Updating the City of Fort Collins Stormwater Master Plan to Include Stormwater Quality and Stream Restoration

Mark Kempton, P.E., CFM
Stormwater Master Planning Manager &
Shane Boyle, P.E., CFM
Stormwater Master Planning Engineer

City of Fort Collins Utilities – Stormwater Department

Stormwater Master Plan Revisions

Why did we do a Master Plan Update?

- Increase emphasis on stormwater quality and protection of City's urban watersheds
- Address poor aquatic habitat and unstable streams throughout the City
- City Council directive in October 2008 as part of Stormwater Repurposing program

Stormwater Master Plan Revisions

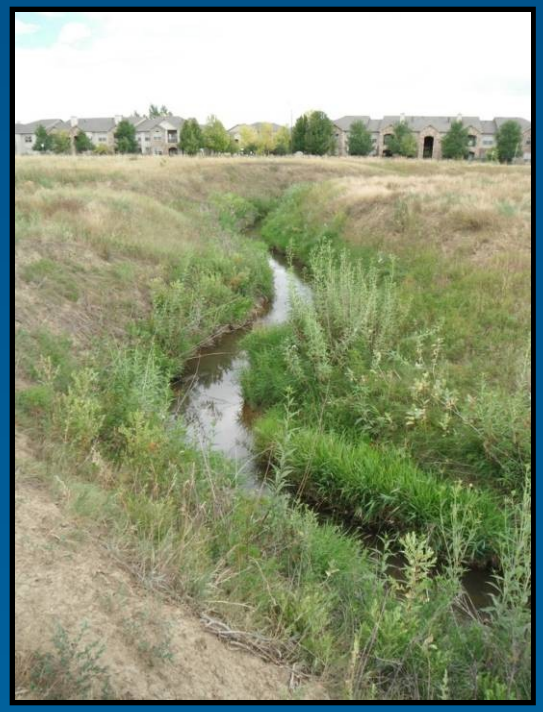
What key results were achieved by updating the Master Plan?

- Integrate 1)flood control, 2)stormwater quality, and 3)stream restoration projects into one comprehensive plan
- A prioritized listing of stream rehabilitation projects
- A prioritized listing of new and retrofitted stormwater quality Best Management Practice (BMP) projects

Stormwater Master Plan Revisions

STORMWATER REPURPOSING

City Council requested a review of the Stormwater Program in October 2008. Council directed that additional emphasis be placed on improving stormwater quality and protecting the City's urban watersheds while preserving natural and beneficial functions of floodplains.



Stormwater Master Plan Revisions

3 NEW STUDIES

The Master Plan Updates were finalized using data, information and results from the following three separate program efforts:

1. **Urban Stream Health Assessment**
2. **Basin-Specific BMP Selected Plans**
3. **Stream Restoration and Stability Study**

Study #1

URBAN STREAM HEALTH ASSESSMENT

Completed by Colorado State University in cooperation with the Fort Collins Stormwater Division.

GOAL – Determine specific stream characteristics that have the greatest impact on improving stream health.

APPROACH – Evaluate the relationships between stream physical, hydrologic and biological characteristics and evaluate the overall health of streams using EPA accepted methods (determination of biological indices).

Study #1

URBAN STREAM HEALTH ASSESSMENT

Results and Recommendations:

- Focus in-stream rehabilitation on only those areas with significant upstream BMP coverage
- A minimum of 40% of a watershed should be undeveloped or have BMP facility coverage
- Need more than one metric (i.e. a matrix) to assess stream health
- Irrigation flows pose significant challenges to stream health due to high shear stress, sediment loads and variable flow regimes

City of Fort Collins

Stormwater Master Plan Revisions

1. Urban Stream Health Assessment
2. Basin Specific MMP Selected Plans
3. Stream Restoration and Stability Study

3 NEW STUDIES

The Master Plan Updates were finalized using data, information and results from the following three separate program efforts:

Study #2

Study #2

BASIN-SPECIFIC BMP SELECTED PLANS

- Spring Creek
- Dry Creek
- Fox Meadows
- Old Town
- Mail Creek
- Canal Importation
- Fossil Creek
- West Vine
- Foothills
- McClelland's Creek

Study #2

BASIN-SPECIFIC BMP SELECTED PLANS

Work completed as part of the update included:

- Hydrologic model updates
- Hydrologic sensitivity analyses
- Conceptual BMP / WQ phase
- Triple Bottom Line Analysis
- Alternatives Analysis phase
- Preparation of the Selected Plan

Study #2

WATER QUALITY BMP ALTERNATIVES ANALYSIS – BMP SELECTION PROCESS

- Perform a basin-by-basin Triple Bottom Line (TBL) analysis for all potential BMPs
- Rank BMPs based upon TBL results
- Identify locations within the basin to apply the ranked BMPs
- If a higher ranked BMP does not physically work in a specific location, move to the next ranked BMP to investigate suitability.

Fossil Creek - TBL Evaluation of BMPs

Triple Bottom Line Analysis Map (TBLAM)

Project or Decision:	Fossil Creek Basin	Evaluated by:	Shane, Mark, Craig

Environmental

STRENGTHS:

- WQ Pond
  - Serves multiple purposes
  - Creates expanded habitat and wetland enhancement
  - Can help provide open space credits in a development
  - Treats a large area, requiring installation of few other BMPs
  - Proven technology
  - Extensive life-cycle (lasts a long time)
- Bioswales/Infiltration
  - Creates expanded habitat on a micro scale
  - Can be installed in areas with limited access and construction options
  - Fits in well with other SW improvements
- Preservation Areas
  - Typical developed-land pollutants will not leave the site
  - Preserves existing habitat
  - Maintains community buffers
- Irrigation Diversions
  - Reduce the potential for long-term channel degradation associated with clear-water irrigation routing
  - Enables engineered stabilization measures to be implemented
  - Reduces nutrient loading
  - Reduces long term maintenance burdens in waterways
  - Reduces impacts on habitat and wildlife/vegetation
  - Reduced obstruction from diversion removal promotes fish passage + micro invertebrate health
  - Reduced evaporation potential increases water conservation

