

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)

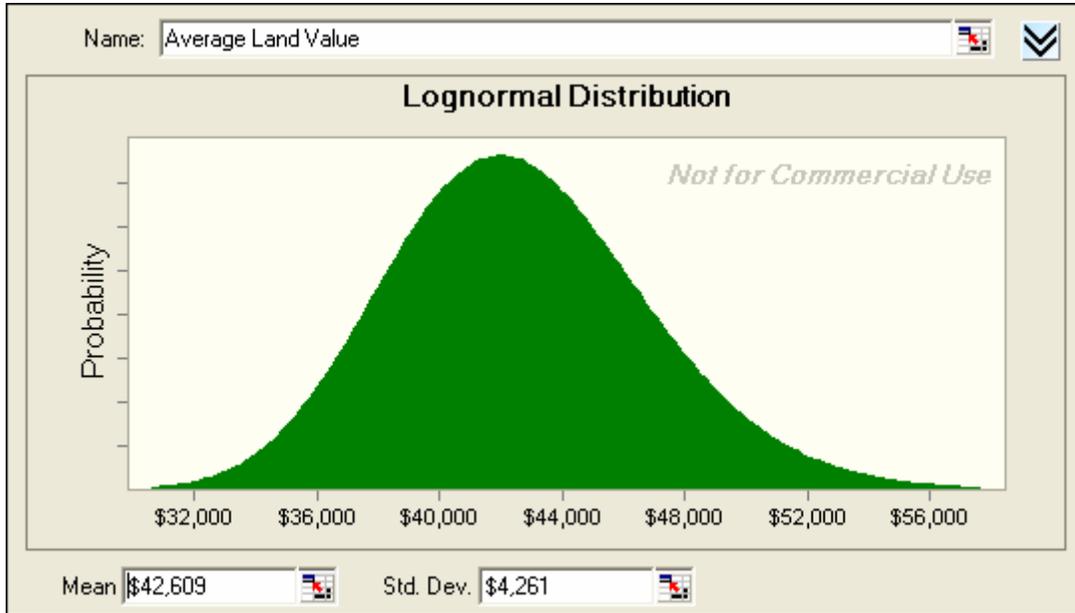
Construction costs were estimated based on estimated unit rates bounded by a high and low end estimate based on current construction trends and experience with recent similar construction projects.

3.1.4 Uncertainty Analysis

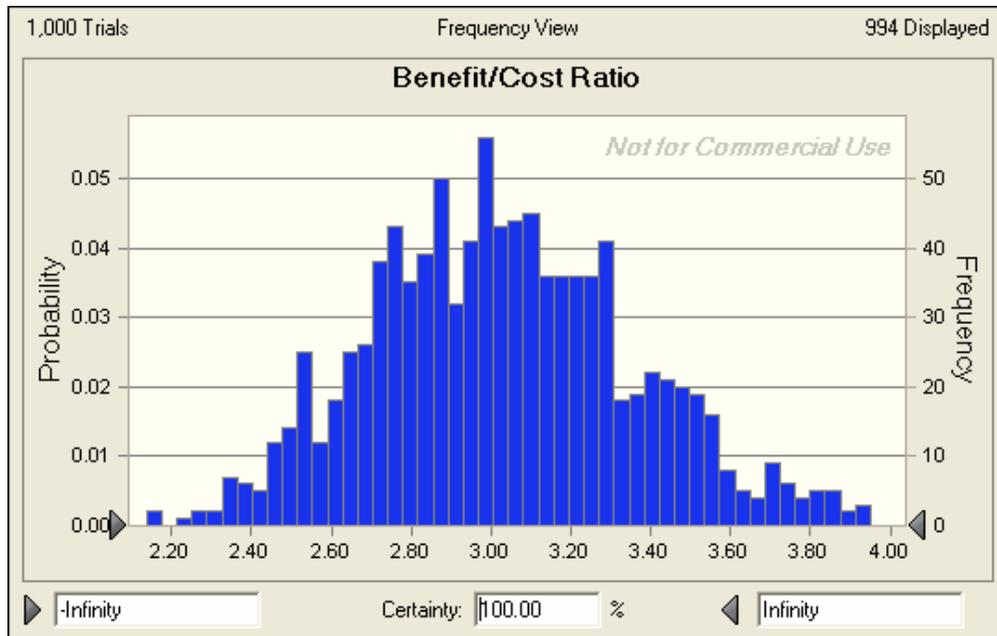
Due to the inherent uncertainties associated with estimating the floodplain extents, damages, benefits and costs, the benefit-cost ratios were evaluated utilizing a probabilistic approach incorporated into the spreadsheet model. (see Section 4.1.4) Crystal Ball, a software package that performs Monte 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.

