of both the Coal Creek diversion to Clark Reservoir and the proposed Edson Reservoir. Further, it was concluded that the Middle Boxelder Creek Improvements and I-25 split flow diversion (in the case of Alternative 5A) have direct Regional Benefits, as they reduce the potential flooding in other areas as well as locally. The Middle Boxelder Creek Improvements would eliminate the Boxelder Overflow floodplain and significantly reduce the potential for overflows into the Cooper Slough Basin. The I-25 split flow diversion channel (if required) would allow for the I-25 box culverts to be opened without adversely impacting areas downstream. **Figure 3-9** provides a summary of the hydrology for Alternative 5A with various project components.

▪ FEMA =	1650 cfs
▪ Clark =	174 cfs
▪ Edson =	1650 cfs
▪ Clark & Edson =	174 cfs
▪ Clark, Edson, & I 25 =	174 cfs



▪ FEMA =	4054 cfs
▪ Clark =	3777 cfs
▪ Edson =	2370 cfs
▪ Clark & Edson =	1463 cfs
▪ Clark, Edson, & I 25 =	1463 cfs

▪ FEMA =	6978 cfs
▪ Clark =	6698 cfs
▪ Edson =	4985 cfs
▪ Clark & Edson =	3906 cfs
▪ Clark, Edson, & I 25 =	3906 cfs

▪ FEMA =	2905 cfs
▪ Clark =	2838 cfs
▪ Edson =	2597 cfs
▪ Clark & Edson =	2464 cfs
▪ Clark, Edson, & I 25 =	2464 cfs

▪ FEMA =	1840 cfs
▪ Clark =	1724 cfs
▪ Edson =	1224 cfs
▪ Clark & Edson =	951 cfs
▪ Clark, Edson, & I 25 =	951 cfs

▪ FEMA =	2774 cfs
▪ Clark =	2694 cfs
▪ Edson =	2285 cfs
▪ Clark & Edson =	2144 cfs
▪ Clark, Edson, & I 25 =	2144 cfs

▪ FEMA =	2511 cfs
▪ Clark =	2332 cfs
▪ Edson =	1653 cfs
▪ Clark & Edson =	1285 cfs
▪ Clark, Edson, & I 25 =	1285 cfs

▪ FEMA =	5685 cfs
▪ Clark =	5397 cfs
▪ Edson =	4398 cfs
▪ Clark & Edson =	3884 cfs
▪ Clark, Edson, & I 25 =	3884 cfs

▪ FEMA =	4000 cfs
▪ Clark =	3816 cfs
▪ Edson =	3120 cfs
▪ Clark & Edson =	2746 cfs
▪ Clark, Edson, & I 25 =	4516 cfs

▪ FEMA =	4216 cfs
▪ Clark =	3931 cfs
▪ Edson =	2941 cfs
▪ Clark & Edson =	2440 cfs
▪ Clark, Edson, & I 25 =	669 cfs

FEMA flows presented are the revised FEMA regulatory flow rates.



FIGURE 3-9
Hydrology Summary for Project Components

The TAC therefore recommended that the following Regional alternative and phasing be considered for funding through a Regional entity:

Regional Improvements (Phase I) (2007-2009)

1. Diversion of Coal Creek to Clark Reservoir
2. Edson Reservoir (maximize capacity to minimize the potential for split flows at the I-25 box culverts)
3. Middle Boxelder Creek Improvements (including improvements to the Larimer and Weld Canal)

Non-regional Improvements (Phase II) (2008-2010)

4. I-25 Split Flow Diversion Channel (depending on storage within Edson Reservoir)
5. Improvements to Prospect Road West of I-25
6. Cache la Poudre Overflow
7. Opening of the existing plug at the I-25 box culverts north of Prospect Road

Other Local Improvements (Phase III) (2010-2020)

8. Middle Boxelder Creek Road Crossing Improvements
9. Cooper Slough/Mulberry Street and Lake Canal Improvements

Estimated total costs for the above improvements are estimated to be approximately **\$32.8 million**.

In addition, the Timnath diversion channel is being proposed by the Town of Timnath and being constructed separately. If timing allows, Timnath may contribute to the Regional Strategy as peak design flow rates will be significantly reduced or eliminated as a result of the Regional Improvements.

4.0 Funding Evaluations

4.1 Funding Evaluations

The elements of the Boxelder Creek Regional Financing Strategy encompass the following key objectives:

1. **Benefits.** The benefits of a regional storm drainage plan and construction program would be many, and would include both local and regional benefits greater than the costs incurred (i.e. benefit/cost ratio greater than 1).
2. **Equitable Distribution of Costs.** It is most equitable to distribute costs of regional planning and improvements over a large area through recurring fees and charges imposed by a regional Storm Drainage Authority along with one-time system development fees imposed when a property is annexed or developed.
3. **Choice of Entity.** The vehicle that is recommended is a Storm Drainage Authority formed by an Intergovernmental Agreement among Larimer County, the Town of Wellington, the City of Fort Collins and any other jurisdictional entities that would like to participate. The Storm Drainage Authority would have the power to impose fees and charges throughout the Boxelder Creek Drainage Basin and to borrow money secured through bonds and loans to finance the proposed project.
4. **Role of Other Local Governments.** Colorado law provides that governmental entities may contract to provide to provide together, or through a mutually created entity, any function, service or facility which each of the governmental entities is lawfully authorized to provide. Governmental entities are specifically authorized to form drainage facilities and entities. If the decision is made to proceed through formation of an authority, it is anticipated that Larimer County, the Town of Wellington, the City of Fort Collins and possibly others will enter into an Intergovernmental Agreement governing the formation, duties and governance of the Storm Drainage Authority.

The financial analysis for the Boxelder Creek Drainage Improvement Project(s) has paralleled the engineering efforts and has drawn from the results of the Recommended Plan and Strategy identified above. As part of this effort a grant and low interest loan search was performed and the results of potential external funding sources have been incorporated into the financial analysis as the best case scenario. Details on the grant research are included in **Appendix D**.

4.2 Potential Funding Mechanisms

Several potential funding mechanisms exist for the various alternatives evaluated. These include the following:

- FEMA Pre-disaster Mitigation (PDM) grants
- Grants from the NRCS
- Low interest loans from the CWCB
- Colorado Lottery Funds associated with open space and trail corridors
- Development and impact fees associated with a LID and PID

- Trails/Parks and Recreation Funds
- Colorado Department of Transportation (CDOT)
- Private

In addition, some alternatives offer certain advantages related to funding. For instance, the I-25 corridor may be widened in the future and this would offer the opportunity to provide for an overflow drainage channel for the Boxelder Creek overflow conveyance channel as recommended in Alternative 2.

4.3 Recommended Funding Strategy

The recommended funding strategy including all financial plan assumptions, grants and outside contributions and phasing of project components is highlighted below.

4.3.1 Financial Plan Assumptions

The Plan identifies approximately \$32.8 million in capital facilities (2006 dollars) over the planning period over the next ten years. These capital projects as shown on **Table 4-1** are further broken into Regional, Fort Collins, and Other/Larimer County costs. This plan assumes that the Alliance will form a Drainage Authority which will be responsible for implementing the Regional Improvements. CWCB low-interest loans or proceeds from municipal bonds will be obtained for construction of the facilities and will be paid back through assessments made to properties located within the Drainage Authority boundaries (areas within the existing Boxelder Creek watershed). Grants will also be pursued to offset some of the costs associated with the project. An Inter-Governmental Agreement (IGA) is required as part of this effort as the City of Fort Collins, Town of Wellington and Unincorporated areas of Larimer County all benefit from the Regional Improvements.