LIMITATIONS:

- WQ Pond
  - May exacerbate pond overtopping issues for existing ponds
  - Encourages mosquito breeding, larvae treatment will be required
  - E-coli nuisance problem created by waterfowl
- Bioswales/Infiltration
  - Treats a smaller area
  - Technology is generally untested or unproven
  - Plantings require maintenance
- Preservation Areas
  - Continued use of pesticides on agricultural lands results in higher nitrate and phosphate loads in streams and rivers
- Irrigation Diversions
  - May reduce habitat potential and impact wildlife and vegetation by reducing base flows

Social

STRENGTHS:

- WQ Pond
  - Easy to construct
  - Serves multiple purposes
  - Treats a large area, requiring installation of few other BMPs
  - Proven technology
  - Low maintenance/impact on the community
  - Attracts waterfowl
  - Can be aesthetically pleasing if implemented correctly
- Bioswales/Infiltration
  - Fits in well with other SW improvements
  - Can be aesthetically pleasing done right
  - Easily incorporated into overall development plan
  - Easily-applied BMP in areas with limited available space
- Preservation Areas
  - Can provide a community benefit because of the additional open space
  - Conservation easement provides a benefit to the existing land owners
  - Decrease in flooding potential of undeveloped properties
  - Conservation easements provide community-wide tax benefits
  - Maintains community buffers
  - Creates an education and outreach opportunity
- Irrigation Diversions
  - Opens the door for engineered stabilization measures to be implemented
  - May result in removal of irrigation diversions = more aesthetically pleasing and safe Reduces long term maintenance burdens in waterways
  - Reduces flooding potential along the edge of waterways
  - Reduces losses in irrigation systems if piped

LIMITATIONS:

- WQ Pond
  - May exacerbate pond overtopping issues for existing ponds
  - Encourages mosquito breeding
  - Odor issues, and perception of living next to a "swamp"
  - Requires a large land area, reducing developable area
- Bioswales/Infiltration
  - Lack of planting maintenance is visually unappealing
  - Odor issues, and perception of living next to a "swamp"
  - Maintenance requires frequent access on adjacent private property; accessibility challenge
  - Requires purchase of easements from adjacent landowners
  - Tends to breed mosquitoes
- Preservation Areas
  - Open areas create a negative public perception of undeveloped land
  - Requires a large area to be preserved at one time
- Irrigation Diversions
  - Large-scale project that impacts multiple stakeholders and adjacent property owners
  - Requires lots of space for implementation
  - Can reduce habitat potential and impact wildlife and vegetation by removing water resource
  - Modifies aesthetics of water conveyance features adjacent to private properties

Economic

STRENGTHS:

- WQ Pond
  - Inexpensive to construct and maintain
  - Can help provide open space credits in a development
  - Treats a large area, requiring installation of few other BMPs
  - Focuses a large treatment area in one location
  - Can be incorporated into existing detention ponds if volume is available
  - Proven technology
- Bioswales/Infiltration
  - Can be installed in areas with limited access and construction options
  - Fits in well with other SW improvements
  - Easily incorporated into overall development plan
- Preservation Areas
  - Possibility of continued agricultural uses
  - Does not require maintenance
  - Conservation easements provide community-wide tax benefits
- Irrigation Diversions
  - Economically beneficial to irrigators
  - Reduces losses in irrigation systems if piped

LIMITATIONS:

- WQ Pond
  - May exacerbate pond overtopping issues for existing ponds
  - Requires a large footprint that reduces total developable acreage
  - Reduces potential tax revenue
  - Requires mosquito abatement
- Bioswales/Infiltration
  - Plantings and substrate require extensive maintenance
  - Initial cost of construction is high
  - Cost of long-term maintenance is high
  - Provides small benefit at a higher unit cost
  - Requires purchase of easements from adjacent landowners
- Preservation Areas
  - Economic cost of non-development may outweigh benefit of preservation
  - Decrease in tax revenue
  - Initial expense is high
  - Diverts funding from flood control
- Irrigation Diversions