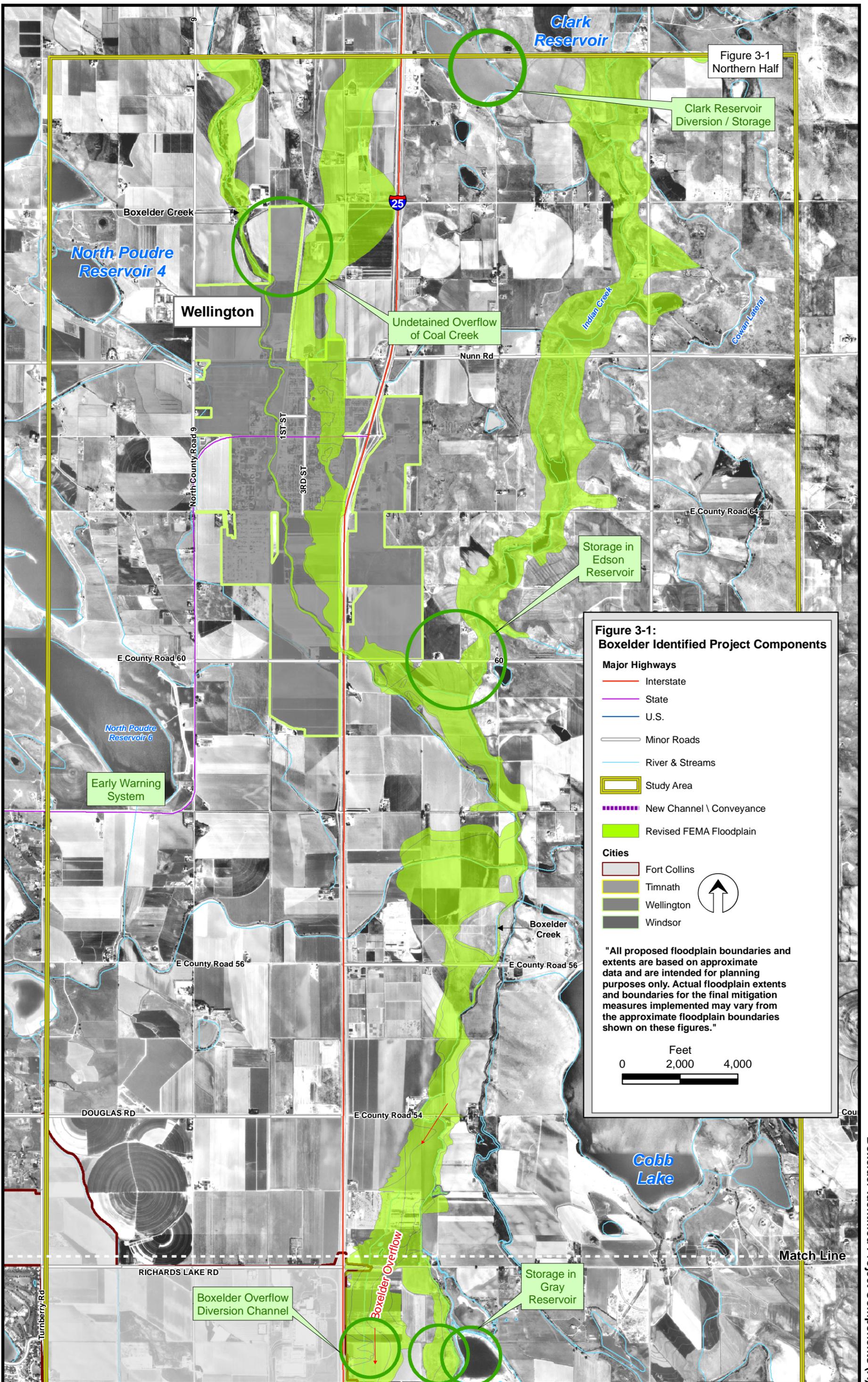


Figure 3-1 Northern Half

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

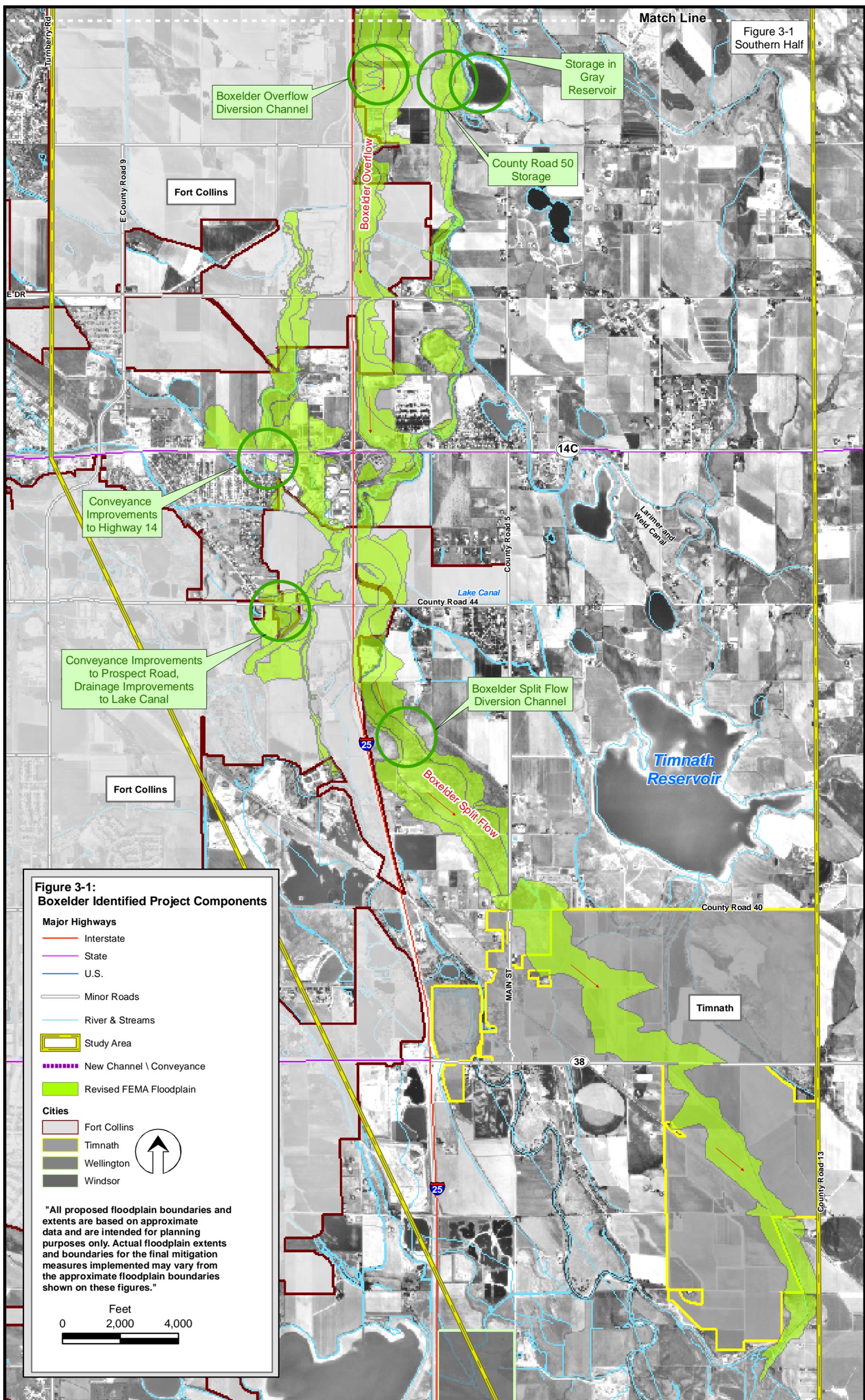
Scale: 0, 2,000, 4,000 Feet

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."

Boxelder Identified Project Components (A)

Figure 3-1:

Figure 3-1
Southern Half



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

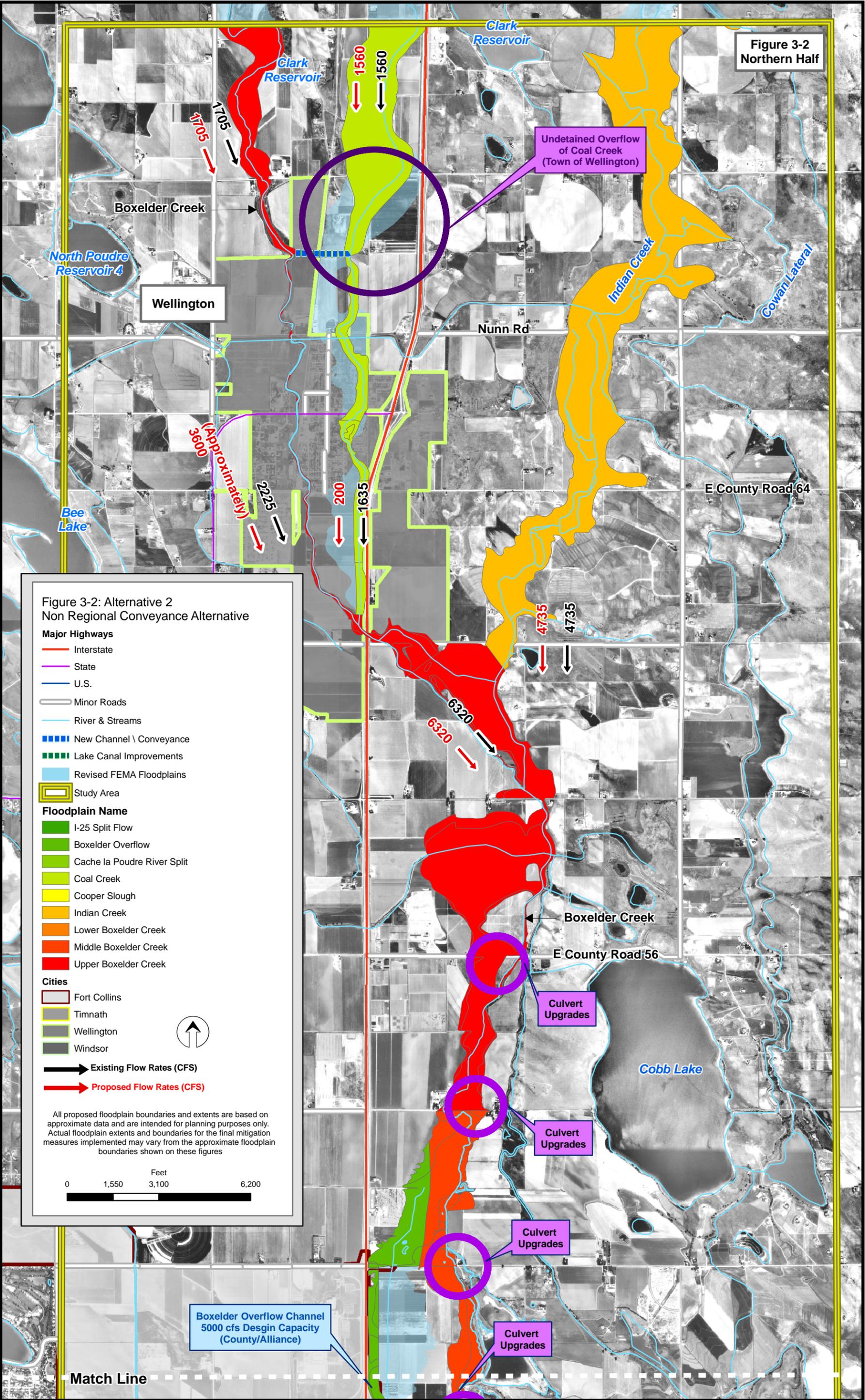


Figure 3-2: Alternative 2 Non Regional Conveyance Alternative (A)