Table 4-1: Boxelder Creek Capital Projects and Participants					
	Total Cost	County/Other	Fort Collins/Other	Regional	Total
Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)	\$ 6,200,000	0%	0%	100%	100%
Edson Reservoir (990 ac-ft)	\$ 5,100,000	0%	0%	100%	100%
Boxelder Creek Crossing Improvements	\$ 8,400,000	100%	0%	0%	100%
Improvements to Prospect Road (4,500 cfs)	\$ 3,900,000	0%	100%	0%	100%
Cache la Poudre Overflow (2,500 cfs)	\$ 2,200,000	0%	100%	0%	100%
Middle Boxelder Creek Stream Improvements	\$ 1,100,000	0%	0%	100%	100%
Construction of siphon/waterway structure - Larimer/Weld Canals	\$ 1,300,000	0%	0%	100%	100%
Cooper Slough/Mulberry Street Improvements	\$ 3,600,000	0%	100%	0%	100%
Boxelder I-25 Split Flow Diversion Channel (500 to 1,000 cfs)	\$ 1,000,000	100%	0%	0%	100%
Timnath Diversion Channel (2,800 cfs)	\$ -	100%	0%	0%	0%
TOTALS	\$32,800,000	\$9,400,000	\$9,700,000	\$13,700,000	\$32,800,000

4.3.2 Grants and Outside Contributions

As part of this Financial Analysis a review of potential external funding including grants, low interest loans, and outside contributions was performed. The output from this review is included in **Appendix D**. These alternative funding sources were reviewed with the TAC and the FAC for applicability to the capital projects included in the Recommended Plan. If all identified grants and outside contributions are achieved this is considered to be the “best case” scenario. **Table 4-2** shows that the best case scenario would include \$6.9 million in grants and \$10.5 million in outside contributions.

4.3.3 Phasing of Capital Projects

Once the capital costs were determined for the Recommended Plan, the phasing of these projects was determined during the next ten years. Critical projects were included in Phase I (2007 to 2010). Additional required projects were moved to Phase II of the planning process (2011 to 2017) to facilitate the smoothing of capital project financing costs. **Table 4-3** shows the capital financing plan from 2007 to 2017. The phasing of the CIP is shown first without grants and external financing and then with them overlaid on the estimated construction costs. All projects in Phase II are subject to an annual construction inflation rate of 4 percent per year.

**Table 4-2
Potential Grant Funding Sources**

**Boxelder Creek Alliance
Potential Grant Funding Sources**

	Total Cost	Grants					Other			Total Grants & Developer Contributions	
		FEMA PDM/FMA Grant	COE Grants	NRCS Grant	HUD Community Development Block Grant	Colorado State Historical Fund	State of Colorado Parks and Trails Grant (GOCO)	CDOT*	Private Developers		Larimer County Parks and Recreation
Alternative 5A											
Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)	\$6,200,000	\$3,000,000									
Edson Reservoir (990 ac-ft)	\$5,100,000		\$1,000,000	\$1,000,000			\$500,000			\$300,000	
Boxelder Creek Crossing Improvements	\$8,400,000							\$1,000,000	\$7,400,000		
Improvements to Prospect Road (4500 cfs)	\$3,900,000								\$166,667		
Cache la Poudre Overflow (2500 cfs)	\$2,200,000								\$166,667		
Middle Boxelder Creek Stream Improvements	\$1,100,000						\$500,000			\$150,000	
Construction of siphon/waterway structure - Larimer/Weld Canals	\$1,300,000						\$500,000			\$150,000	
Cooper Slough/Mulberry Street Improvements	\$3,600,000								\$166,667		
Boxelder I-25 Split Flow Diversion Channel (500 to 1000 cfs)	\$1,000,000							\$250,000	\$750,000		
Timnath Diversion Channel (2800 cfs)	\$0										
TOTALS	\$32,800,000	\$3,000,000	\$1,000,000	\$1,000,000	\$200,000	\$200,000	\$1,500,000	\$1,250,000	\$8,650,000	\$600,000	\$17,400,000

**Table 4-3
Recommended Capital Financing Plan from 2007 to 2017**

**Boxelder Creek Alliance
Phasing of Capital Improvement Projects**

CIP - No Grant Funding

Project Name	Start Date	Project Cost	Project Cost		Years to Construct	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			Less External \$			CY 06	CY 07	CY 08	CY 09	CY 10	CY 11	CY 12	CY 13	CY 14	CY 15	CY 16	CY 17
Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)	2007	\$6,200,000	0%		3	\$ -	\$ 2,066,667	\$ 2,066,667	\$ 2,066,667	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Edson Reservoir (990 ac-ft)	2008	\$5,100,000	0%		2	\$ -	\$ -	\$ 2,550,000	\$ 2,550,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Boxelder Creek Crossing Improvements	2013	\$8,400,000	0%		5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,881,600	\$ 2,182,656	\$ 2,619,187	\$ 3,247,792	\$ -
Improvements to Prospect Road (4500 cfs)	2007	\$3,900,000	0%		3	\$ -	\$ 1,300,000	\$ 1,300,000	\$ 1,300,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Cache la Poudre Overflow (2500 cfs)	2007	\$2,200,000	0%		3	\$ -	\$ 733,333	\$ 733,333	\$ 733,333	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Middle Boxelder Creek Stream Improvements	2008	\$1,100,000	0%		2	\$ -	\$ -	\$ 550,000	\$ 550,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Construction of siphon/waterway structure - Larimer/Weld Canals	2009	\$1,300,000	0%		1	\$ -	\$ -	\$ -	\$ 1,300,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Cooper Slough/Mulberry Street Improvements	2013	\$3,600,000	0%		3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,344,000	\$ 1,559,040	\$ 1,870,848	\$ -	\$ -
Boxelder I-25 Split Flow Diversion Channel (500 to 1000 cfs)	2007	\$1,000,000	0%		2	\$ -	\$ 500,000	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Timnath Diversion Channel (2800 cfs)		\$0	0%		0	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total		\$32,800,000	0%			\$ -	\$ 4,600,000	\$ 7,700,000	\$ 8,500,000	\$ -	\$ -	\$ -	\$ 3,225,600	\$ 3,741,696	\$ 4,490,035	\$ 3,247,792	\$ -

