

# US 36 Flood Recovery



*Emergency and Permanent Repairs from  
Estes Park to Lyons*

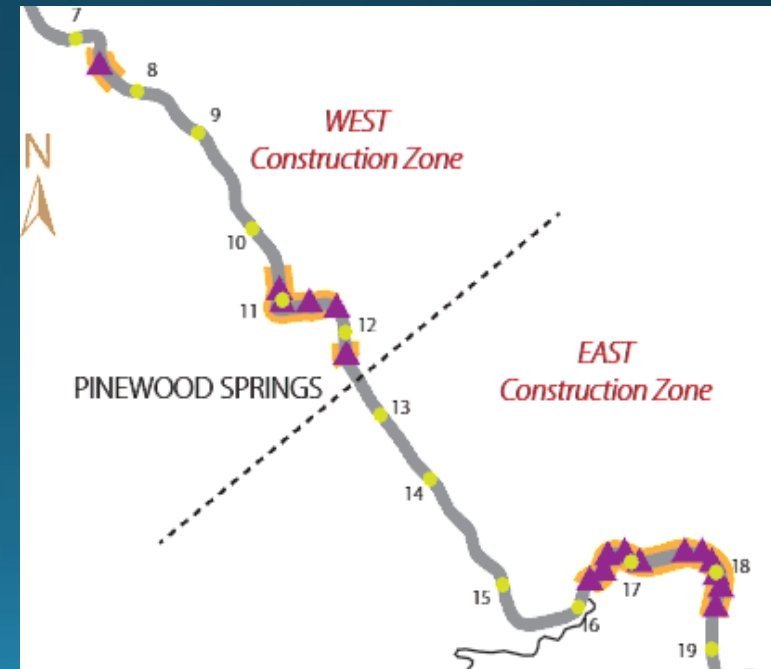
# The Flood

- September 2013 - flooding ravaged the State and caused wide-spread destruction to communities, rivers, and transportation systems
- CDOT was faced with an overwhelming challenge of repairing, rebuilding, and reopening almost 400 lane miles of flood-damaged roads and bridges to restore connections and help speed the recovery process
- The Estes Park community was stranded because the three highways accessing the town were washed out and impassable
- One of the most heavily destroyed roadway systems was US 36 from Estes Park to Lyons



# The Assessment

- 17 damaged sites from MP 7.7 to 18.6 were identified
- The river undermined the roadway embankment, in some places down to bedrock
- The washouts caused road sections, including asphalt, road base, guardrail, and signing, to collapse into the river
- Massive debris fields of uprooted trees, cars, river rock, sand, and a collection of private property from flooded houses were left in the river beds



# The Partnership



- Out of the box thinking and innovative collaborations were encouraged because the Department had never experienced such large-scale destruction
- CDOT contacted Central Federal Lands (CFL), a division of the Federal Highways Administration (FHWA), to pursue a partnering opportunity.
- CFL agreed to be a part of the US 36 reconstruction efforts and an agreement was executed in October 2013 to join forces.
- The CDOT/CFL partnership is the first known alliance in Colorado that involves state and federal transportation agencies collaborating on an emergency/permanent repair project

# The Mission

- Construct a safer and more resilient roadway that will ensure connection between Estes Park and the Front Range when another similar flood event occurs.