Figure 3-2
Southern Half

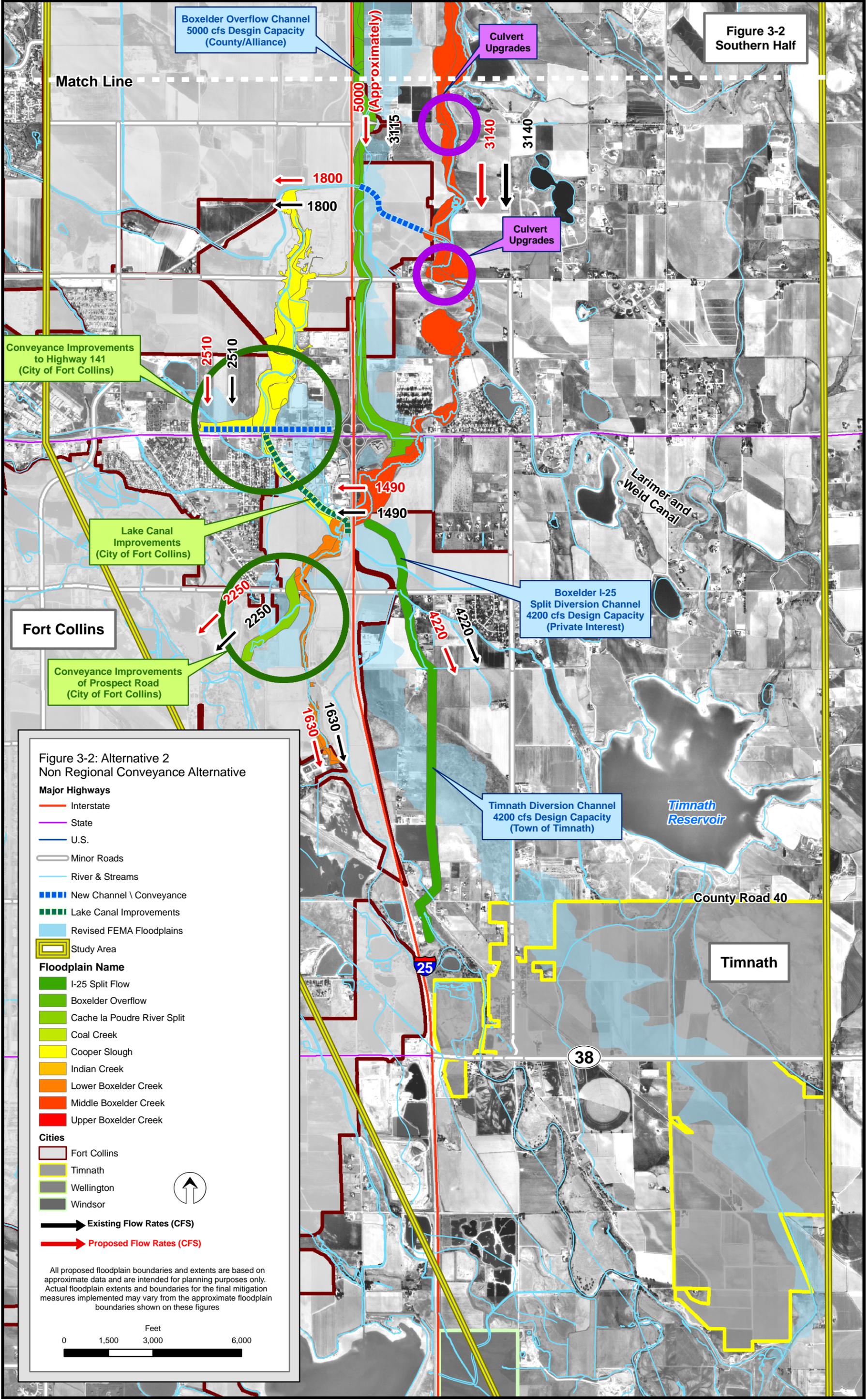
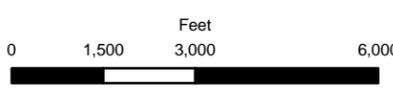


Figure 3-2: Alternative 2
Non Regional Conveyance Alternative

- 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



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

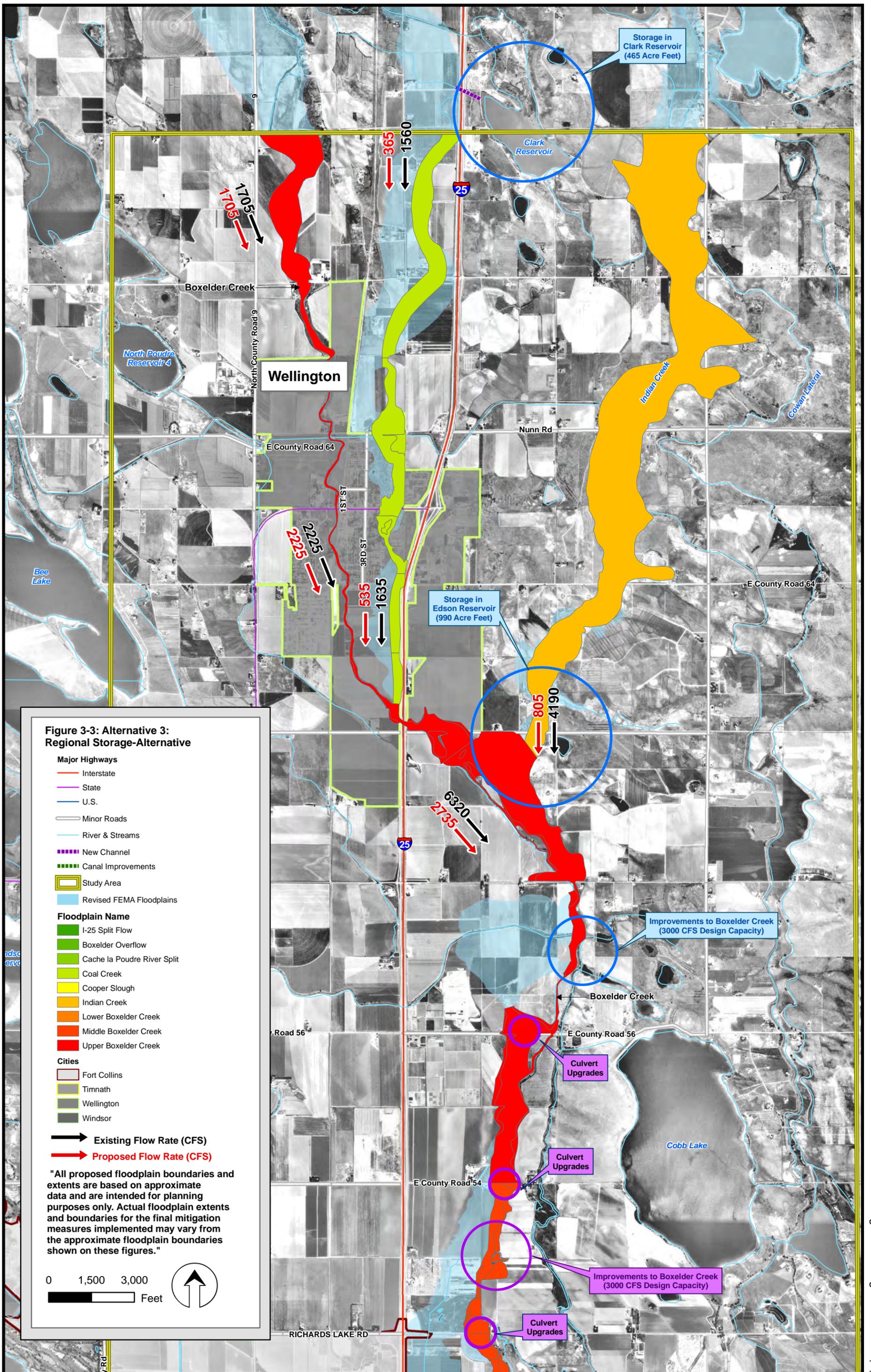


Figure 3-3: Alternative 3: Regional Storage-Alternative (A)