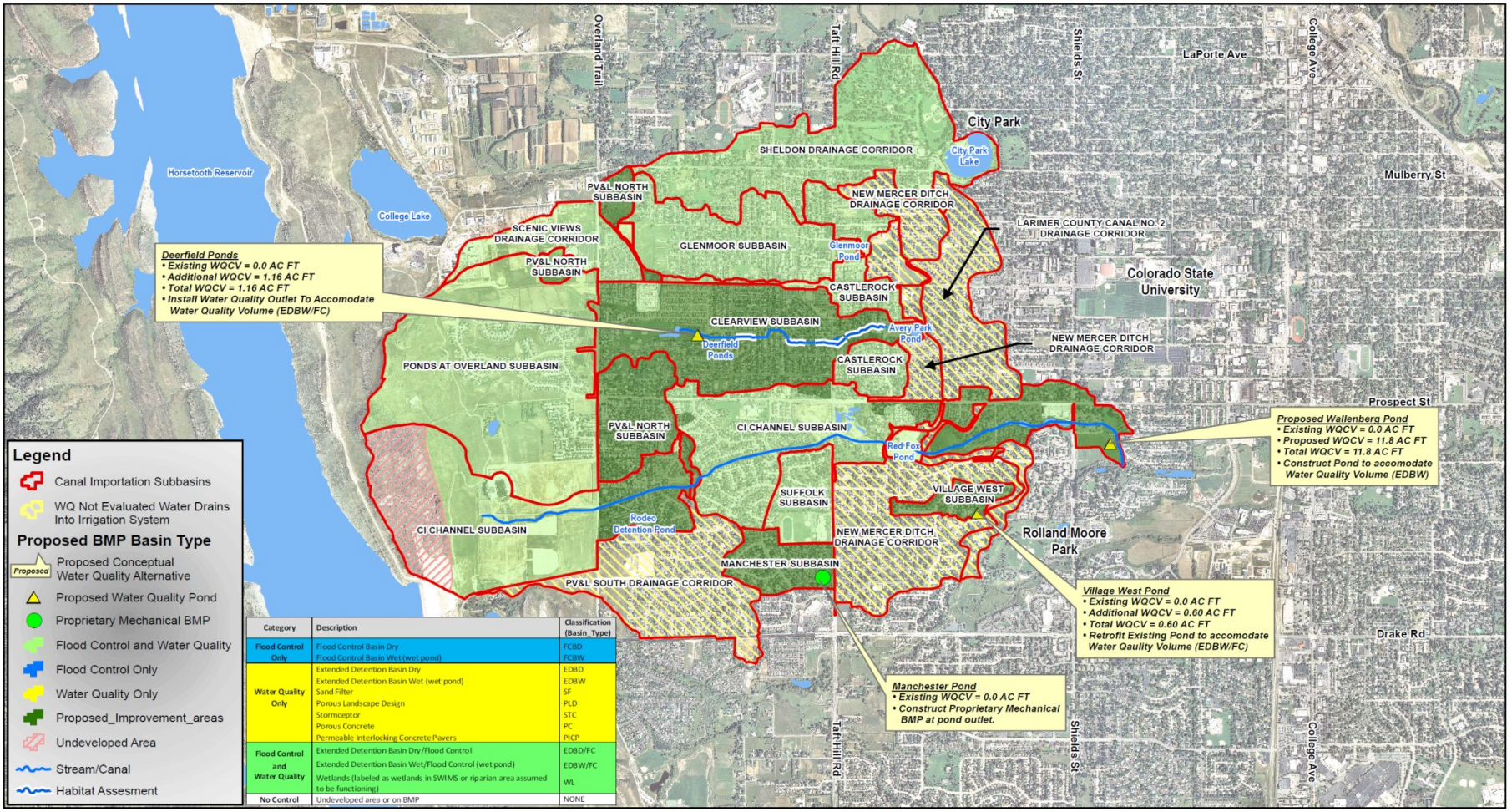
Form Completed **October 11, 2011**

This form is based on research by the City of Olympia and Evergreen State College

Fossil Creek - TBL Rankings of BMPs

BMP	Ranking	Notes
Water Quality Pond		Largest number of strengths in all categories with few limitations.
Irrigation Diversions	**2**	Significant limitations in Economic with few strengths. Largest number of environmental strengths with almost no limitations. About the same number of strengths and limitations in Social. Economic limitations may limit implementation.
P		

CI Basin – Sample BMP/Stream Restoration Map



Anderson Consulting Engineers, Inc.
Civil • Water Resources • Environmental

City of Fort Collins

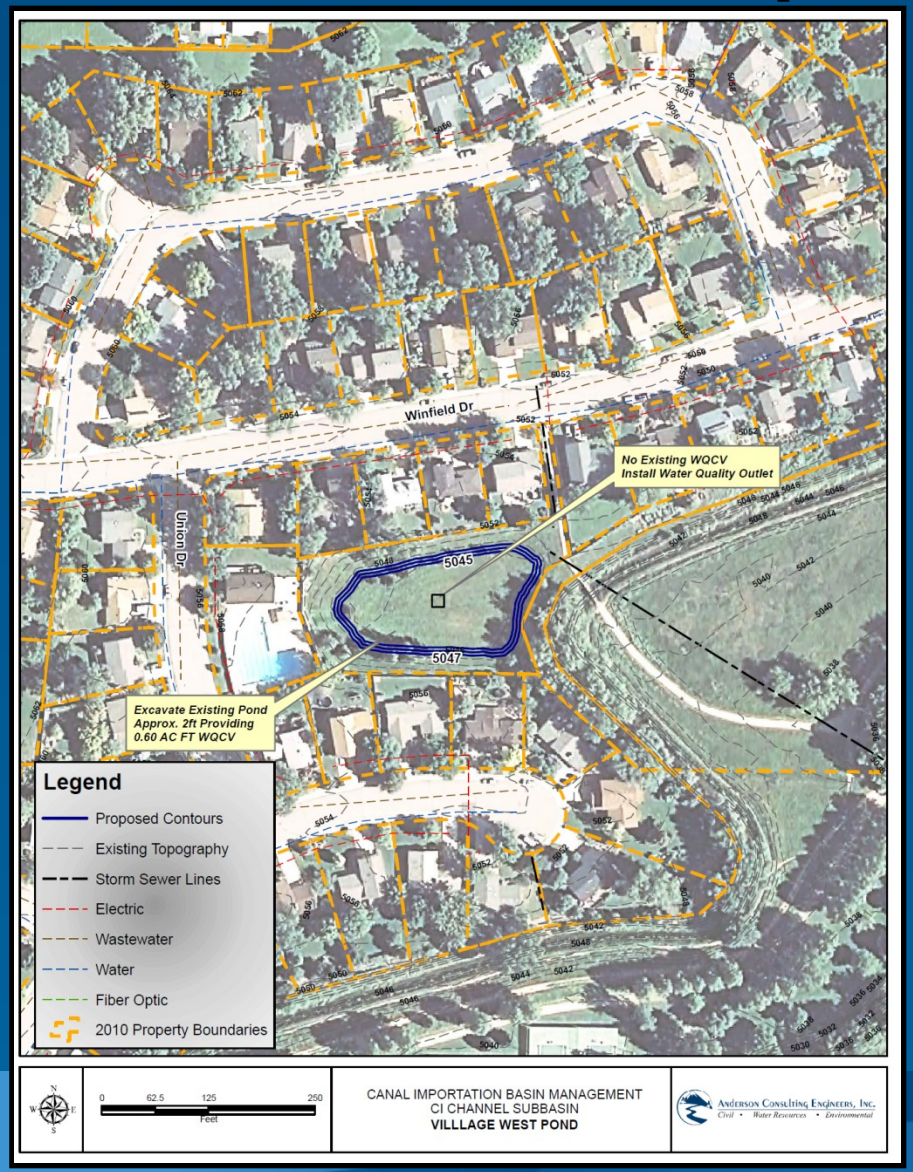
CANAL IMPORTATION BASIN MANAGEMENT
PROPOSED CONDITIONS BMP MAP