CIP with Grant and Outside Funding

Project Name	Start Date	Project Cost	Project Cost		Years to Construct	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			Less External \$	Other		CY 06	CY 07	CY 08	CY 09	CY 10	CY 11	CY 12	CY 13	CY 14	CY 15	CY 16	
Coal Creek Diversion and Storage in Clark Reservoir (465 ac-ft)	2007	\$6,200,000	\$2,800,000	0%	3	\$ -	\$ 933,333	\$ 933,333	\$ 933,333	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Edson Reservoir (990 ac-ft)	2008	\$5,100,000	\$2,300,000	0%	2	\$ -	\$ -	\$ 1,150,000	\$ 1,150,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Boxelder Creek Crossing Improvements	2013	\$8,400,000	\$0	0%	5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Improvements to Prospect Road (4500 cfs)	2007	\$3,900,000	\$3,733,333	0%	3	\$ -	\$ 1,244,444	\$ 1,244,444	\$ 1,244,444	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Cache la Poudre Overflow (2500 cfs)	2007	\$2,200,000	\$2,033,333	0%	3	\$ -	\$ 677,778	\$ 677,778	\$ 677,778	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Middle Boxelder Creek Stream Improvements	2008	\$1,100,000	\$450,000	0%	2	\$ -	\$ -	\$ 225,000	\$ 225,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Construction of siphon/waterway structure - Larimer/Weld Canals	2009	\$1,300,000	\$650,000	0%	1	\$ -	\$ -	\$ -	\$ 650,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Cooper Slough/Mulberry Street Improvements	2013	\$3,600,000	\$3,433,333	0%	3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,281,778	\$ 1,486,862	\$ 1,784,235	\$ -	\$ -
Boxelder I-25 Split Flow Diversion Channel (500 to 1000 cfs)	2007	\$1,000,000	\$0	0%	2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Timnath Diversion Channel (2800 cfs)	0	\$0	\$0	0%	0	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total		\$32,800,000	\$15,400,000			\$ -	\$ 2,855,556	\$ 4,230,556	\$ 4,880,556	\$ -	\$ -	\$ -	\$ 1,281,778	\$ 1,486,862	\$ 1,784,235	\$ -	\$ -

4.3.4 Long Range Plan

The next step is to overlay the construction phasing and associated capital costs with the funding requirements and allocates the funding requirements to Regional, Ft. Collins, and Larimer County on an annual basis for financial planning purposes. This is shown once again with and without grants and outside contributions in **Table 4-4**. This provides the annual cash flow requirements for each participant.

4.3.5 Funding of Regional Facilities

The final step in this plan is to determine the best and the worst case scenario for funding the required Regional Facilities. Regional facilities will be funded by annual fees assessed to properties within the Boxelder Creek Watershed. Two scenarios were developed based on the assumption that some form of a Drainage Authority is created and has the ability to issue debt. **Table 4-5** illustrates the potential sizing of the debt issue based on the best and worst case (grants and outside funding versus debt used for all identified Regional Facilities). It should be noted that even if debt is issued anywhere from \$800,000 to \$2 million will be required as the local cash share. In addition, it could take up to two years once the IGA is established to enter the municipal debt market. If a CWBC low-interest loan can be obtained to fund the Regional Facilities the cost of issuance and interest rate could be lower and therefore required annual repayment costs and annual fees would be lowered accordingly.

Table 4-4
Long Range Capital Costs and Funding Requirements

	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	Total
Capital Improvement Fund - No Grants or Developer Contributions												
Capital Improvement Fund												
	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	Total
Beginning Reserve Balance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Revenues and Transfers In												
Wellington	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
County	\$ -	\$ 500,000	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ 1,881,600	\$ 2,182,656	\$ 2,619,187	\$ 3,247,792	\$ 10,931,235
Fort Collins	\$ -	\$ 2,033,333	\$ 2,033,333	\$ 2,033,333	\$ -	\$ -	\$ -	\$ 1,344,000	\$ 1,559,040	\$ 1,870,848	\$ -	\$ 10,873,888
Timnath	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Regional	\$ -	\$ 2,066,667	\$ 5,166,667	\$ 6,466,667	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,700,000
Other	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total Rev. and Transfers In	\$ -	\$ 4,600,000	\$ 7,700,000	\$ 8,500,000	\$ -	\$ -	\$ -	\$ 3,225,600	\$ 3,741,696	\$ 4,490,035	\$ 3,247,792	\$ 35,505,123
Expenditures and Transfers Out												
Capital Projects	\$ -	\$ 4,600,000	\$ 7,700,000	\$ 8,500,000	\$ -	\$ -	\$ -	\$ 3,225,600	\$ 3,741,696	\$ 4,490,035	\$ 3,247,792	\$ 35,505,123
Total Expenditures	\$0	\$4,600,000	\$7,700,000	\$8,500,000	\$0	\$0	\$0	\$3,225,600	\$3,741,696	\$4,490,035	\$3,247,792	\$35,505,123
Ending Balance Capital Improvement Fund	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	Total
Capital Improvement Fund - With Grants & Developer Contributions												
Capital Improvement Fund												
	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	Total
Beginning Reserve Balance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Revenues and Transfers In												
Wellington	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
County	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Fort Collins	\$ -	\$ 1,922,222	\$ 1,922,222	\$ 1,922,222	\$ -	\$ -	\$ -	\$ 1,281,778	\$ 1,486,862	\$ 1,784,235	\$ -	\$ 10,319,541
Timnath	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Regional	\$ -	\$ 933,333	\$ 2,308,333	\$ 2,958,333	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 6,200,000
Other	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total Rev. and Transfers In	\$ -	\$ 2,855,556	\$ 4,230,556	\$ 4,880,556	\$ -	\$ -	\$ -	\$ 1,281,778	\$ 1,486,862	\$ 1,784,235	\$ -	\$ 16,519,541
Expenditures and Transfers Out												
Capital Projects	\$ -	\$ 2,855,556	\$ 4,230,556	\$ 4,880,556	\$ -	\$ -	\$ -	\$ 1,281,778	\$ 1,486,862	\$ 1,784,235	\$ -	\$ 16,519,541
Total Expenditures	\$0	\$2,855,556	\$4,230,556	\$4,880,556	\$0	\$0	\$0	\$1,281,778	\$1,486,862	\$1,784,235	\$0	\$16,519,541
Ending Balance Capital Improvement Fund	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