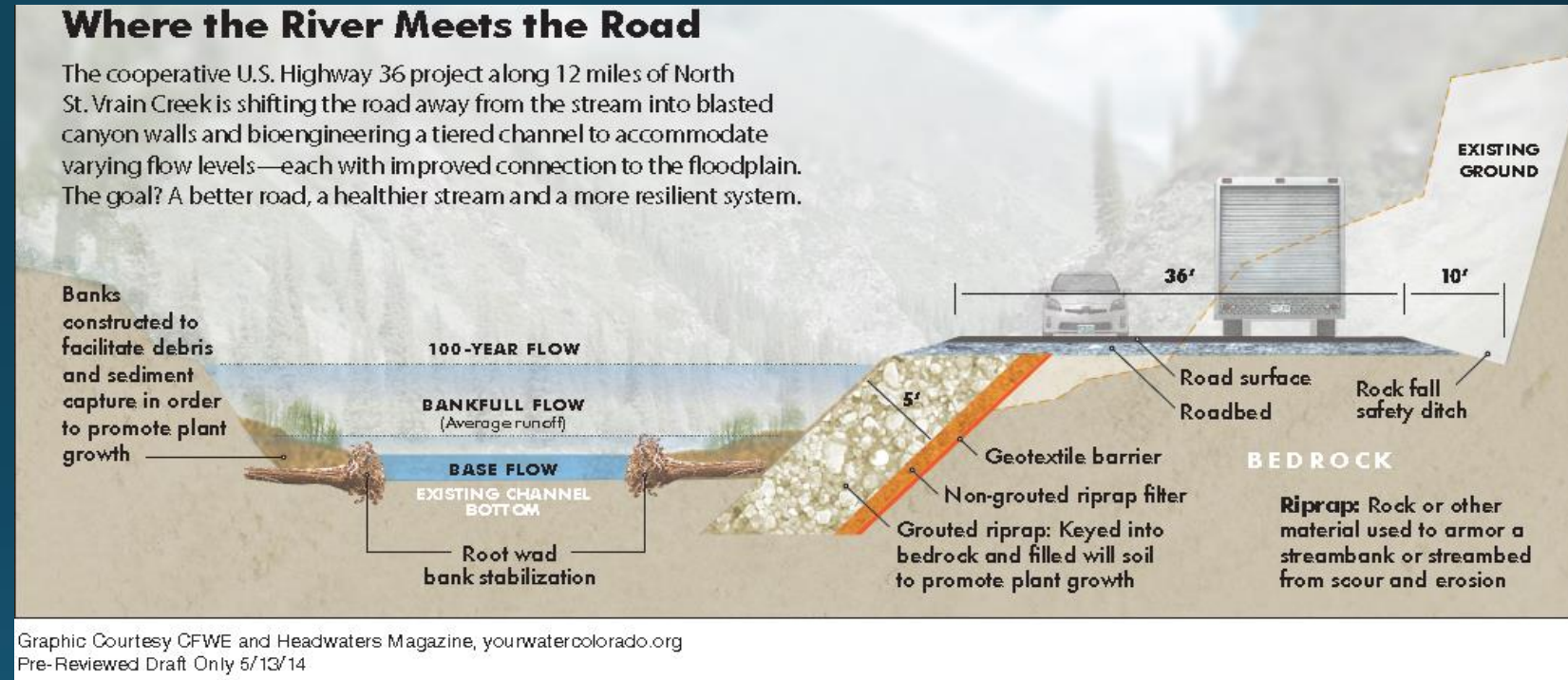


- Accident history was analyzed and problematic areas were identified and approved for safety improvements

# The Plan

The Project was split up into two phases:

- Phase I
  - Addressed the emergency repairs
  - January 2014 and was completed in July 2014
  - Involved repairing approximately three miles of roadway
  - Repairs included rock excavation and blasting, building up the subgrade, laying base, and paving the bottom mat of asphalt, armoring the road embankment with large rip rap (5'+ boulders) and restoring functionality to the stream to avoid future damage to the roadway during spring run off.
- Phase II
  - Addressed the permanent repairs
  - July 2014 and will be completed in October 2014
  - Included paving the final two mats of asphalt and installing guardrail, signing and striping
  - Rebuilt an approximate mile-long stretch of road as well as completing the stream restorations.



The Partnership Agreement involved CFL designing the project and taking the lead during construction on Phase I, with CDOT taking the lead on construction in Phase II.