N W E S

0 1,000 2,000 4,000
Feet

City of Fort Collins

Proposed BMPs



- Excavate pond and provide new water quality outlet
- Maintain existing pond invert
- Move and/or re-plant trees
- Requires close interaction with affected neighbors

City of Fort Collins

Stormwater Master Plan Revisions

3 NEW STUDIES

The Master Plan Updates were finalized using data, information and results from the following three separate program efforts:

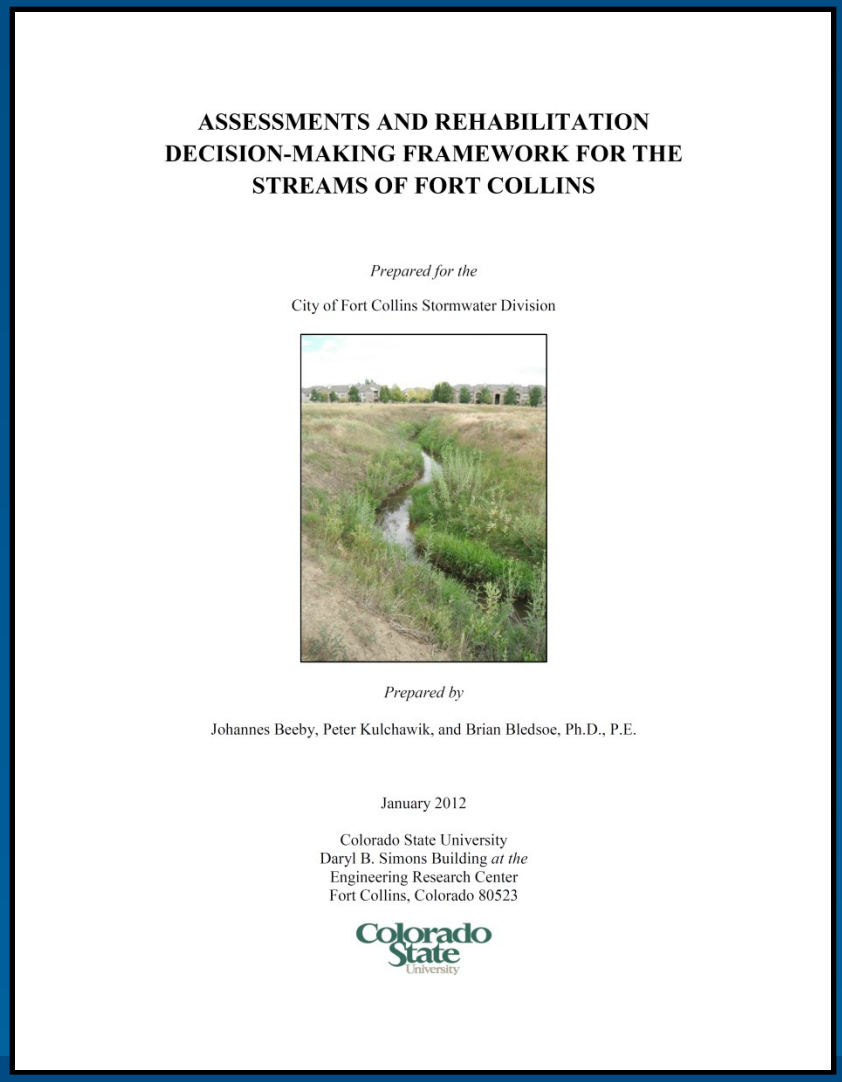
1. **Urban Stream Health Assessment**
2. **Basin-Specific BMP Selected Plans**
3. **Stream Restoration and Stability Study**

Study #3

STREAM RESTORATION / STABILITY STUDY

Conducted by CSU in 2011.

GOAL - Prioritize future stream management and rehabilitation work on 10 streams within the City of Fort Collins in coordination with the basin-specific BMP selected plans.



ASSESSMENTS AND REHABILITATION DECISION-MAKING FRAMEWORK FOR THE STREAMS OF FORT COLLINS

Prepared for the

City of Fort Collins Stormwater Division

Prepared by

Johannes Beeby, Peter Kulchawik, and Brian Bledsoe, Ph.D., P.E.

January 2012

Colorado State University
Daryl B. Simons Building *at the*
Engineering Research Center
Fort Collins, Colorado 80523

Colorado State University

City of Fort Collins

Study #3

STREAM RESTORATION / STABILITY STUDY

OBJECTIVES - The objectives of the work were to:

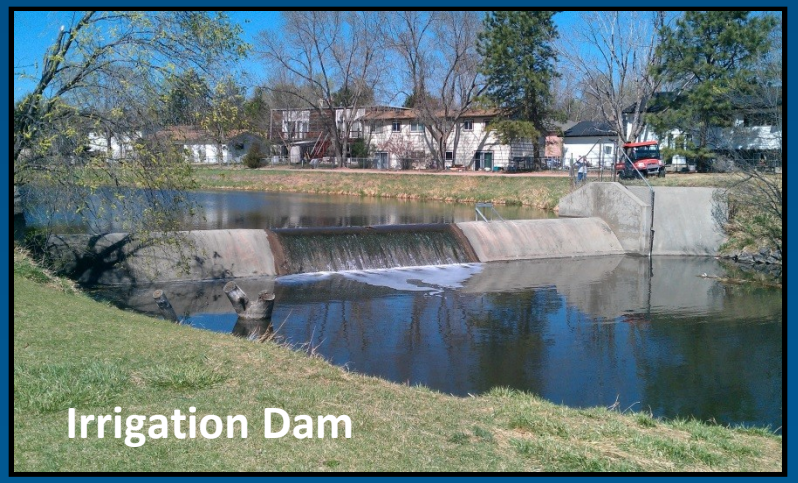
- **Perform a geomorphic assessment on a segment-by-segment basis. Determine channel evolution stage, channel susceptibility to vertical and lateral erosion, and stream habitat condition.**
- **Use the data to identify geomorphic thresholds and assess candidate restoration sites.**
- **Identify and prioritize future stream management and rehabilitation work through the development of a Multi-Criterion Decision Analysis (MCDA) matrix.**