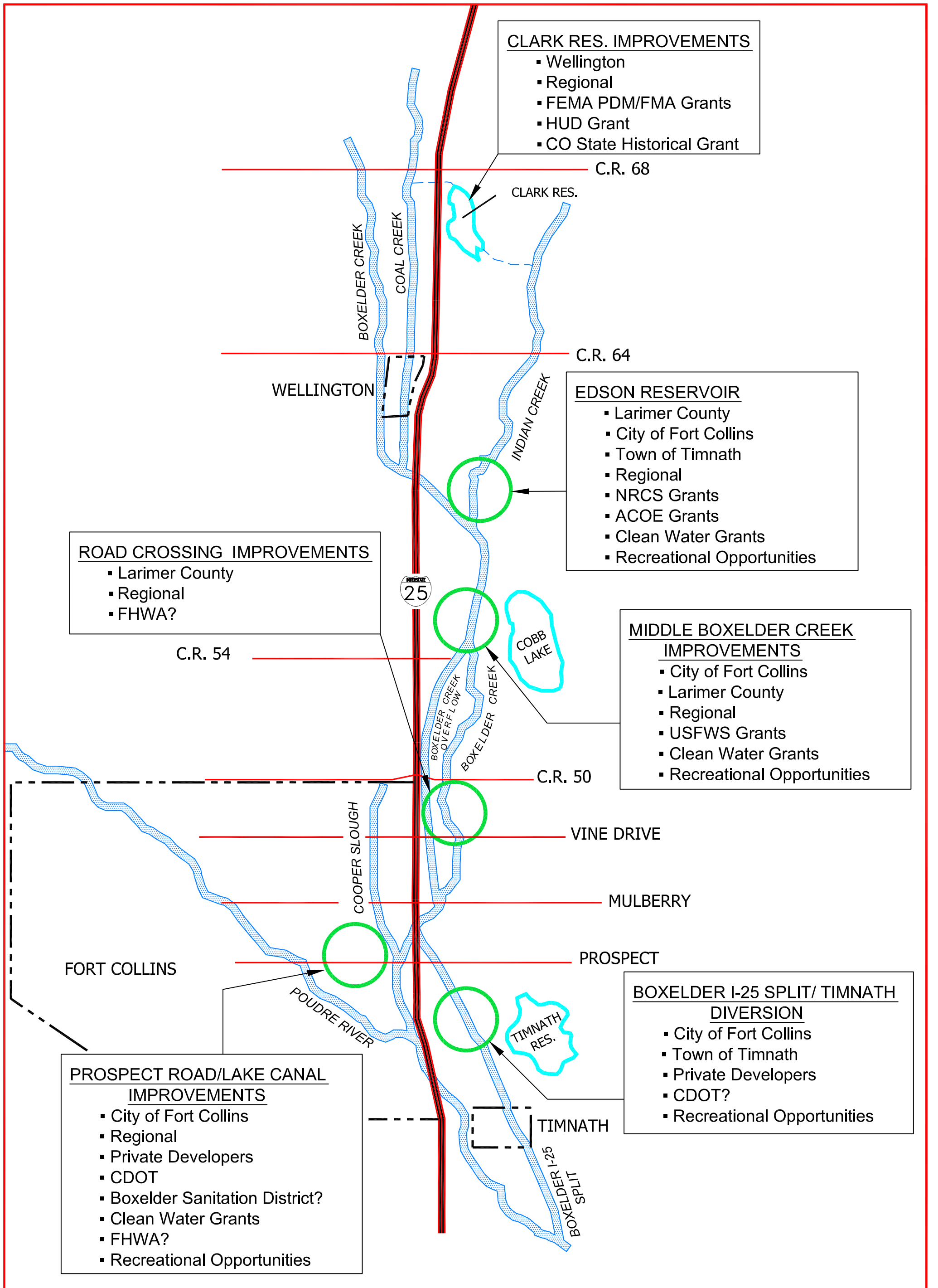
Table 4-5: Potential Debt Share					
Regional Funding Projection Without Grants					
Amount of Issue:	\$13.70	million	Net Proceeds:	\$12.23	million
Interest Rate*:	4.6%		Annual Debt Service:	\$1061,000	
Term:	20	years	Cash Required from Regional:	\$1.47	million
Issuance Costs:	3.0%		Percent of Cash to Debt:	11%	
Debt Service Reserve:	1	yr DS pmt.			
Regional Funding Projection With Grants					
Amount of Issue:	\$6.80	million	Net Proceeds:	\$6.07	million
Interest Rate*:	4.6%		Annual Debt Service:	\$526,000	
Term:	20	years	Cash Required from Regional:	\$0.73	million
Issuance Costs:	3.0%		Percent of Cash to Debt:	11%	
Debt Service Reserve:	1	yr DS pmt.			

*Federal Reserve statistical release selected interest rates, April 2006.

A secured payment source will be required to issue debt or obtain a low interest CWCB loan. Some suggested alternatives follow in **Table 4-6**. Scenario 1 illustrates the projected fees required to pay for annual debt service to construct required capital facilities from 2007 to 2010 if all parcels currently in the Boxelder Flood Plain are assessed the fees. The fees are shown first without the benefit of any grants or developer contributions (worst case scenario) and then with potential external funding (best case scenario). Scenario 2 provides the same best and worst case annual fee assessments but is based on only the fees being assessed on parcels actually removed from the flood plain. It is anticipated that the funding sources will be derived from some combination from two groups of fee payers: One consisting of all owners of properties within the basin and the other consisting of owners or properties which will be removed from the floodplain through construction of the proposed improvements.

Table 4-6 shows the expected debt issue for various scenarios of allocation of costs (per acre, per parcel and per structure). It is envisioned that the final funding allocations will be based on a combination of monthly fees per parcel and one-time development fees for all parcels within the basin. However, a reasonable rate (based on the evaluations undertaken) appears to be in the range of \$4 to \$10 per month for residential parcels and one-time development fees (for properties removed from the floodplain) of between \$1,300 to \$2,500 per acre. The final funding strategy for the Regional Improvements will be developed as part of establishing the Regional Drainage Authority.

Table 4-6: Economic Impacts of Fee Assessments for Regional Facilities per Year				
Scenario 1: Fees Assessed on All Parcels Currently in Flood Plain				
	Without Grants		With Grants	
	Number	Annual Fee	Number	Annual Fee
Per Acre	4,960	\$213.91	4,960	\$96.77
Per Parcel	809	\$1,311.50	809	\$593.33
Per Structure	693	\$1,531.02	693	\$692.64
Per \$ Assessed Valuation	\$124,516,961	\$0.009	\$124,516,961	\$0.004
Scenario 2: Fees Assessed Based On All Parcels in the Boxelder Basin				
	Without Grants		With Grants	
	Number	Annual Fee	Number	Annual Fee
Per Acre	5,290	\$200.57	5,290	\$90.74
Per Parcel	6,210	\$170.85	6,210	\$77.29
Per Structure	3,810	\$278.48	3,810	\$125.98
Per \$ Assessed Valuation	\$135,419,370	\$0.008	\$135,419,370	\$0.004



BOXELDER CREEK SCHEMATIC
POTENTIAL FUNDING STRATEGIES

5.0 Recommended Implementation Plan

5.1 Summary of Recommended Alternative

The Recommended Alternative is proposed to be funded through both Regional Contributions (Phase I) and Local Contributions (Phase 2 and 3). The Alliance proposes to form a Storm Drainage Authority (the “Authority”) pursuant to Colorado law, providing for intergovernmental contracting ability. The Authority will be responsible for implementing the Regional Improvements (Phase I) highlighted below. It is anticipated that a CWCB low-interest loan will be obtained for construction of the facilities and will be paid back through monthly fees and charges as well as a system of development fees raised by the Authority from properties located within the Boxelder Creek Drainage Basin. Grants will also be pursued to offset some of the costs associated with the project.

It is expected that an Inter-Governmental Agreement (IGA) among the City of Fort Collins, Town of Wellington and Unincorporated areas of Larimer County will be required in order to form the Authority.

The recommended alternative for the Boxelder Creek Regional Drainage Improvement Project consists of the following project phases and components:

Regional Improvements, Phase I: Edson Reservoir, Coal Creek Diversion to Clark Reservoir, Middle Boxelder Improvements (2007-2010)

Depending on the preliminary design of available upstream storage at the proposed Edson Reservoir site, additional storage and/or diversion of the I-25 split flow channel may be required.