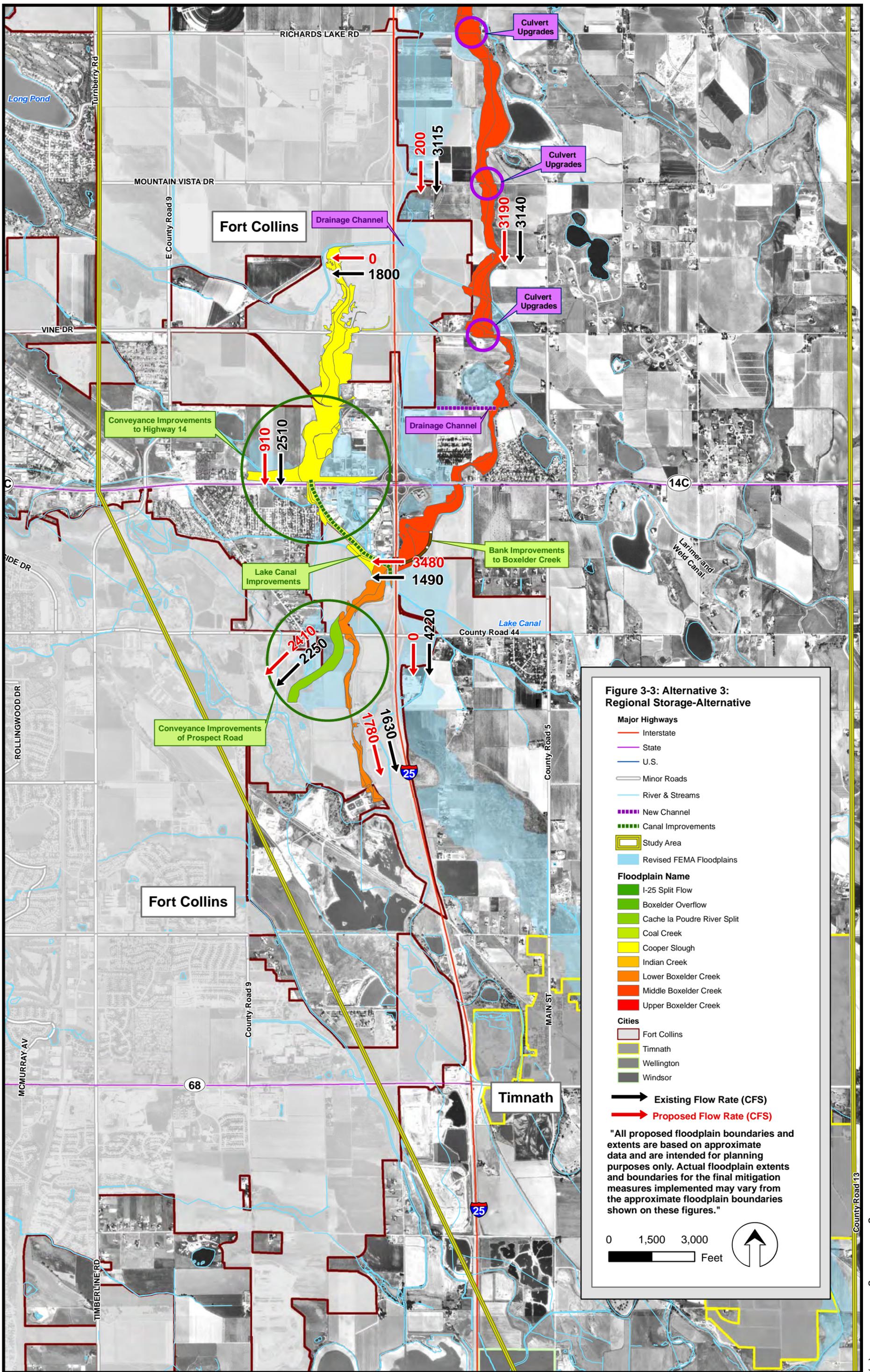


Figure 3-3: Alternative 3: Regional Storage-Alternative (B)