# The Road



**BEFORE**

**AFTER**

Increased safety by:

- Added 6' shoulders in each direction
- Added 10' rock fall ditch to catch falling rocks from mountainside

# The Road



Shifted 5'-60' (average of 20') towards the mountainside



# The Road

Softened the Curves



**BEFORE**



**AFTER**

# The Blasting



- Approximately 250,000 cubic yards of granite was removed
- Two work zones totaling almost two mile blasting length

# The Blasting



This picture represents about 2% of the material that was moved by May

# The Excess Material



Coordinated with surrounding local agencies and other CDOT projects to move ~170,000 cubic yards to other flood projects

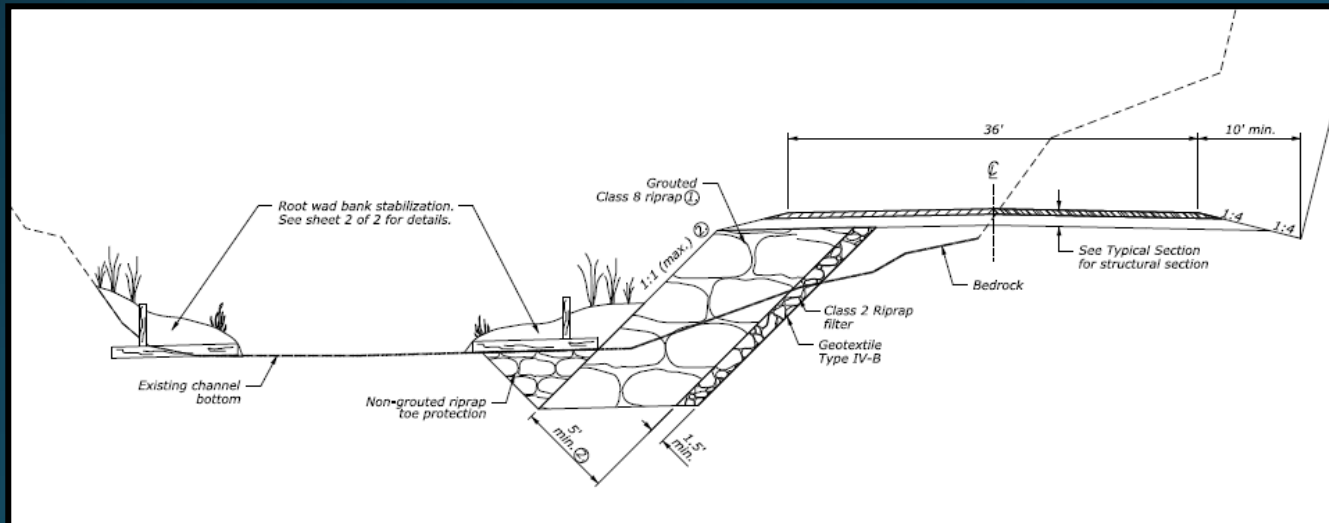
## Excess Material Coordination by Agency

Big Elk Meadows*
Big Thompson Conservation District
Boulder County - Maintenance
Boulder County - Parks and Open Space
Boulder County - Transportation*
Colorado Parks and Wildlife
Colorado Water Conservation Board*
CDOT - Maintenance
CDOT - SH 7*
CDOT - SH 34
Environmental Protection Agency*
Estes Park*
Forest Service*
Glen Haven*
Jamestown*
Larimer County*
Left Hand Water Conservancy District
Longmont
Lyons*
Natural Resources Conservation Service
Northern Colorado Water Conservancy District*
Rocky Mountain National Park
St. Vrain Water Conservancy District

\*denotes material received

# The Embankment Armoring

- Needed to armor before spring runoff because road was at risk
- Used material from blasting (large 5'-8' rocks)
- Keyed into bedrock at bottom of the river
- Spot grouted inside to lock in place