- **Diversion of Coal Creek to Clark Reservoir (approximately 465 acre-feet design capacity) (Implementation Period: 2007-2010)**
 - Improvement of the North Poudre Canal to capture and convey Coal Creek flood flows into Clark Reservoir (approximately 1,560 cfs design capacity)
 - Culvert crossings associated with the North Poudre Canal at I-25 (design capacity approximately 1,560 cfs)
 - Dredging of Clark Reservoir (approximately 532,400 cubic yards to provide for approximately 465 acre-feet of flood storage within the top 3 feet of the existing reservoir)
 - Associated land acquisition and right-of-way (approximately 28.3 acres)
 - Spillway and outlet works improvements to Clark Reservoir to ensure adequate flood storage
 - Agreement associated with flood storage reserve capacity within the reservoir
 - Constructed and funded through the Boxelder Regional Alliance (potential for FEMA PDM grants and CWCB Low-interest loans)

✓ **Estimated Construction Cost: \$6.2 million**

- ✓ **Regional Benefits:** Reduces peak discharges downstream (approximately 90% in Coal Creek; 5-10% in Boxelder Creek) via attenuation in Clark Reservoir
- ✓ **Local Benefits:** Reduces floodplain extents by approximately 150-215 acres; minimizes flooding potential and damages for approximately 180 structures (including 2 schools, community center, residential and commercial structures)

➤ **Construction of Edson Reservoir (approximately 660 to 990 acre-feet design capacity) (Implementation Period: 2008-2010)**

- Construction of an earthen embankment and ungated outlet to impound approximately 660 to 990 acre-feet of storage on Indian Creek just upstream of County Road 60
- Associated land acquisition and right-of-way (approximately 90 to 131 acres)
- Depending on the final available storage volume at the Edson site, a diversion at the Boxelder I-25 split flow may be required (maximum discharge of 700-1,000 cfs)
- Constructed and funded through the Boxelder Regional Alliance (potential for NRCS grants and CWCB Low-interest loans)

- ✓ **Estimated Construction Cost: \$4.1 to \$6.1 million** (\$5.1 million assumed for cost estimating purposes)
- ✓ **Regional Benefits:** Significantly reduces peak discharges downstream (approximately 40-60%) via attenuation in Edson Reservoir; minimizes size of required downstream conveyance improvements; reduces floodplain extents and potential for downstream split flows
- ✓ **Local Benefits:** Minimizes flooding potential and damages to approximately 165 existing structures within Larimer County and Fort Collins (in conjunction with other improvements)

➤ **Middle Boxelder Creek Stream Improvements (approximately 3,600 to 4,100 cfs design capacity) (Implementation Period: 2008-2010)**

- Improvements to Middle Boxelder Creek from County Road 54 to County Road 52 (3,600 to 4,100 cfs design capacity)
- Construction of two (2) storm drainage channels to direct flow to Boxelder Creek
- Constructed and funded through the Boxelder Regional Alliance (potential grants from USFWS, USEPA, Parks and Trails Districts)

- ✓ **Estimated Construction Cost: \$1.1 million**
- ✓ **Regional Benefits:** Potential trail and recreational opportunities
- ✓ **Local Benefits:** Reduces potential for overflow and split flows adjacent to I-25 and impacting Cooper Slough; removes approximately 535 acres of the Boxelder Overflow (in conjunction with upstream detention)

➤ **Construction of a siphon/wasteway structure along the Larimer and Weld Canal at Boxelder Creek (Implementation Period: 2009-2010)**

- Siphon (design capacity equal to the decreed capacity of the Larimer and Weld Canal) or wasteway structure (3,600 cfs design capacity)
- Constructed and funded through the Boxelder Regional Alliance

- ✓ **Estimated Construction Cost: \$1.3 million**
- ✓ **Regional Benefits:** : Reduces overtopping potential of the Larimer and Weld Canal and diversion of floodwater to Cooper Slough
- ✓ **Local Benefits:** Minimal

Total funding requirement for the Phase I Regional Improvements is approximately \$13.7 million (depending on the final design of Edson Reservoir and available storage; other sites including the CR50 Storage Site may be evaluated during preliminary design).

- **Construction of the I-25 Split Flow Diversion Channel (ties into the Timnath Diversion channel) for between 700 and 1,000 cfs capacity (Regional Alliance along with Private Developers)**

Depending on the amount of detention storage available at the Edson site, a partial diversion of Boxelder Creek overflows at the I-25 split may be required. Design discharges will be significantly reduced as a result of the Regional Improvements implemented. Private interests will only be responsible for that portion of the diversion channel that directly impacts individual property interests.

- 50 to 150-wide footprint including a diversion channel and a regional trail incorporated onto a bench of the channel
- Approximately 6,800 feet long (from Boxelder Creek to County Road 42E)
- Overflow structure on the right bank of Boxelder Creek upstream of I-25 crossing
- Compound channel section with 700-1,000 cfs design capacity channel utilized to minimize the footprint for future conditions (assuming Regional storage is constructed)
- Associated land acquisition and right-of-way (approximately 10 acres)
- Flume and siphon crossing at Cache la Poudre Reservoir Inlet Ditch (CLPRID)
- Flume and siphon crossing at Lake Canal
- Seven 8' high by 10' wide culvert (or similar conveyance bridge) crossing at Prospect Road
- Constructed by the Boxelder Regional Alliance (if required) based on the final design of Edson Reservoir.

- ✓ **Estimated Construction Cost: \$0 to \$1.6 million** (assumed to be \$1 million for cost estimating purposes)
- ✓ **Regional Benefits:** Trail system; provides open space; protects County Road 42E, CLPRID and Lake Canal
- ✓ **Local Benefits:** Removes approximately 300 acres from floodplain, minimizes flooding potential to approximately 8 existing structures

Other Non-Regional Improvements, Phase II: Prospect Street Improvements and Cache la Poudre Overflow (2007-2009)

The following improvements are required such that the existing box culvert plugs at the I-25 crossing can be removed. Costs for these improvements may be partially funded by the City of Fort Collins. The Regional Improvements will significantly reduce the design flows within the Cooper Slough Basin that contribute to the flooding potential within Boxelder Creek downstream of Prospect Road. However, flows will increase as a result of increasing the conveyance capacity of the I-25 box culverts (i.e. removing the plugs).

➤ **Improvements to Prospect Road West of I-25 (approximately 4,500 cfs design capacity)**

- Improvement of Boxelder Creek from just upstream of I-25 to just downstream of Prospect Road (4,500 cfs design capacity)
- Culvert/bridge crossing of Prospect Road (4,500 cfs design capacity)
- Associated land acquisition and right-of-way (approximately 1.5 acres)
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$3.9 million**
- ✓ **Regional Benefits:** Allows for removal of the Boxelder Creek I-25 culvert plugs (reduces potential for split flow downstream of I-25 crossing of Boxelder Creek)
- ✓ **Local Benefits:** Minimizes flooding potential and damages to existing structures and facilities; minimize overtopping potential of Prospect Road; minimizes overtopping potential of the CLPRID and Lake Canal; removes approximately 15 acres from the existing floodplain

➤ **Cache la Poudre Overflow (approximately 2,500 cfs design capacity)**

- Construction of a side-flow spillway structure on Boxelder Creek, just downstream of Prospect Road (2,530 cfs design capacity)
- Construction of an outfall channel and swale to convey flows to an existing oxbow of the Poudre River (2,530 cfs design capacity)
- Associated land acquisition and right-of-way (approximately 20.1 acres)
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$2.2 million**
- ✓ **Regional Benefits:** Allows for removal of the Boxelder Creek I-25 culvert plugs (reduces potential for split flow downstream of I-25 crossing of Boxelder Creek); potential recreational opportunities
- ✓ **Local Benefits:** Minimizes flooding potential and damages to existing structures and facilities; removes approximately 80 acres from floodplain; minimize overtopping potential of Prospect Road; minimizes overtopping potential of the CLPRID and Lake Canal

Total funding requirement for Phase II is approximately \$6.1 million.