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

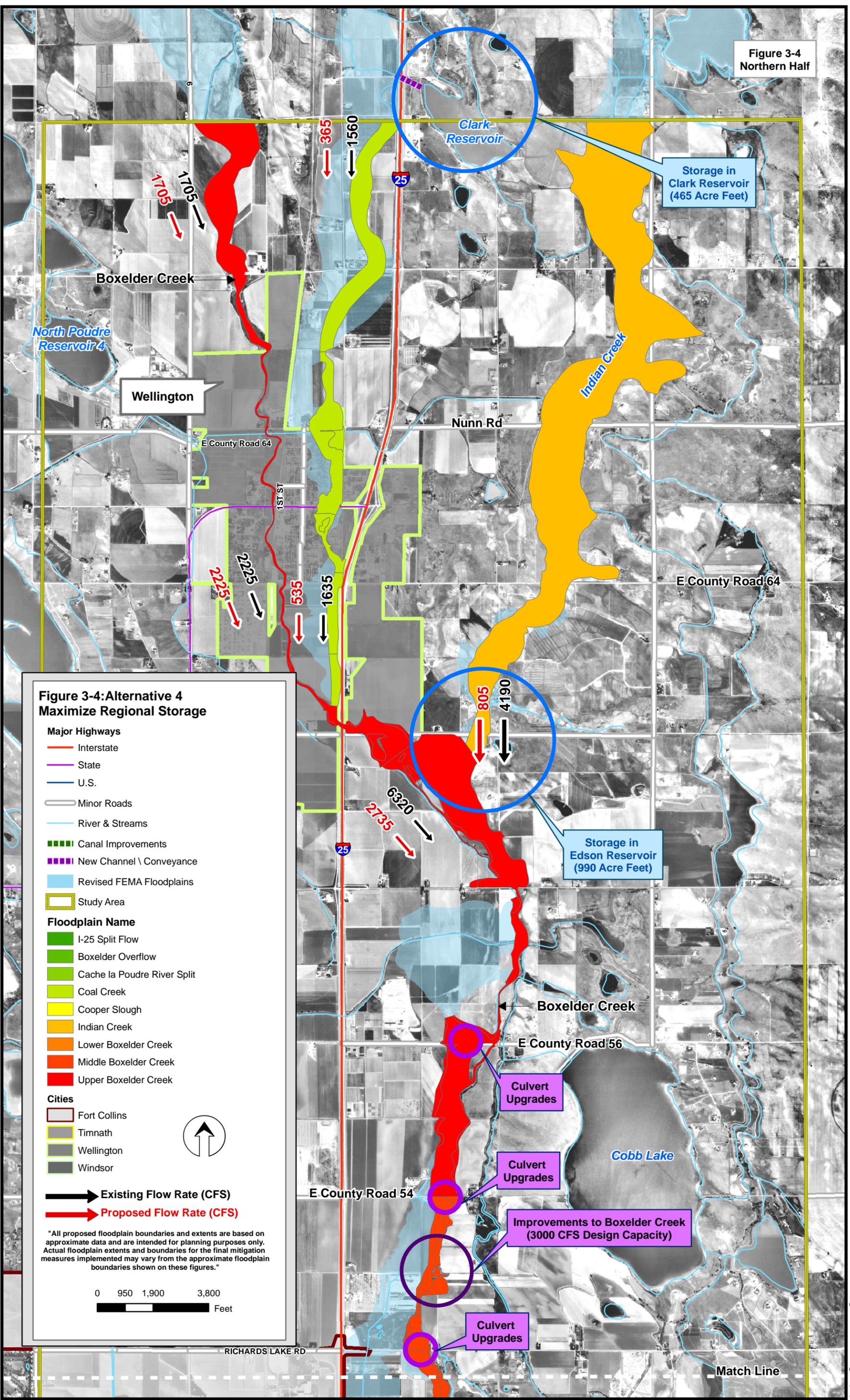


Figure 3-4: Alternative 4 Maximize Regional Storage

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

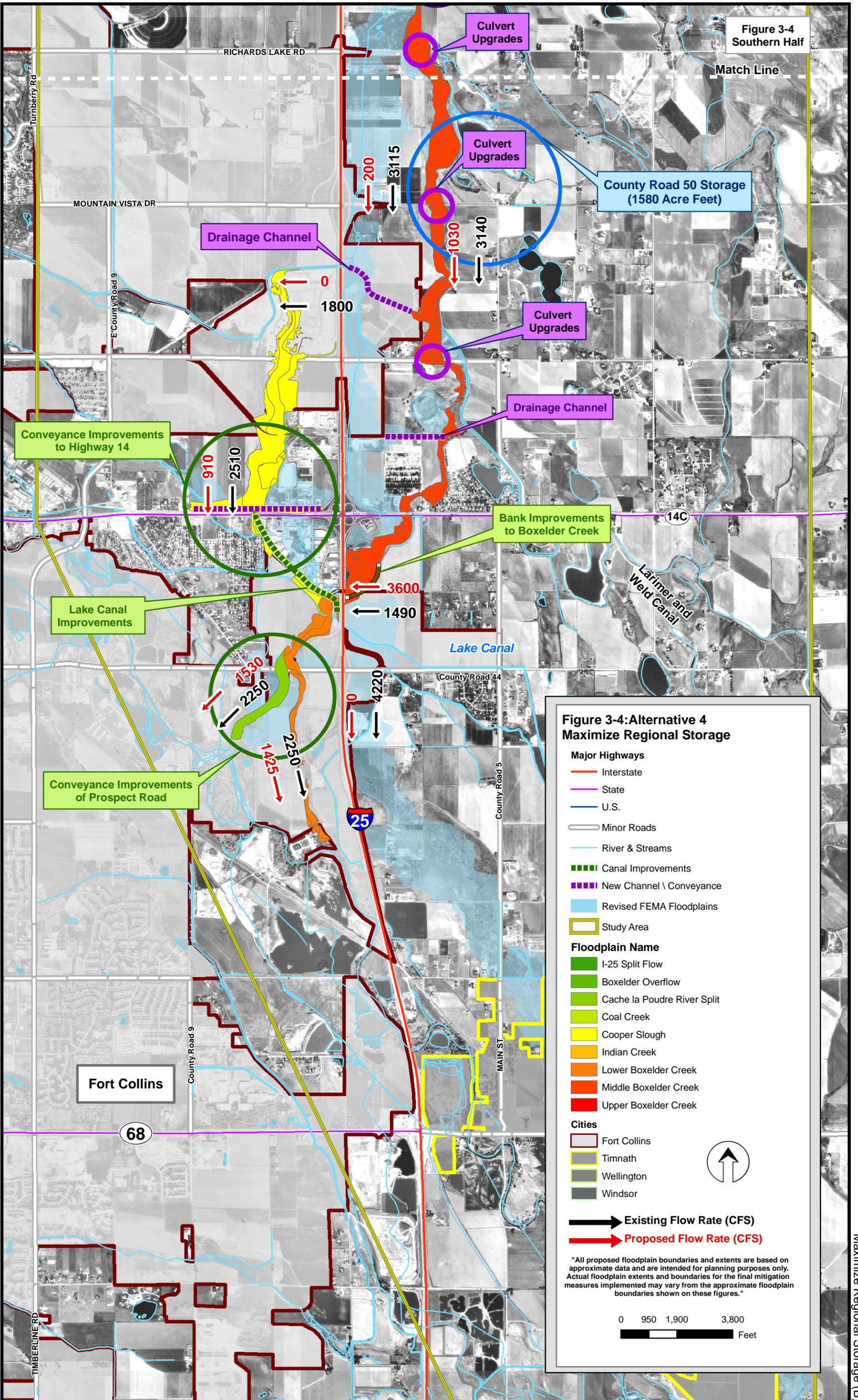


Figure 3-4: Alternative 4
Maximize Regional Storage

- 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."

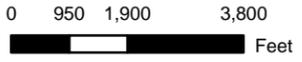


Figure 3-4: Alternative 4
Maximize Regional Storage (B)

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

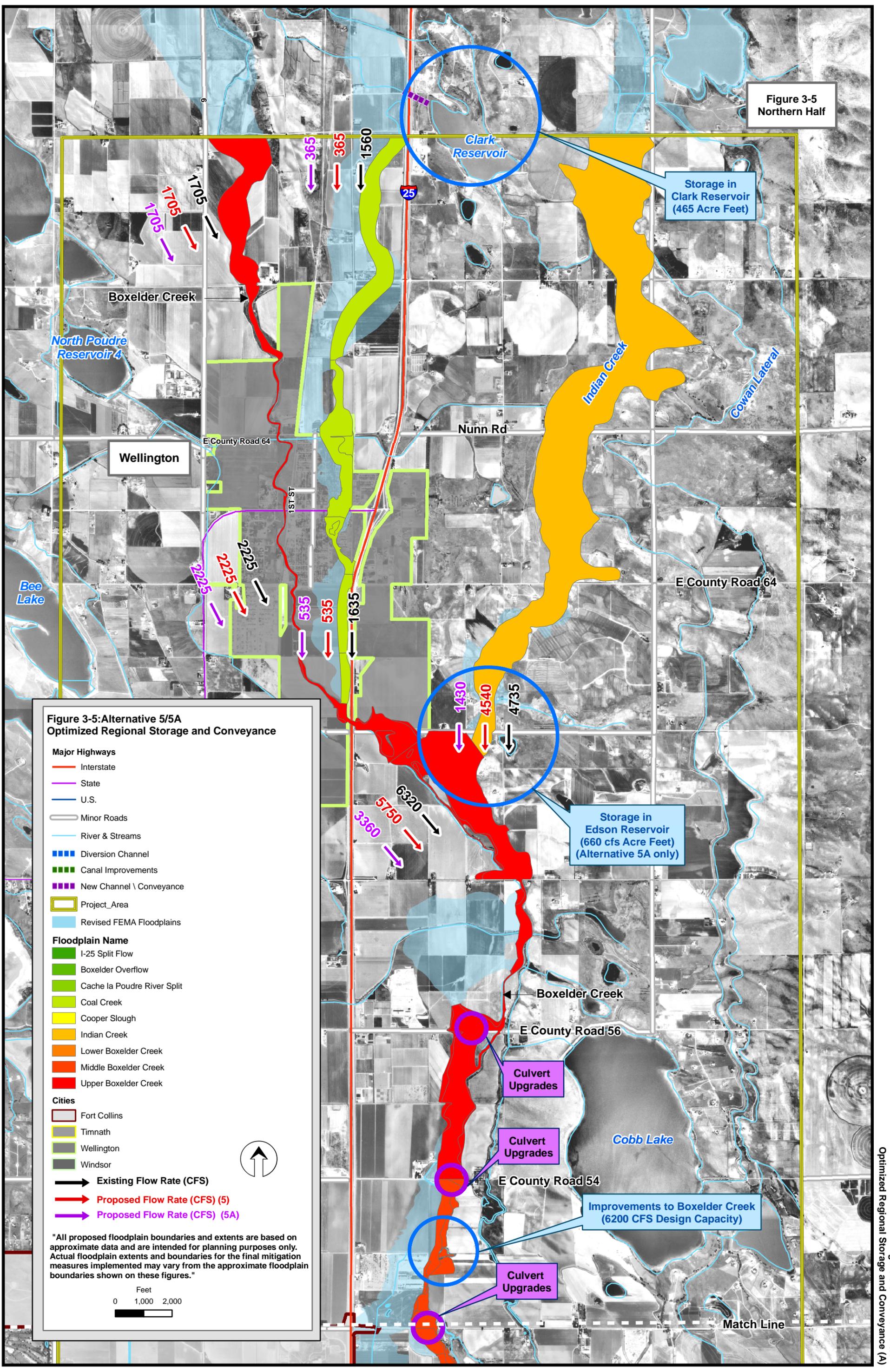


Figure 3-5: Alternative 5/5A
Optimized Regional Storage and Conveyance

- 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."