City of Fort Collins

Obstacles to Fish Passage

Irrigation Diversion Structure

Grade Control Structure



Erosion Problems

Study #3

STREAM RESTORATION / STABILITY STUDY

- Stream Power (Measure of Stream Energy)
  - Important for diverse in-stream habitat
  - Too low - creates glide habitat with little diversity
  - Too high - creates instability within the channel
- Stream Bed Slope
  - Major factor in stream stability and habitat diversity
  - Too low - creates glide habitat with little diversity
  - Too high - creates instability within the channel

Study #3

STREAM RESTORATION / STABILITY STUDY

- Irrigation Return Flows
  - Changes hydrologic flow regime in the stream
  - Creates significant changes in base flow from season to season and year to year
  - Major factor affecting stream instability

City of Fort Collins

Irrigation Flows

- Irrigation flows are transported through several of the City's natural streams
- Drastically alter the natural flow regime – high, sustained flows cause severe erosion
- Diversion structures and dams impede fish passage and habitat connectivity

On-line irrigation pond on Spring Creek

Irrigation Flows

Irrigation Flows released from here (300cfs)

Result in this

City of Fort Collins

Study #3

STREAM RESTORATION / STABILITY STUDY

- Multi-Criterion Decision Analysis (MCDA) Tool
  - Tool for prioritizing stream rehabilitation and basin-wide BMP projects
  - Equally rates the importance of environmental, social, and economic benefits to the project and overall drainage basin
  - Multi-discipline approach to completing the tool - City Depts. – Stormwater, Natural Resources, Sustainability, Engineering, Environmental Planning, Outreach – also Natural Areas Board

Stormwater Master Plan Revisions

Weight 5 = High 1 = Low	Criteria Sub-Criteria	Channel: Reach: Sub-reach:
5	**Environmental**	
3.9	Habitat Improvement Potential	
3.5	Fish Passage Benefit	
4.3	Habitat Connectivity Benefit	
4.8	Watershed-Scale Benefit	
5	**Economic**	
2.9	Engineering Analysis/Design	
3.3	Land Acquisition	
3.9	Construction Costs	
3.5	Maintenance Costs/Access	
4.0	Practicality/Contructability	
5	**Social**	
2.8	Aesthetic Improvement Potential	
4.4	Public Safety Improvements	
3.1	Neighborhood Chracter/Acceptance	
2.0	Education/Outreach Opportunities	
5	**Physical Stream Characteristics - Erosion**	
3.9	Lateral	
4.3	Vertical	
4.3	Threats to Safety/Infrastructure	
2.3	Irrigation Management	
	REACH TOTAL SCORE	

Multi-Criterion Decision Analysis (MCDA) Tool

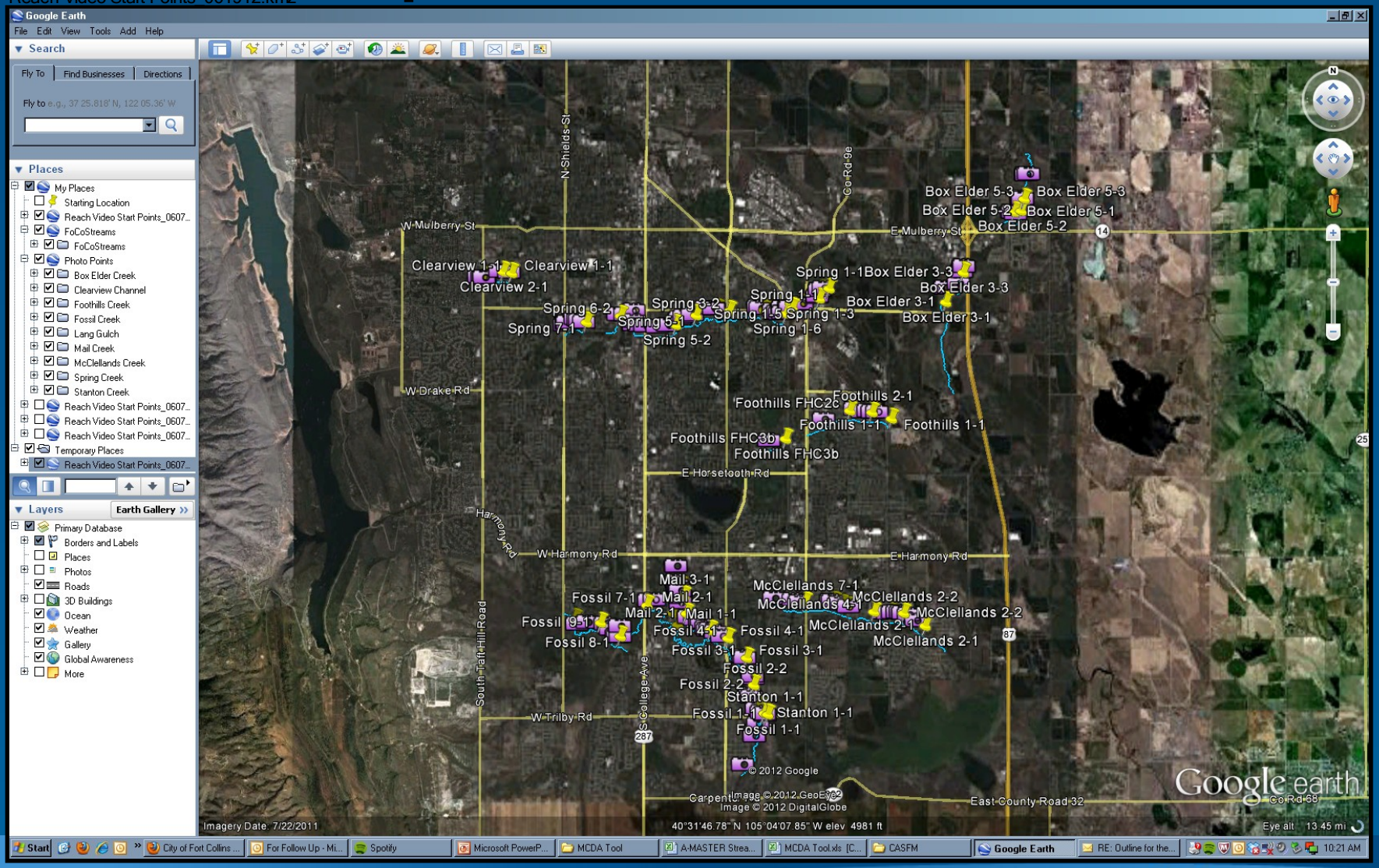
- Provides a meaningful way to prioritize projects
- Transparent, rational, flexible and defensible methodology