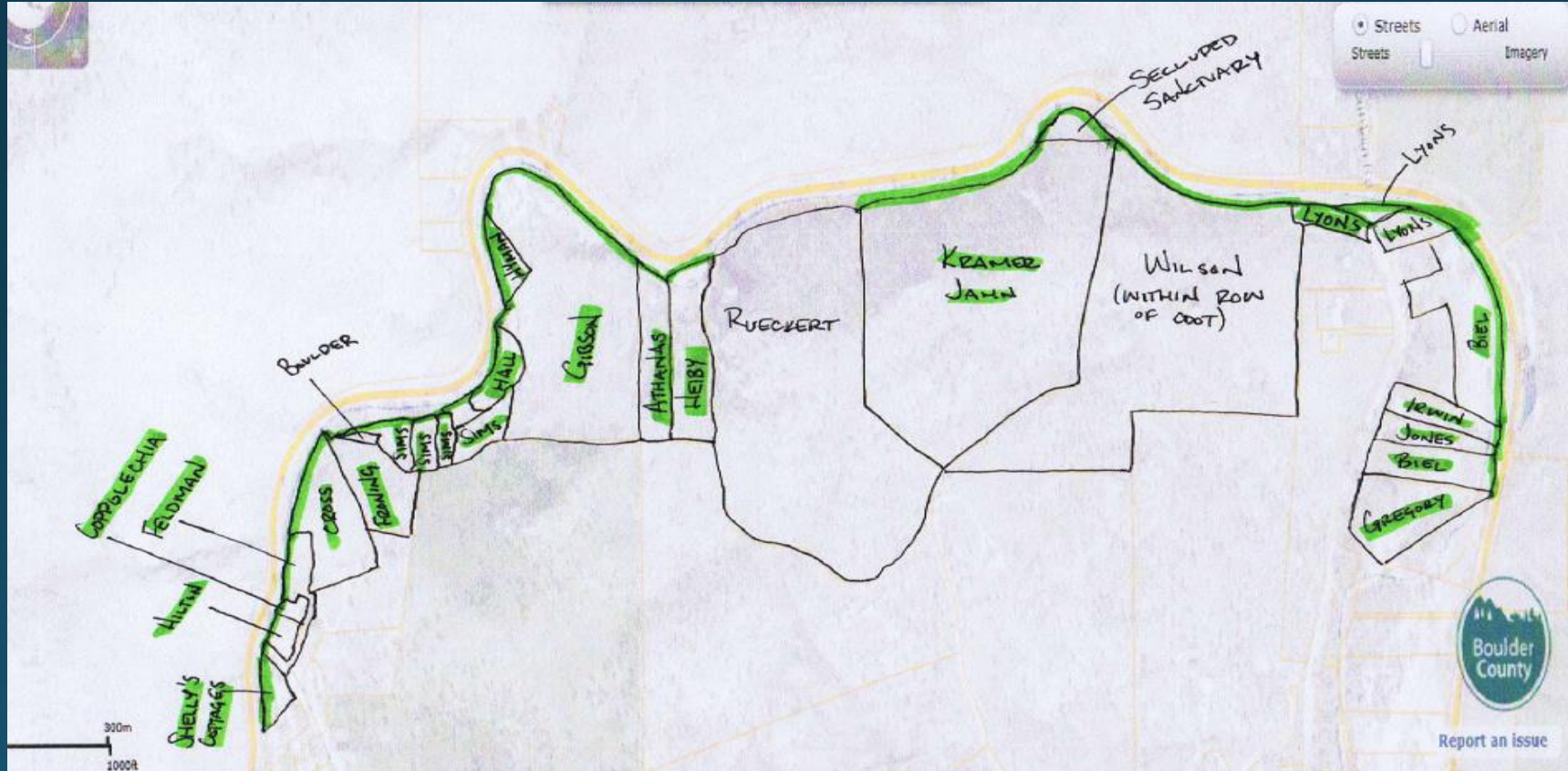
# The River



- Presented a unique opportunity to take a holistic corridor approach and partner with stream restoration experts while rebuilding the highway
- Sought out the Colorado Water Conservation Board (CWCB) and Crane and Associates to help guide the stream restoration efforts
- Identified how the river and road interact with each other
- Leveraged materials, equipment, manpower, and expertise onsite to responsibly rebuild the corridor
- Helped identify opportunities and best practices that mutually benefited multiple elements