Other Local Improvements, Phase III: Middle Boxelder Creek Road Crossing Improvements and Cooper Slough/Mulberry Street and Lake Canal Improvements (2010-2020)

Phase III of the Proposed Improvements will consist of increasing the conveyance capacity at County Road crossings and providing improvements to within the Cooper Slough Basin at Mulberry Street and the Lake Canal. Costs for these improvements will be born from the Regional Funding mechanism and may be partially funded through agreements with Private Developers. The Regional Improvements will significantly reduce the design flows within the Cooper Slough Basin that contributes to the flooding potential within Boxelder Creek downstream of Prospect Road.

➤ **Boxelder Creek Road Crossing Improvements (Larimer County and Private Developers)**

These improvements will be implemented as roadways and development progresses north towards Wellington. Design discharges will be significantly reduced as a result of the Regional Improvements implemented.

- Installation of culvert/bridge crossings on Boxelder Creek at County Road 58, County Road 56, County Road 54 (Douglas Road), County Road 52, County Road 50 (Mountain Vista Road), County Road 48 (Vine Drive) and State Highway 14 (Mulberry Street) (3,600 to 4,100 cfs design capacity)
- Constructed and funded as development and roadway improvements progresses

- ✓ **Estimated Construction Cost: \$8.4 million**
- ✓ **Regional Benefits:** Minimizes potential for road overtopping and erosion; potential recreational opportunities
- ✓ **Local Benefits:** Reduces potential for overflow and split flows

➤ **Cooper Slough/Mulberry Street and Lake Canal Improvements (City of Fort Collins and Private Developers)**

These improvements will be implemented and coordinated with the City of Fort Collins as development progresses. Design discharges will be significantly reduced as a result of the Regional Improvements implemented.

- Construction of a side-flow spillway structure on the Lake Canal, just upstream of State Highway 14 along with an outfall channel from Lake Canal to the crossing at State Highway 14 (910 cfs design capacity).
- Improvement of the Lake Canal from the confluence with Copper Slough to Boxelder Creek Minor bank improvements to the Cache la Poudre Reservoir Inlet Ditch (CLPRID).
- Improvements to Cooper Slough from State Highway 14 to its termination in the Lake Canal (910 cfs design capacity).
- Local drainage improvements at Mulberry Street including upgrading culvert crossings for Cooper Slough
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$3.6 million**
- ✓ **Regional Benefits:** Minimal
- ✓ **Local Benefits:** Reduces floodplain extents and potential for damages to approximately 90 residential and commercial structures; removes approximately 130 acres from floodplain

Total funding requirement for Phase III is approximately \$12.0 million.

Total Regional Project Costs are estimated to be approximately \$13.7 million. Total Project costs are estimated to be approximately \$32.8 million.

In addition, to the above Regional Improvements, the Town of Timnath is moving forward with a local diversion project that will provide conveyance for the entire existing condition FEMA 100-year regulatory flow discharge (approximately 2,800 cfs). With the above Regional Improvements, the I-25 split flow will be reduced from between 0 to approximately 1,000 cfs (depending on available storage within Edson Reservoir). As such, the size of the Timnath Diversion Channel could be significantly reduced or eliminated. However, timing of the Regional project has prompted the Town of Timnath to progress with the design and construction of a diversion channel to accommodate the FEMA regulatory flow rates. If timing allows, Timnath may elect to contribute to the Regional project. The current plans for the Timnath Diversion channel include the following:

- 150-wide footprint including a diversion channel and a regional trail incorporated onto a bench of the channel
- Approximately 7,920 feet long (from County Road 42E to confluence with the Cache la Poudre River via Oxbow Lake)
- Associated land acquisition and right-of-way (approximately 42.5 acres)
- Flume and siphon crossing at Unnamed Ditch
- Seven 8' high by 10' wide culvert crossing at County Road 40
- Constructed and funded by the Town of Timnath and Private Developer interests.

- ✓ **Estimated Construction Cost: \$0 to \$5.7 million** (not included in Regional funding strategies)
- ✓ **Regional Benefits:** Trail system; provides open space
- ✓ **Local Benefits:** Removes approximately 760 acres from floodplain; minimizes flooding potential to approximately 45 existing structures

The plan requires that each municipality agree that the Drainage Authority can overlap its boundaries and that they will collect or lend authority for collection of “capital” fees for the Boxelder Basin to the Authority. As such, an Inter-governmental Agreement (IGA) is required. This IGA has been in development since the creation of the Boxelder Regional Alliance.

The “community of beneficiaries” will be asked to pay for the proposed improvements on a common, consistent, equitable and fair basis based on the overall general benefit and special benefit achieved through the proposed improvements.

5.2 Public Outreach

Public outreach was conducted during development of this Regional Master Plan and included the following:

- Alliance Newsletters
- Alliance Meetings (open to the Public)
 - December 1, 2005
 - February 2, 2006
 - June 20, 2006
- Press Release (February 24, 2006)
- Informational Flyer
- Newspaper Articles
 - February, 2006; *Fossil Creek Current*
 - April 14, 2006; *Northern Colorado Business Report*
- Presentation to the Mulberry Corridor Owner’s Association (March 7, 2006)
- Open House Presentation (March 7, 2006)

Comments were solicited and received during the March 7, 2006 Open House. Information related to the public outreach undertaken is included in **Appendix F**.

5.3 Implementation and Funding Strategy

The objective of the funding strategy is to outline a strategy to fund the items in the list of Boxelder Creek Regional Drainage Improvement Projects (the “Regional Improvements”). The funding strategy assumes that purely local improvements would be constructed by individual property owners or small groups of property owners who would benefit from the local improvement.

Types of Benefit - The Technical Advisory Committee and the Financial Advisory Committee have identified various benefits from the Regional Improvements. All property in the Basin would benefit from the increased capacity to handle storm run-off, the decrease in both size and number of structures necessary to contain and route water, including decreased road crossings, and the increased level of public safety during flooding. Property located wholly or partly in the

floodplain would have other potential benefits, including increases in property values attributable to rezoning and development and a decreased or eliminated need to pay flood insurance premiums.

Properties which Benefit Generally (Out of Floodplain)--General benefit is the benefit that is received generally by **all** properties contributing runoff to Boxelder Creek due to the reduction in improvements and services needed in the event of a flood. The Authority would identify the level of basin wide fees needed to provide a level of service consistent with the storm water master plan. If this amount is determined to be \$4 per month per average sized residence, then the Authority would assess \$4 per month to owners of average sized residences everywhere in the geographic area which is tributary to Boxelder Creek, regardless of jurisdiction.

<i>Proposed Fee</i>	<i>Improved Properties</i>	<i>Developing Properties</i>
Where assessed:	The Basin Tributary to Boxelder Creek	The Basin Tributary to Boxelder Creek
Type of Payment:	SWU Monthly Fee	System Development Fee
Basis of payment:	Acreage/Impervious	Acreage/Impervious
Requirements for Formation:	Intergovernmental Agreement	Intergovernmental Agreement

Properties which Benefit Specially (Being Removed from Floodplain)--Special benefit is the benefit that accrues only to **certain** properties by virtue of their removal from the floodplain. Such properties would pay a greater amount per acre because they have a greater benefit. In part, this will be paid through a floodplain removal fee paid by existing homeowners being removed from the floodplain. Properties developing after construction of the improvements will be asked to pay a one-time equity buy-in fee as a fair contribution or “reimbursement” to the Authority for their share of the capital investment in flood control facilities.