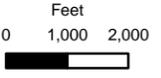
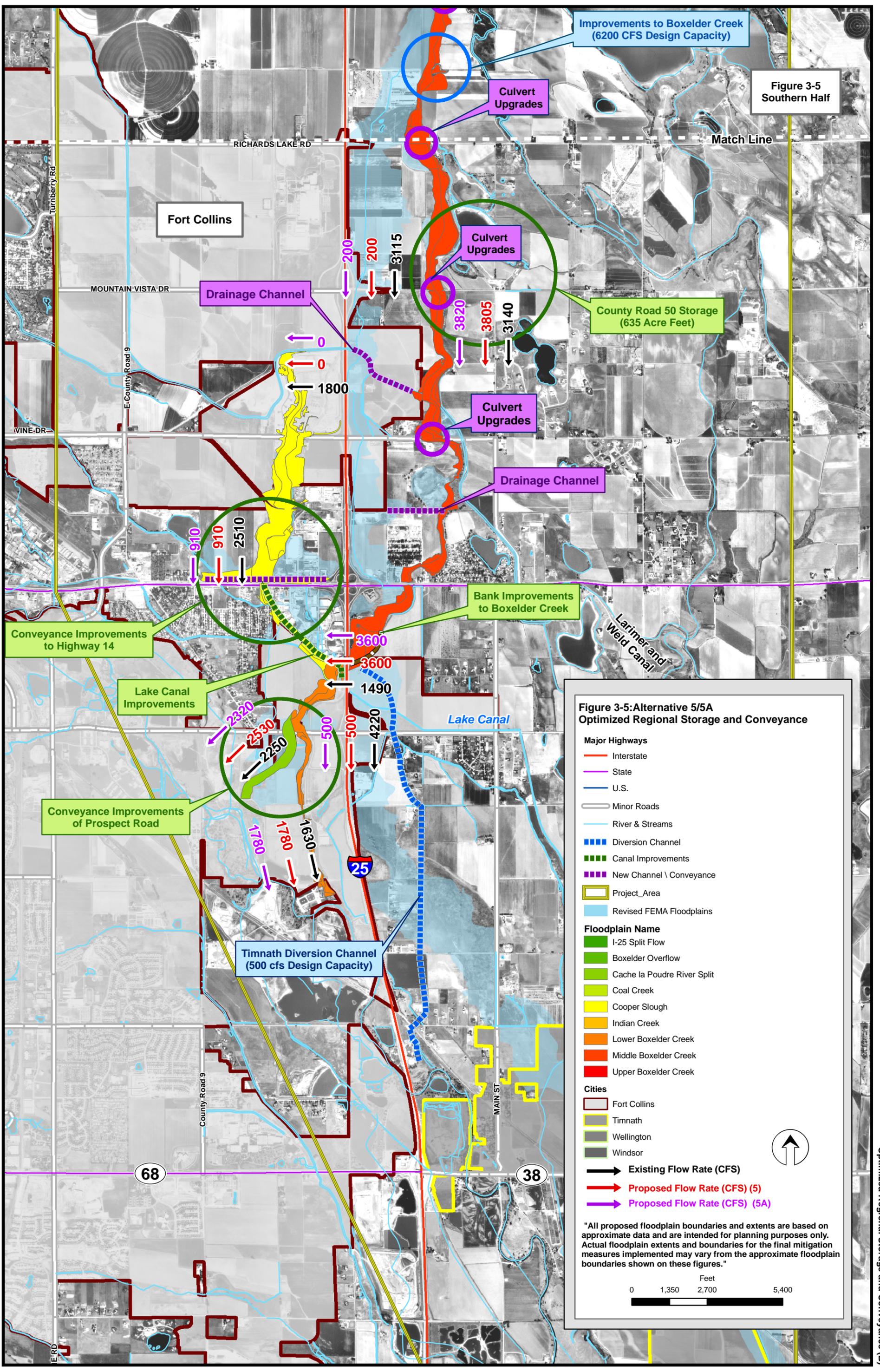


Figure 3-5: Alternative 5/5A
Optimized Regional Storage and Conveyance (A)



Improvements to Boxelder Creek (6200 CFS Design Capacity)

Figure 3-5 Southern Half

RICHARDS LAKE RD

Match Line

Fort Collins

Culvert Upgrades

County Road 50 Storage (635 Acre Feet)

Drainage Channel

Culvert Upgrades

Culvert Upgrades

Drainage Channel

MOUNTAIN VISTA DR

VINE DR

E-County Road 9

Bank Improvements to Boxelder Creek

Conveyance Improvements to Highway 14

Lake Canal Improvements

Conveyance Improvements of Prospect Road

Lake Canal

Timnath Diversion Channel (500 cfs Design Capacity)

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

- Major Highways**
- Interstate
 - State
 - U.S.
- Minor Roads**
- Minor Roads
- River & Streams**
- River & Streams
- Channels**
- Diversion Channel
 - Canal Improvements
 - New Channel \ Conveyance
- Project Area**
- Project Area
- Revised FEMA Floodplains**
- 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) (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."

0 1,350 2,700 5,400 Feet

Optimized Regional Storage and Conveyance (B)

Figure 3-5: Alternative 5/5A

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%)

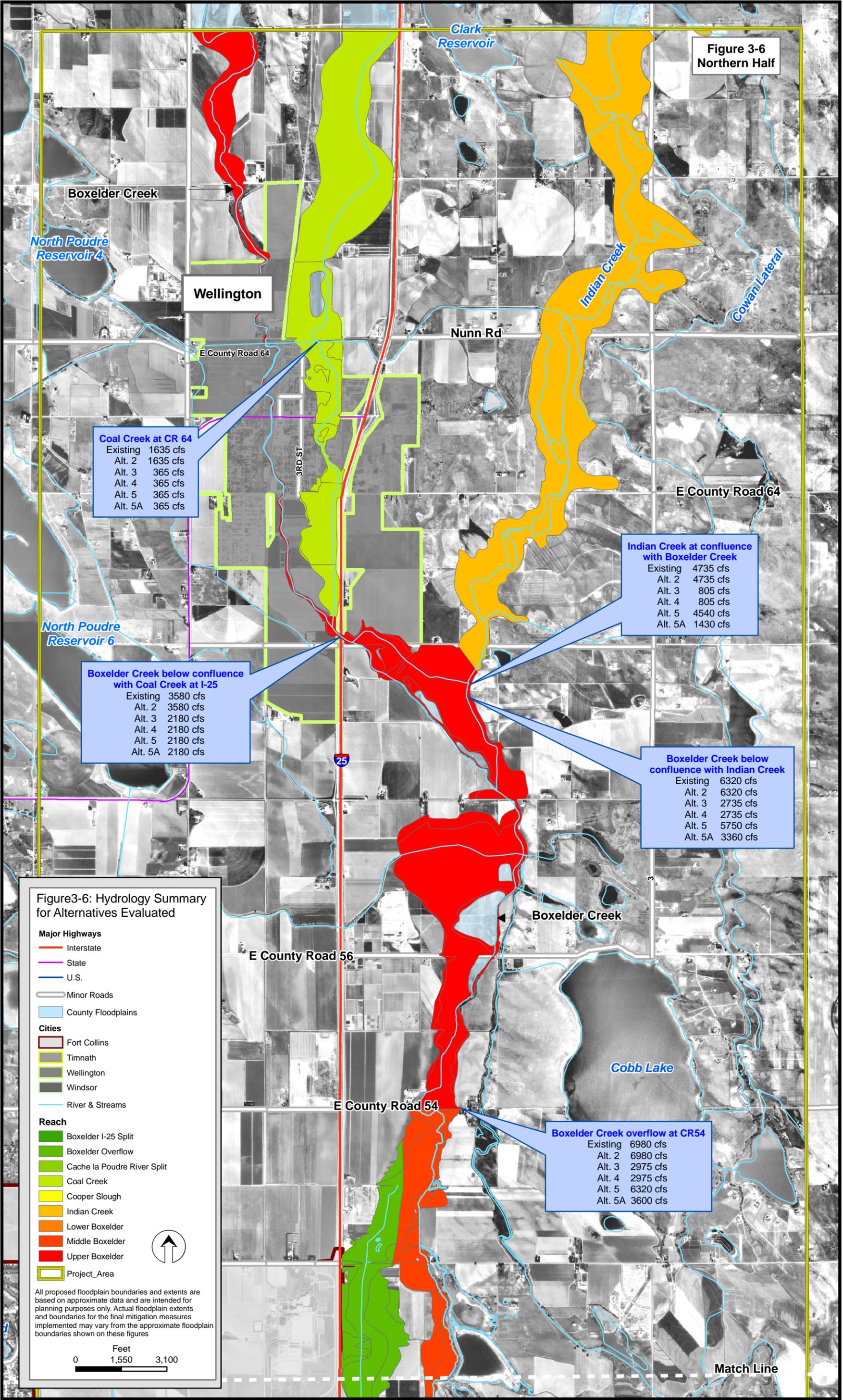
The weighting of the criteria and the scoring of the alternatives was performed in a workshop setting by members of the TAC. This information (along with the funding and economic evaluations) was utilized to assist in selecting a recommended alternative for implementation.