Completion of the MCDA Tool

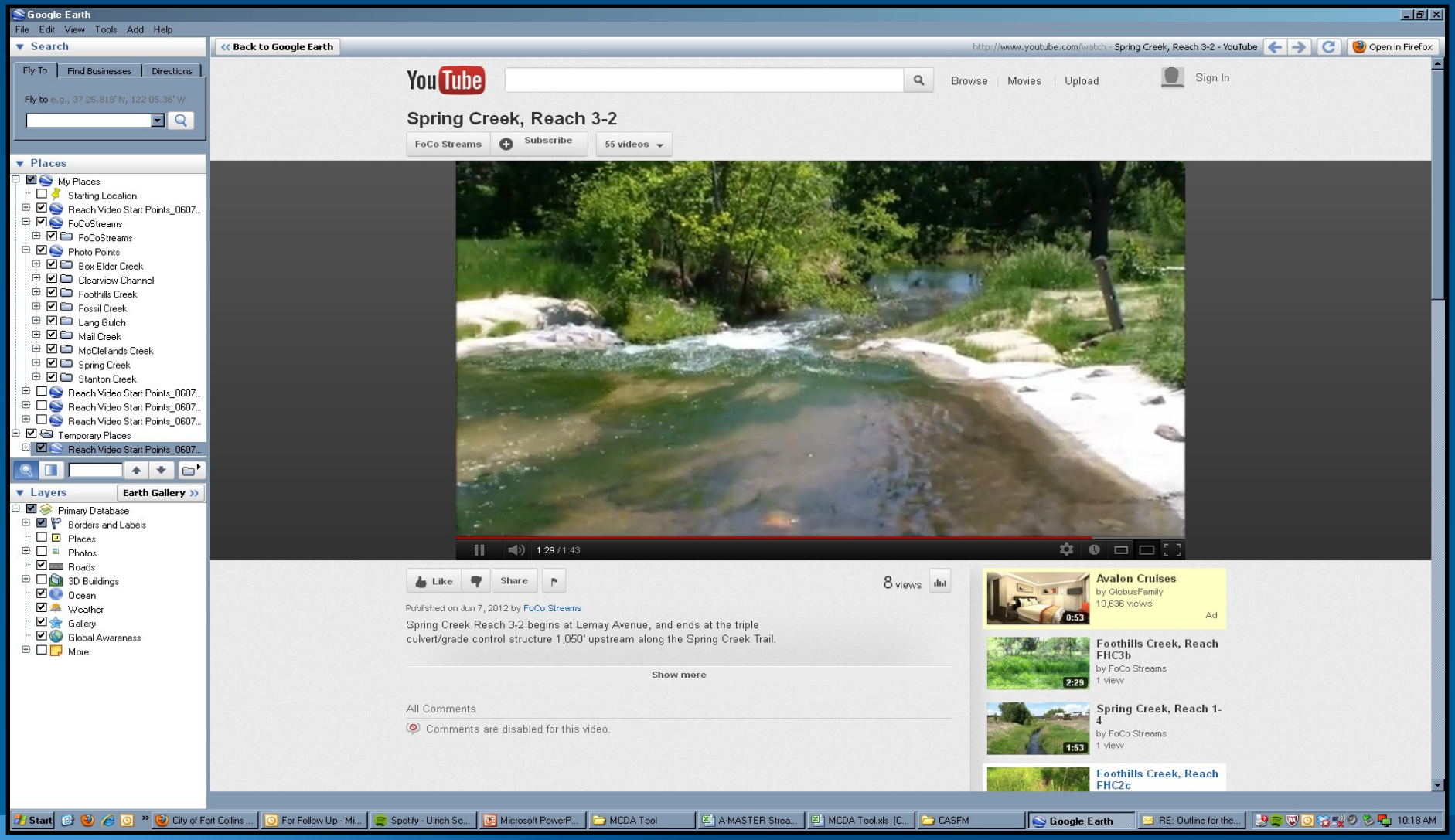
- 3 hour field visit to representative reaches
- 12 people evaluated 17 miles of stream in 3 separate meetings – total 9 hours
- Videos of each stream reach
- Stream video files linked in Google Earth
- Uploaded videos to YouTube and linked from Google Earth