<i>Proposed Fee</i>	<i>Improved Properties</i>	<i>Developing Properties</i>
Where assessed:	In the current FEMA Floodplain	In the current FEMA Floodplain
Type of Payment:	Floodplain Removal Fee	Equity Buy-in Fee
Basis of payment:	Acreage	Acreage
Requirements for Formation:	Formal Public Election for owners of affected property	Intergovernmental Agreement

Sources of Revenue – The Financial Advisory Committee has sought to identify the most appropriate fees, charges or other sources of revenue to equitably distribute the costs of the Regional Improvements. Under Colorado law, there are three forms of impositions or charges that can be used to pay for the Regional Improvements. First, there are fees for services which are imposed as a way of paying the cost of providing a specific service. Second, there are property taxes, which require a vote under TABOR. Third, there are assessments which are imposed on the basis of a specific benefit conferred on the property assessed. It is anticipated that the Regional Improvements will be funded primarily through fees for services. It is not anticipated that there will be any reliance on taxes or assessments to fund the Regional Improvements.

Two types of fees would be imposed throughout the Basin. The first would be a recurring monthly service charge to pay the cost of providing the service on an ongoing basis. The second would be a one-time fee, called a system development fee, that is imposed when a property is developed or annexed. It is expected that both types of fees would be used to pay the costs of the Regional Improvements.

Recommended Entity - A Regional Storm Drainage Authority (the “Authority”), operating as an enterprise for purposes of TABOR, is currently envisioned as the primary vehicle for funding the proposed Regional Improvements. The Authority would borrow money through the issuance of tax-exempt revenue bonds or notes to pay the costs of the Regional Improvements. Debt service on these obligations would be paid by the Authority from the service charges and system development fees, after payment of operation and maintenance expenses of the facilities operated by the Authority.

The Authority would be formed under an Inter-governmental Agreement (IGA) among participating governmental jurisdictions with land in the Basin. Pursuant to Colorado law, governmental entities may contract to perform together anything that could be done by each entity individually. Governmental entities are expressly authorized to contract to form a drainage authority. A drainage authority formed pursuant to such an agreement would have the authority, among others, to develop drainage facilities, to acquire, construct, manage, maintain or operate drainage facilities, to acquire or dispose of property used for drainage purposes, to condemn property, to incur debt and to impose rates and fees. The Authority would have a board of

directors consisting of representatives appointed by the governing bodies of each of the sponsor governments. Under this plan the entire community within the Basin could pay for the proposed Regional Improvements on an equitable and fair basis. The terms of the IGA would define the structure and governance of the Authority. The Authority would act as a regional storm water utility service enterprise, and it would levy fees to provide regional storm water management and flood control services.

5.4 Special Considerations

5.4.1 Design Criteria

The design of the recommended alternative should be undertaken to meet all local, State and Federal requirements. These criteria will include the following:

- Local (Larimer County, City of Fort Collins, and Town of Wellington)
- State (Colorado State Engineer's Office, Colorado Water Conservation Board)
- Federal (Federal Emergency Management Agency)

5.4.2 Utility and Infrastructure Coordination

The recommended alternative could impact several existing and/or proposed utilities. Several irrigation facilities, water lines and sanitary sewers lie within the study corridor. Close coordination with these utilities will be required. These utilities include but are not limited to:

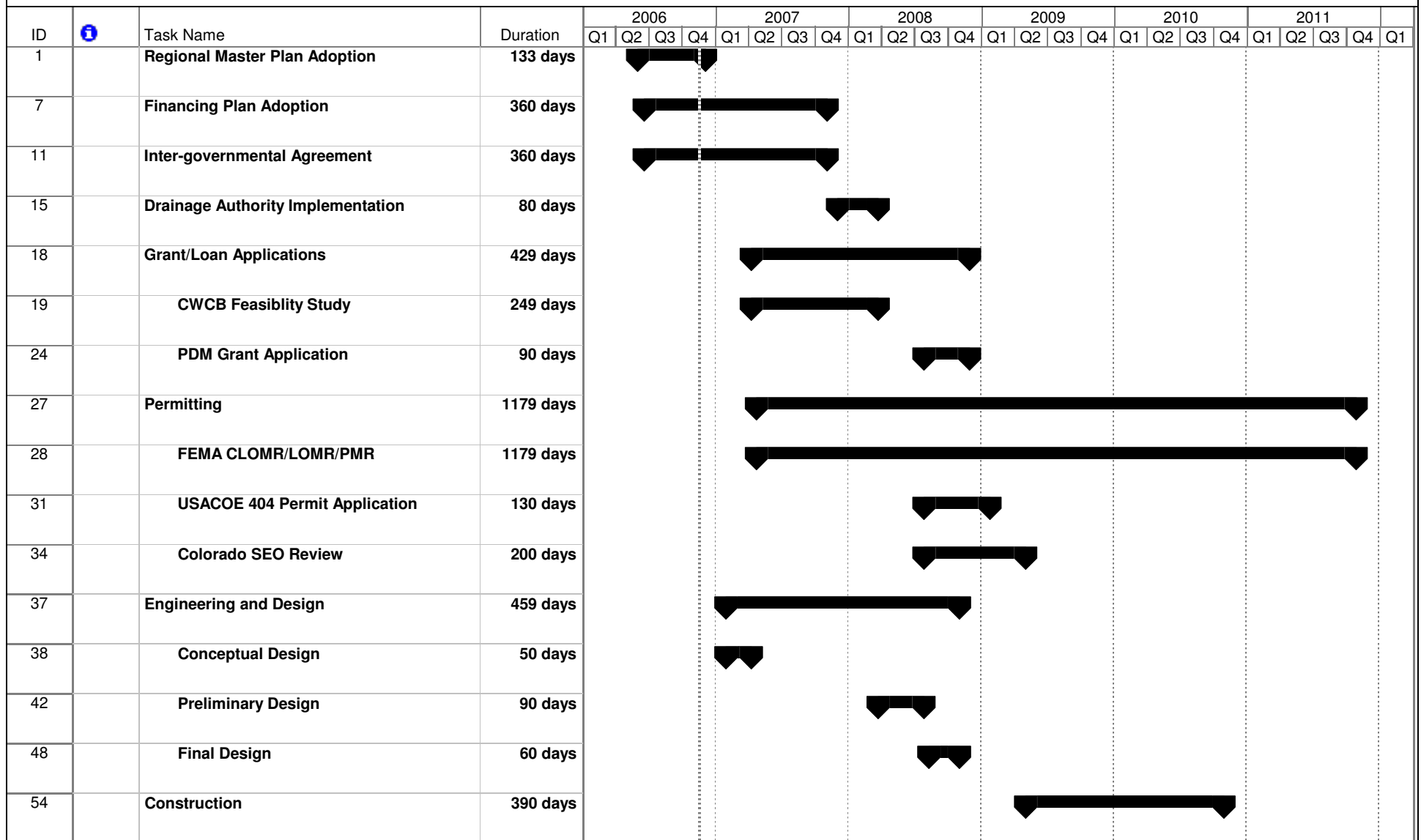
- North Poudre Irrigation Company
- New Cache la Poudre Reservoir Company
- Larimer County Public Works Department
- Larimer and Weld Canal Company
- City of Greeley
- ELCO
- Boxelder Sanitation District
- Union Pacific Railroad
- CDOT

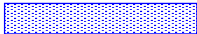








5.4.3 Permits and Approvals

Permits and approvals may be required from the following entities:

- USACE 404 permit
- Larimer County Floodplain Review Board
- FEMA (CLOMR and LOMR/PMR requests)
- Colorado State Engineers Office (SEO) (for Jurisdictional Structures)