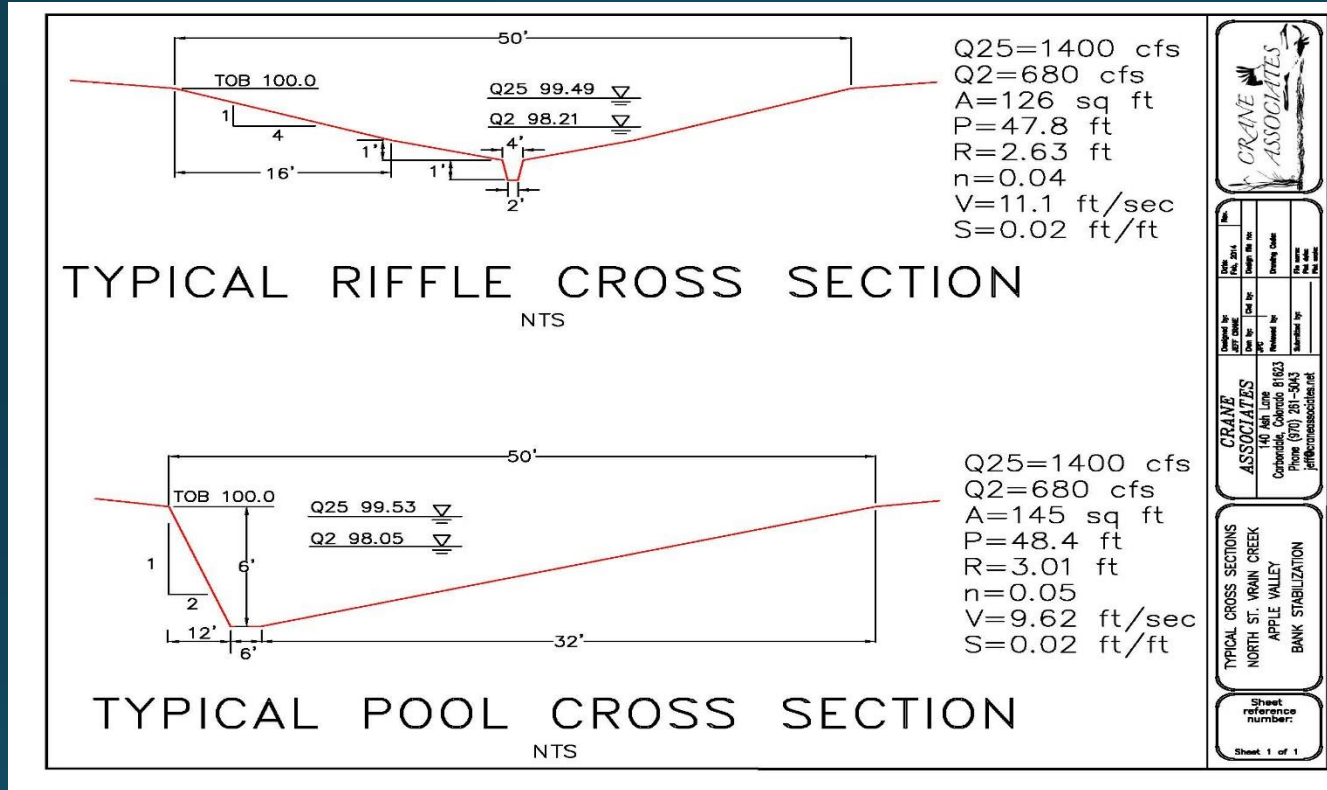
# The Private Properties

- Needed the ability to work on both sides of the channel, not exclusively within CDOT right-of-way
- Received signed "Permission to Enter" forms from:
  - North St. Vrain - 19 of the 20 property owners
  - Little Thompson – All three property owners