Completion of the MCDA Tool

Reach Video Start Points_061912.kmz



Completion of the MCDA Tool



City of Fort Collins

MCDA Tool Results

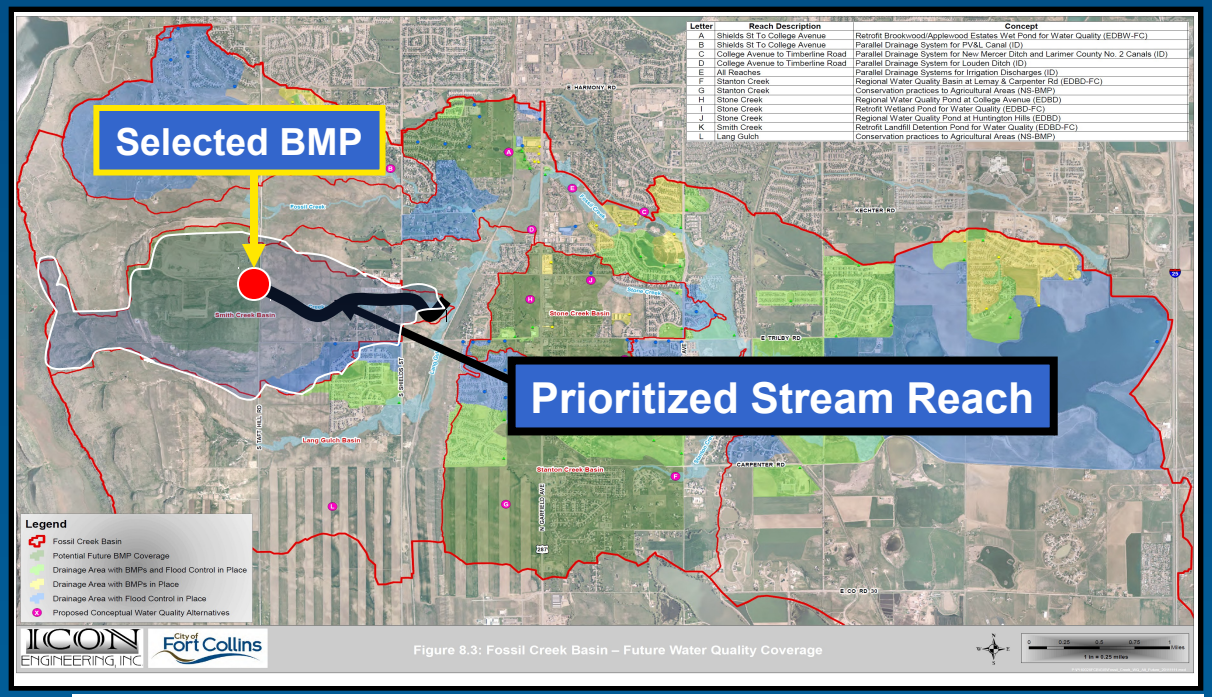
Creek Name	Rank	Reach	Subreach	Overall Score	Reach Length (ft)	Location	Associated BMPs	Notes
Fossil	1	4	1	**2.9**	2250	Upstream of Lemay through Fossil Park		Design needs to incorporate Mail Creek 1-1
Spring	2	1	5	**2.5**	810	Between RR tracks and Riverside		
Mail	3	3	1	**2.5**	980	Directly north of Meadow Passway	Construct all proposed improvemnts in Mail Creek BMP Selected Plan*	
Mail	4	1	1	**2.3**	3240	Confluence with Fossil Creek, northwest from Fossil Park		Dependent on Fossil Creek 4-1 design
Fossil	5	1	1	**2.3**	1120	Between RR tracks and Trilby Rd		
Spring	6	Remove	Edora Dam	**2.2**	NA	Along north side of Edora Park, west of Riverside Ave		
Spring	7	1	6	**2.2**	780	Between Riverside Ave and Edora Dam	Construct new Edora Park Pond	Should be constructed at same time as Edora Dam removal.
Spring	8	3	2	**2.1**	1040	Directly west of Lemay Ave		
Fossil	9	2	1	**2.0**	1880	North of Trilby Rd partway through Paragon Point open space	Construct new WQ Pond in Prairie Dog Meadow NA	
Spring	10	Reconnect	to Poudre	**1.9**	NA	From confluence with Poudre River through Cattail Chorus NA		
Fossil	11	9	1	**1.9**	2130	From Applewood Estates pond through neighborhood to Shields		
Fossil	12	8	1	**1.8**	2020	From RR tracks through open space to Applewood Estates pond		
Stanton	13	1	1	**1.8**	4630	From confluence with Fossil Creek to Carpenter Rd	Construct new WQ Pond at Lemay Ave and Carpenter Road	

City of Fort Collins

MCDA Tool Results

City of Fort Collins

Combine Stream Restoration and BMPs_



Letter	Reach Description	Concept
A	Shields St To College Avenue	Retrofit Brookwood/Applewood Estates Wet Pond for Water Quality (EDBW-FC)
B	Shields St To College Avenue	Parallel Drainage System for PV&L Canal (ID)
C	College Avenue to Timberline Road	Parallel Drainage System for New Mercer Ditch and Larimer County No. 2 Canals (ID)
D	College Avenue to Timberline Road	Parallel Drainage System for Louden Ditch (ID)
E	All Reaches	Parallel Drainage Systems for Irrigation Discharges (ID)
F	Stanton Creek	Regional Water Quality Basin at Lemay & Carpenter Rd (EDBD-FC)
G	Stanton Creek	Conservation practices to Agricultural Areas (NS-BMP)
H	Stone Creek	Regional Water Quality Pond at College Avenue (EDBD)
I	Stone Creek	Retrofit Wetland Pond for Water Quality (EDBD-FC)
J	Stone Creek	Regional Water Quality Pond at Huntington Hills (EDBD)
K	Smith Creek	Retrofit Landfill Detention Pond for Water Quality (EDBD-FC)
L	Lang Gulch	Conservation practices to Agricultural Areas (NS-BMP)

Step 1 – Enter data into MCDA tool for each stream reach

Step 2 – Determine scores for each reach

Step 3 – Prioritize reaches based on score

Step 4 – Match tributary BMP's to prioritized reaches

Stormwater Master Plan Revisions

PUBLIC OUTREACH

- Booth at New West Fest – direct contact with 250 people, over 100,000 at festival
- Facebook, Twitter updates
- Website fcgov.com/stormwater-plan
- Utility bill mailers

Stormwater Master Plan Revisions

FUNDING CONSIDERATIONS

- Flood Control projects currently identified and funded using existing stormwater fees
- Approved Funding scenario;
  - Divert a portion of existing stormwater fees to Stream Rehabilitation / BMP projects – approx. $650K per year
- Pursuing one to two targeted grant opportunities