Figure 5-1 Preliminary Implementation Schedule



Project: Boxelder Implementation Sch Date: Fri 11/17/06	Task		Milestone		External Tasks	
	Split		Summary		External Milestone	
	Progress		Project Summary		Deadline	

5.5 Interim Action Items

It is envisioned that it will take 3-5 years to implement the recommended alternative. The following steps are required prior to complete implementation of the recommended strategy:

1. Completion and adoption (by all affected jurisdictions) of this Master Plan. (December, 2006)
2. Completion of conceptual design and evaluations (including surveying and detailed hydrologic/hydraulic analysis) for the Recommended Alternative. (April, 2007)
3. Completion of a feasibility study and approval by CWCB for low-interest loan application. (May, 2007)
4. Preparation of a Conditional Letter of Map Revision (CLOMR) or Conditional Physical Map Revision (PMR) request and approval by FEMA. (July, 2007)
5. Completion and adoption of the recommend Financing Plan (November, 2007)
6. Completion and adoption (by all affected jurisdictions) of the Inter-governmental Agreement. (November, 2007)
7. Formation of the financing entity and Drainage Authority. (March, 2008)
8. Preliminary design of the Recommended Alternative. (July, 2008)
9. Final design and preparation of bid documents. (November, 2008)
10. Environmental and dam safety permitting associated with the Recommended Alternative. (May, 2009)
11. Selection of contractor. (June, 2009)
12. Construction. (July, 2009-October, 2010)
13. As-built documentation. (November, 2010)
14. Preparation of a Physical Map Revision (PMR) request and approval by FEMA. (April, 2011)
15. Revision to the FEMA regulatory floodplain maps. (October, 2011)

Total estimated additional costs for the Interim Period range from \$135,000 to \$435,000. **Table 5-1** provides a summary of the interim action items, estimated costs and time period.

Table 5-1: Interim Action Items and Estimated Costs

Item	Estimated Time Period	Estimated Cost Range		Consultant Type
		Low Estimate	High Estimate	
Preparation and Adoption of IGA	October, 2006-November, 2007	\$ 10,000	\$ 25,000	Legal
Presentation of Master Plan to Jurisdictional Boards and Council Work Sessions	October, 2006-September, 2007	\$ -	\$ 5,000	Engineering/Financial Consultants
Financial Plan Preparation	October, 2006-November, 2007	\$ 10,000	\$ 25,000	Financial Consultant
Surveying	February-April, 2007	\$ 25,000	\$ 120,000	Surveyor, Mapping
Conceptual Design	March-April, 2007	\$ 25,000	\$ 60,000	Engineering Consultant
CLOMR Preparation	April-July, 2007	\$ 25,000	\$ 80,000	Engineering Consultant
Feasibility Study (for CWCB Loan Application)	April-June, 2007	\$ 15,000	\$ 40,000	Engineering Consultant
Drainage Authority Creation	November, 2006-November, 2007	\$ 25,000	\$ 80,000	Legal
TOTAL		\$ 135,000	\$ 435,000	

* Expected costs to be incurred prior to adoption of the Financing Plan, development of the IGA and formation of the Drainage Authority

6.0 References

- Town of Windsor Drainage Criteria Manual* prepared by EPI, dated April 1990.
- Town of Windsor Master Drainage Plan, Weld County, Colorado* prepared by Anderson Consulting Engineers for the Town of Windsor, dated October 3, 2003.
- City of Fort Collins City Plan* (<http://www.fcgov.com/advanceplanning/city-plan.php>)
- City of Fort Collins Land Use Code* (<http://www.colocode.com/ftcollins/landuse/begin.htm>)
- East Mulberry Corridor Plan* (<http://fcgov.com/advanceplanning/pdf/emcp-intro-doc.pdf>)
- I-25 Corridor Plan* (<http://fcgov.com/advanceplanning/pdf/i25regional-plan-doc.pdf>)
- East Prospect Corridor Plan* (<http://fcgov.com/advanceplanning/prospect-streetscape.php>)
- Urban Drainage and Flood Control District Drainage Criteria Manual*.
- Town of Timnath Master Drainage Plan* prepared by Ayres Associates for the Town of Timnath, dated June 2005.
- Floodplain Mapping for the Boxelder Creek Split Flow Path East of Timnath, Colorado* prepared by Anderson Consulting Engineers, dated December 9, 2002.
- Storm Drainage Report for the Town of Wellington, Larimer County, Colorado*, dated 1982.
- Floodplain Management Study, Boxelder Creek in the Vicinity of the Town of Wellington, CO* prepared by the Soil Conservation Service, dated 1983.
- Regional Master Drainage Plan for the Town of Timnath* prepared by Ayres Associates for the Town of Timnath, dated July 2004.
- Boxelder Creek Floodplain Analysis through the Town of Wellington* prepared by Sear-Brown for the Town of Wellington, dated August 2003.
- Draft Report, Boxelder Creek/Cooper Slough Master Plan, Alternatives Feasibility Analysis* prepared by Anderson Consulting Engineers, Inc. for City of Fort Collins Utilities, dated September 30, 2002.
- Technical Documentation for the Hydrologic Modeling of the Boxelder Creek/Cooper Slough Basin, Volume I* prepared by Anderson Consulting Engineers, Inc. for City of Fort Collins Utilities and Larimer County Engineering, dated January 25, 2002.
- Selected Plan of Improvements for the Boxelder Creek/Cooper Slough Basin* prepared by Anderson Consulting Engineers, Inc. for City of Fort Collins Utilities, dated December 31, 2002 (Revised: April 2, 2004).
- Technical Documentation of the Hydraulic Analysis for the Boxelder Creek/Cooper Slough Basin, Volume x* prepared by Anderson Consulting Engineers, Inc. for City of Fort Collins Utilities and Larimer County Engineering, dated xxxx.
- Technical Summary for the Problem Identification, Channel Stability Evaluation, and Habitat Assessment for the Boxelder Creek/Cooper Slough Basin*, prepared by Anderson Consulting Engineers, Inc. for City of Fort Collins Utilities, dated March 7, 2002 (Revised: May 30, 2002).

Boxelder Creek/Cooper Slough Master Drainage Plan, Conceptual Alternative Analysis Summary prepared by Anderson Consulting Engineers, Inc. for City of Fort Collins Utilities, dated May 17, 2002 (Revised: July 18, 2003).

Feasibility Study for Alternatives to Mitigate Flooding Effects on Boxelder Creek prepared by Mussetter Engineering, Inc. for Land Acquisition & Management, dated November 3, 2005.

Coal Creek Floodplain Feasibility Study, Wellington, Colorado prepared by Nolte & Associates and Engineering Design and Research Corporation for the Town of Wellington, dated January 8, 2001.

Cooper Slough/Boxelder Creek Master Drainageway Planning Study prepared by Simons, Li & Associates, Inc. for the City of Fort Collins, Larimer County and the Colorado Water Conservation Board, dated August 1981.

Guidelines for Benefit-Cost Analysis. Mitigation BCA Toolkit, Version 2.0. Federal Emergency Management Agency. January, 2005.

Technical Documentation for the Boxelder Creek/Cooper Slough Basin Existing Condition Floodplain/Floodway Analysis as part of the FEMA DFIRM for Larimer County prepared by Anderson Consulting Engineers, Inc. for the City of Fort Collins Utilities and Larimer County Engineering Department. May 24, 2006.