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 3-6: 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)

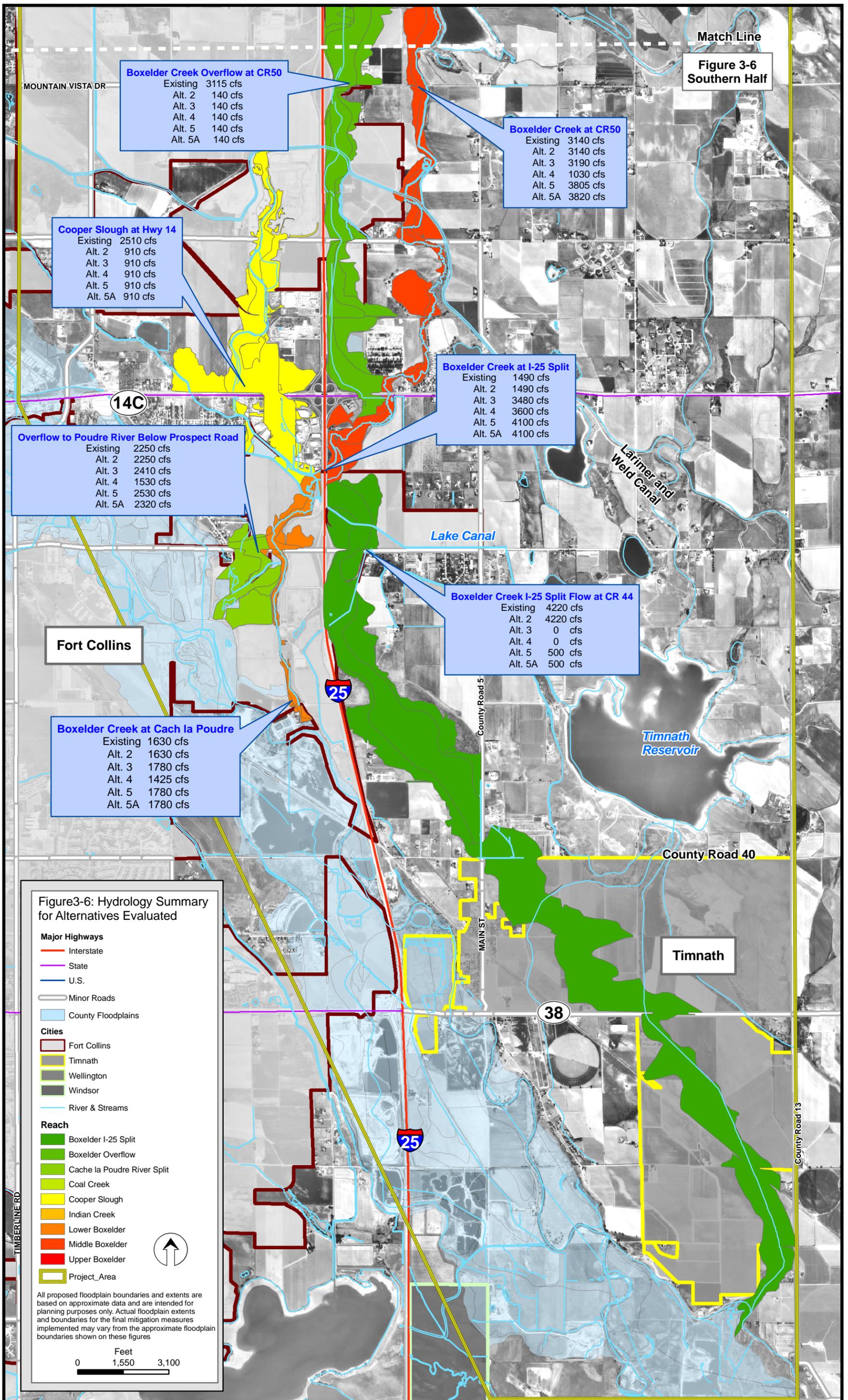
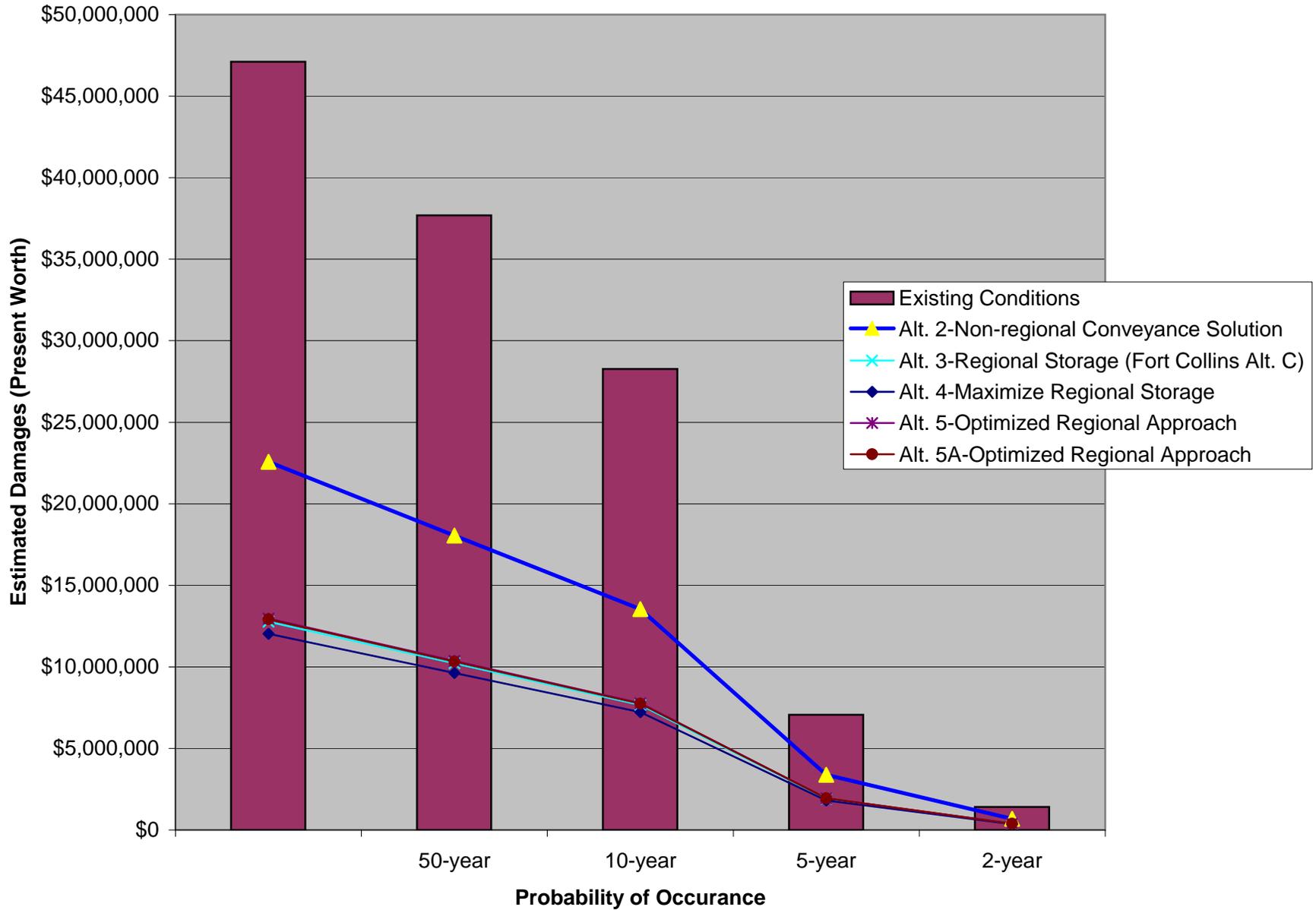
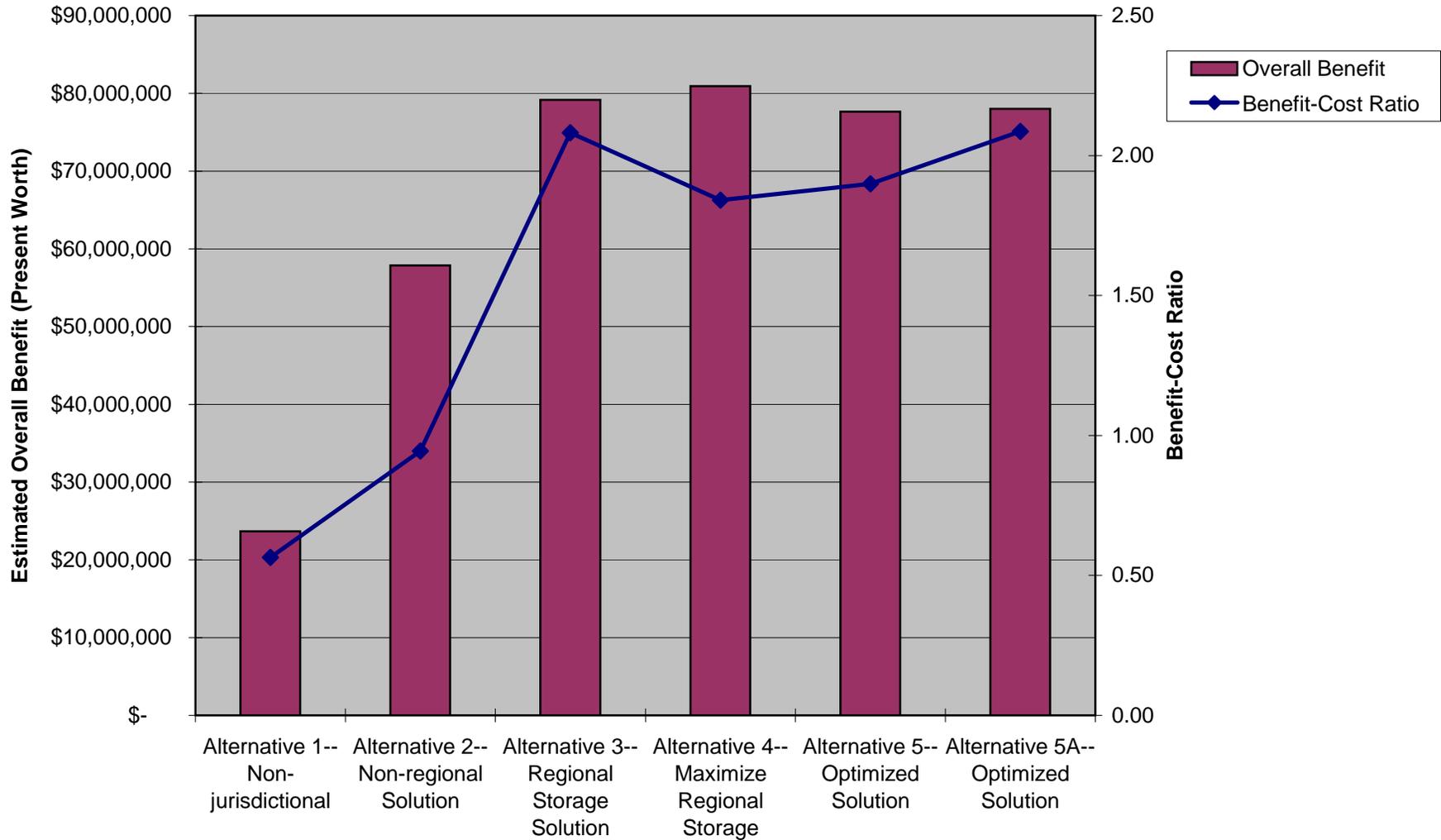