# The Field Fit

No hydrologic model was available with no time to build one

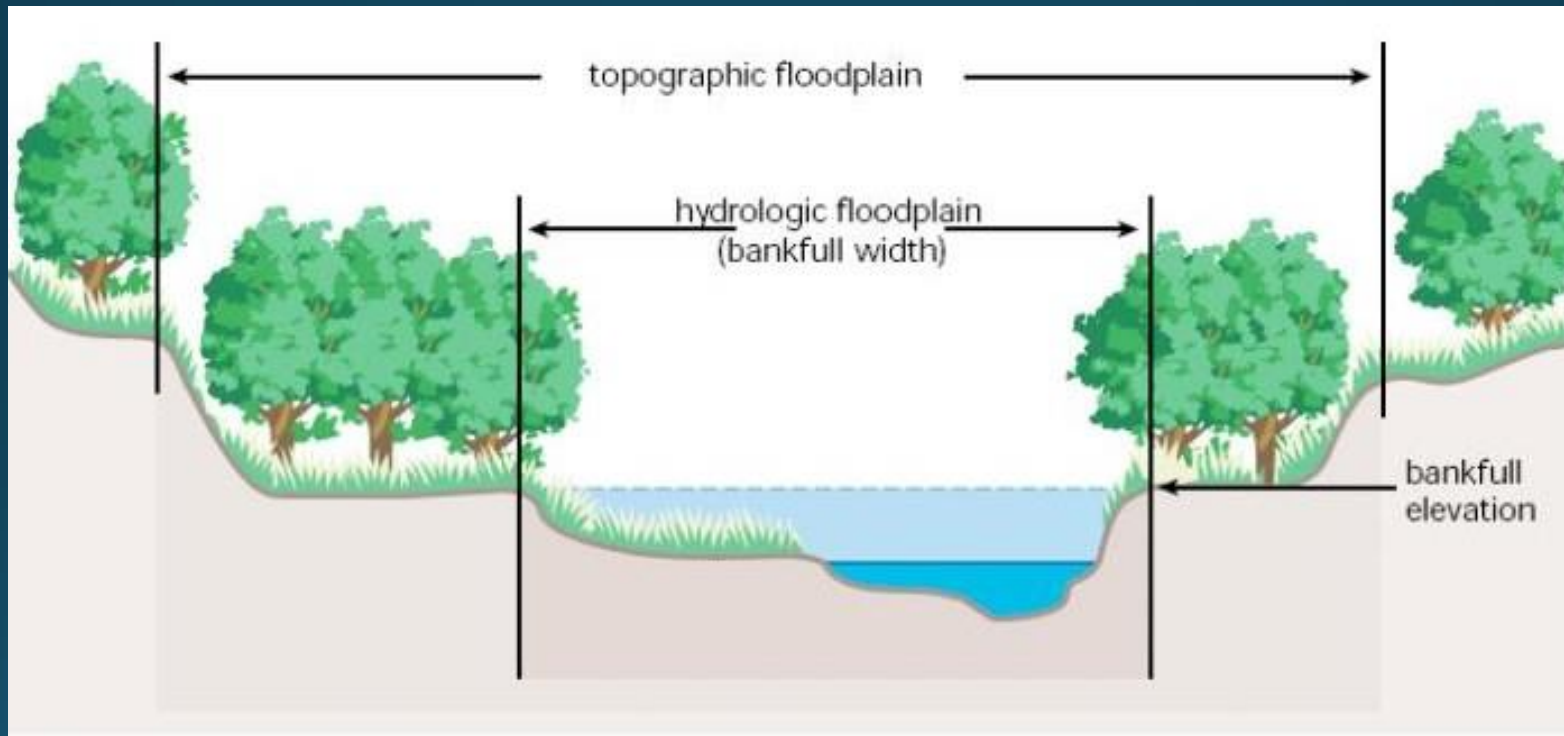


- Used GIS and Autocad data to prioritize structures and improvements
- Identified approximate channel dimensions for riffle and pool reaches, and bench heights for bar construction
- Designed for the 2- and 25-year events