Costs

Streams

- Estimated $435 per linear foot
- Total length = 78,737 feet = 14.9 miles
- Total cost = $34,250,800

BMPs

- $30.3 million over 10 basins

April 2012 McClellands Creek – During restoration

August 2012 McClellands Creek – After restoration

City of Fort Collins

Next Steps in the Process

- Develop a new "Stream Rehabilitation Program" – Public Outreach, Irrigation Flow Management, Design, Capital Projects, Monitoring, Maintenance, Planning and Zoning
  - Ensure interaction between project reaches
  - Close coordination with irrigation companies, HOAs, CSU, School District, and individual property owners
  - Multi-disciplinary team approach to stream restoration design – environmental planners, engineers, environmental consultants, outreach educators

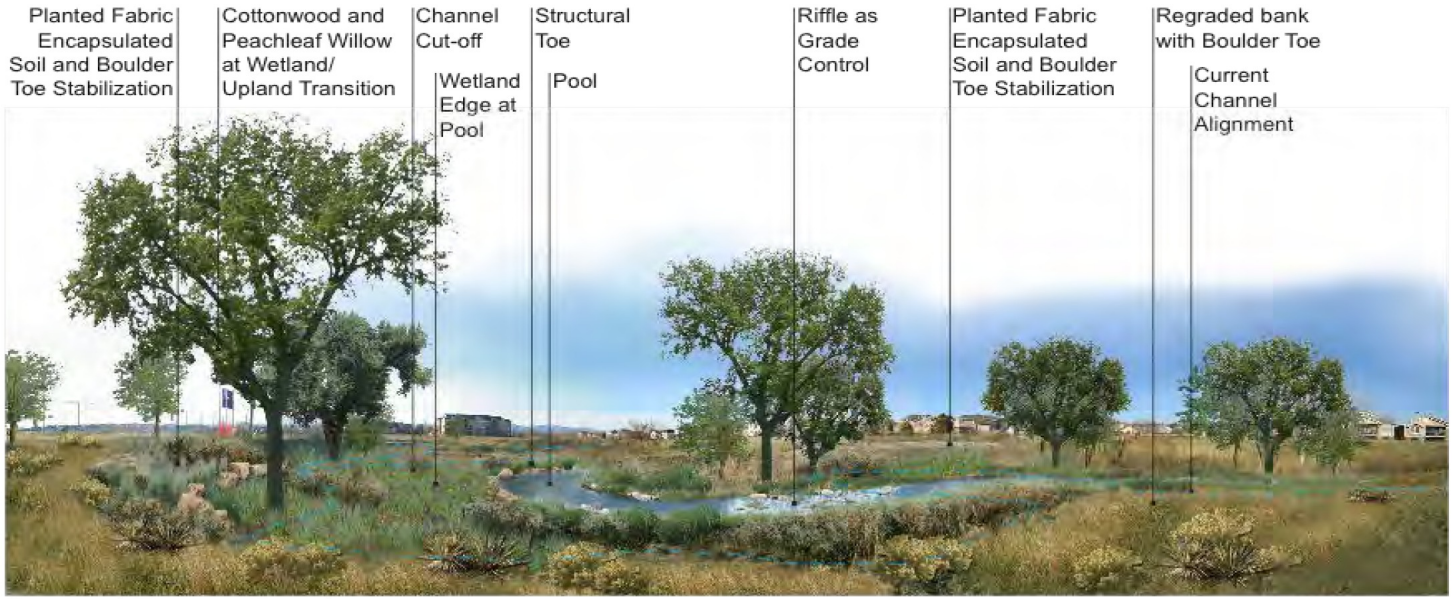
Next Steps in the Process (cont'd.)

- Develop a new "Stream Rehabilitation Program"
  - Develop new vegetation management and riparian buffer standards
  - Develop new stream monitoring and maintenance standards
  - Coordination with local environmental volunteer groups
  - Outreach regarding yard waste in streams

Current Project – Fossil Creek

Current Project – Fossil Creek

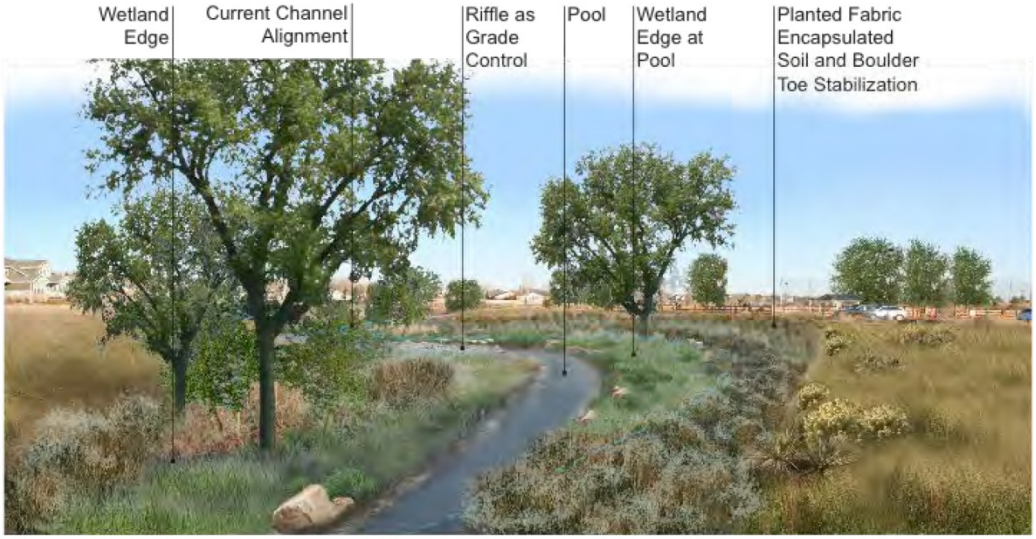
Current Conditions



Desired Future Conditions

Current Project – Fossil Creek

Current Conditions



Desired Future Conditions

Stormwater Master Plan Revisions_

QUESTIONS / FEEDBACK