Figure 3-6: Hydrology Summary for Alternatives Evaluated (B)

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



**Figure 3-8
Overall Benefit Estimates**



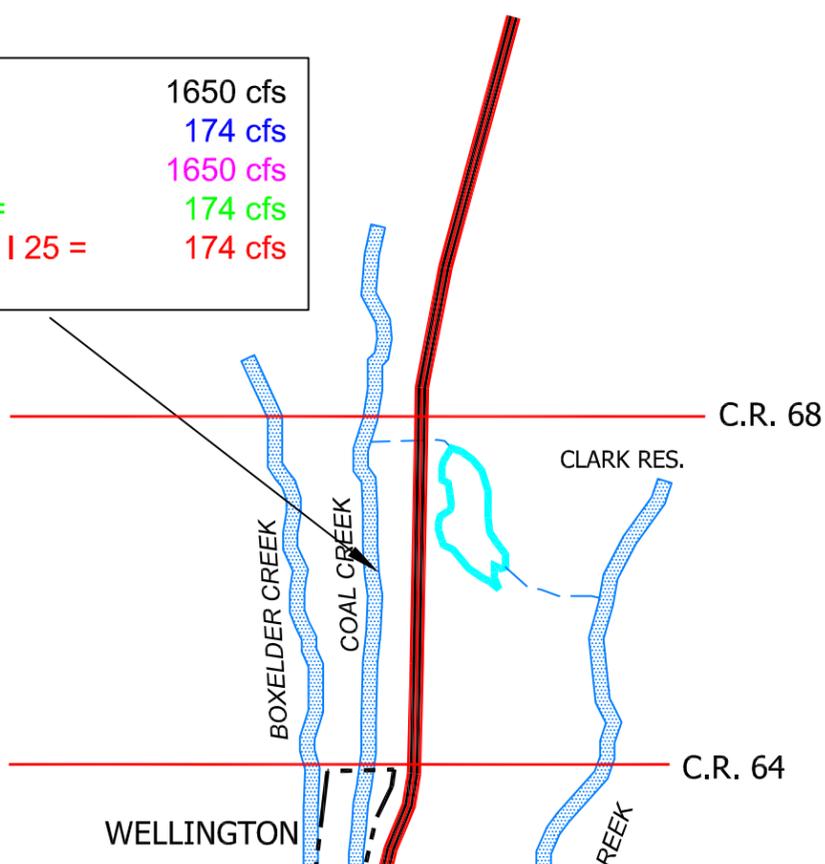
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3.5 Recommended Alternative

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 ration 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



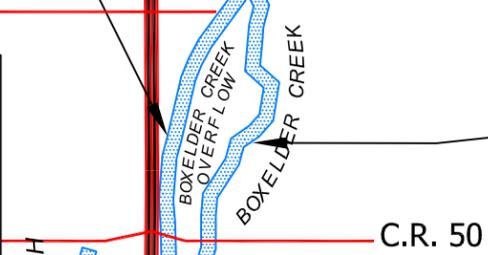
▪ FEMA =	4054 cfs
▪ Clark =	3777 cfs
▪ Edson =	2370 cfs
▪ Clark & Edson =	1463 cfs
▪ Clark, Edson, & I 25 =	1463 cfs

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

C.R. 54

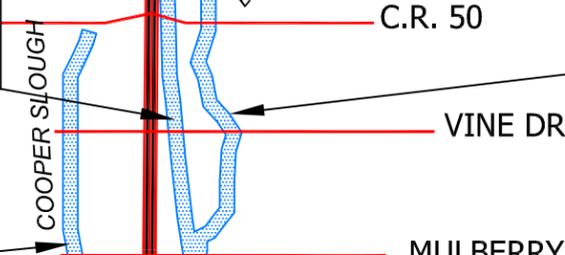
▪ FEMA =	2905 cfs
▪ Clark =	2838 cfs
▪ Edson =	2597 cfs
▪ Clark & Edson =	2464 cfs
▪ Clark, Edson, & I 25 =	2464 cfs

▪ 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

FORT COLLINS



▪ 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.