# High Flow Channels

- Created in areas where ample space exists
- Helps define floodplain areas that will allow the river to responsibly expand in high flow events



Floodplain benches balance the low flow channel while allowing high water to access the floodplain and dissipate energy

# Low Flow Channels

- Improves aquatic habitat during base flow time periods
- Migrates within the existing high flow channel



# Channel Shaping

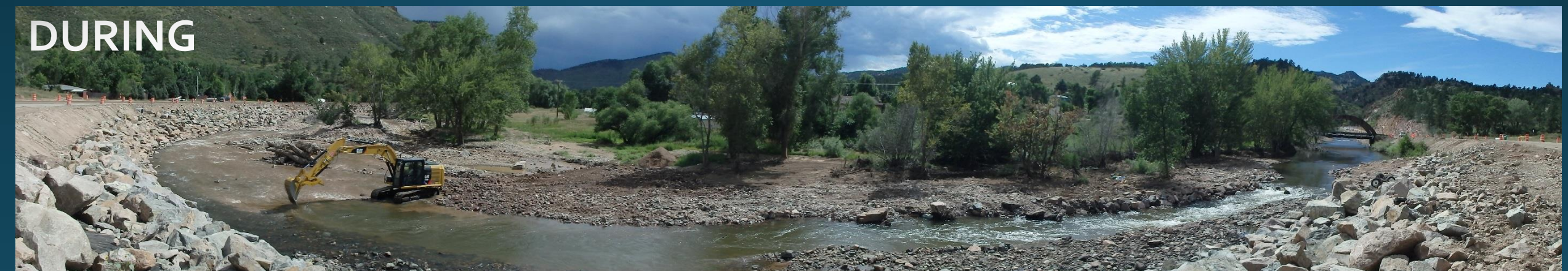


BEFORE

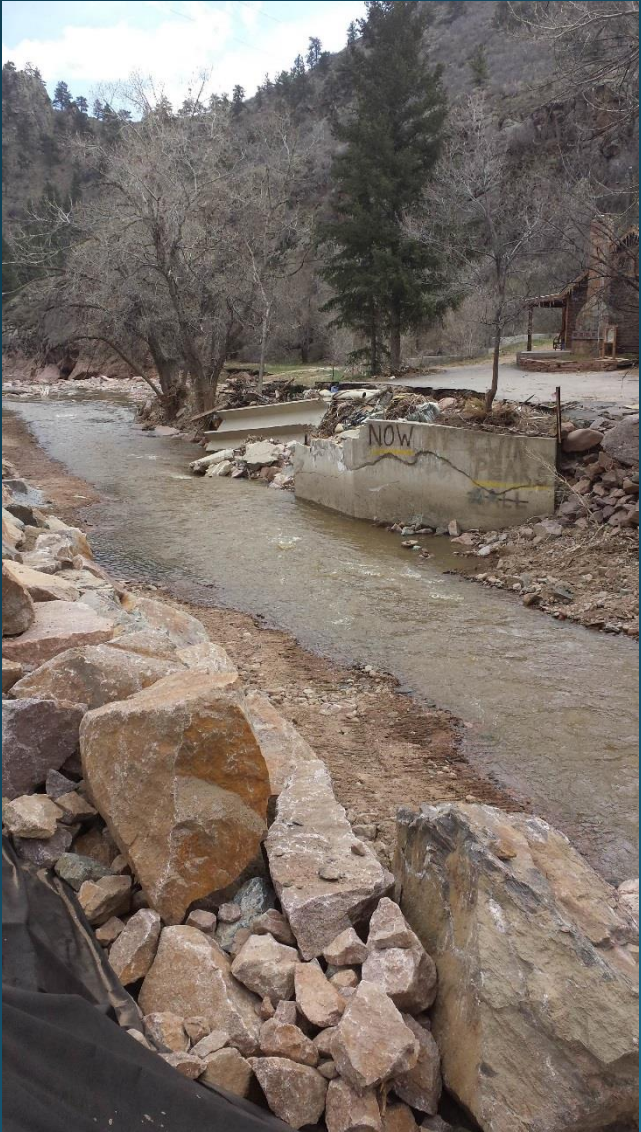


AFTER

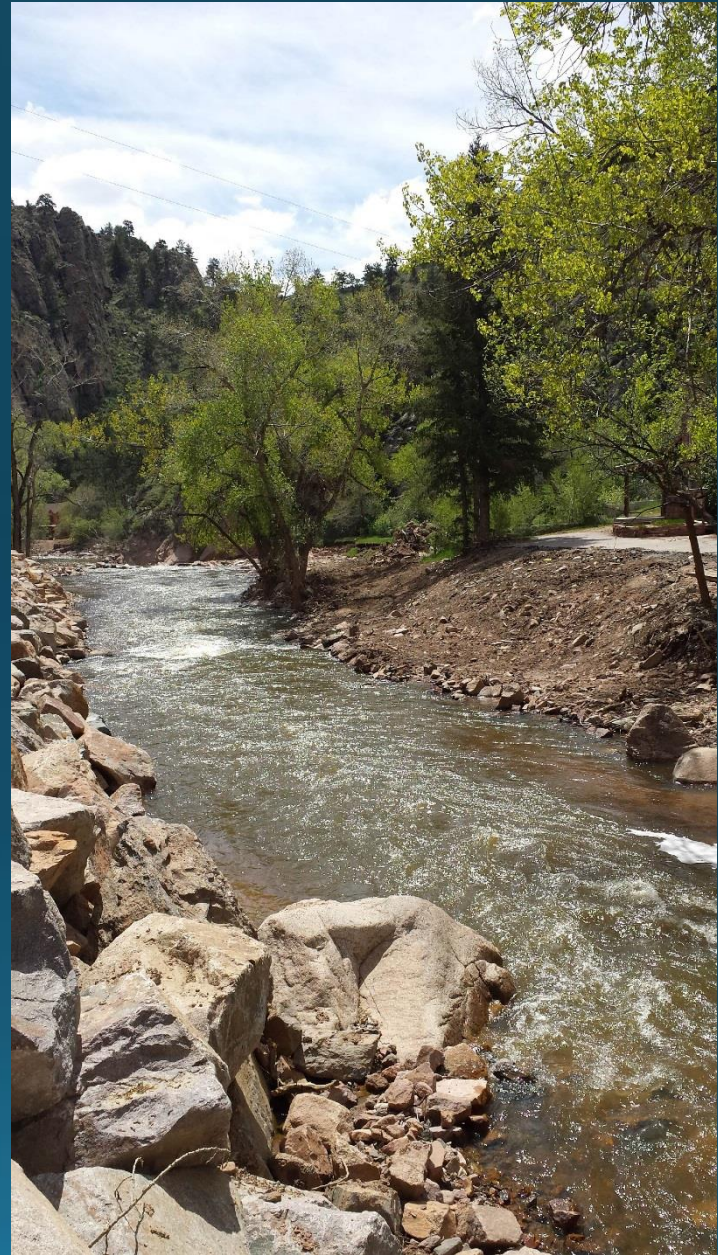
# Channel Shaping



# Constraint Removal



BEFORE



AFTER

# Energy Dissipaters

- Used Boulder clusters, large woody debris, and meandering low flow channels
- Mitigate undercutting and destruction from flood event
- The lower 20% of the river carries the highest velocity and can cause the most destruction



# Point Bars

- Constructed at most sites to reduce the width to depth ratio of the low flow channel
- Increase floodplain capacity while adding complexity to the channel
- Used large buried rocks and logs



# Root Wads

- Assist with Bank Stabilization
- Aid in silt deposition
- Create fish habitat





# Habitat Promotion

- Riparian
- Animal
- Fish
- Plant



# Recreational Opportunity

- Removal of recreational hazards
- Passive Accesses
- Master Plan will define future opportunities

