COLORADO
Department of Transportation

REBUILDING COLORADO AFTER 2013 FLOODS

2016 WASHTO Construction & Materials Subcommittee Annual Meeting

Agenda

- 2013 Event
- CDOT Flood Goals
  1. **Efficient Project Delivery**
  2. Maximize Eligible Funding
  3. **Mitigate Audit Risks**
  4. Good Data & Document Management
  5. Effective Communication
  6. **Build Back Better: Risk and Resiliency**

September 2013 Event

- Catastrophic flooding along Colorado's Front Range from Colorado Springs north to Fort Collins
- Impact area 200 miles x 50 miles
- 486 miles of state highway closed
- 200+ bridges and culverts damaged
- 120,000 cubic yards of debris removed
- Over $3B in Statewide damages

September 2013 Flood Event

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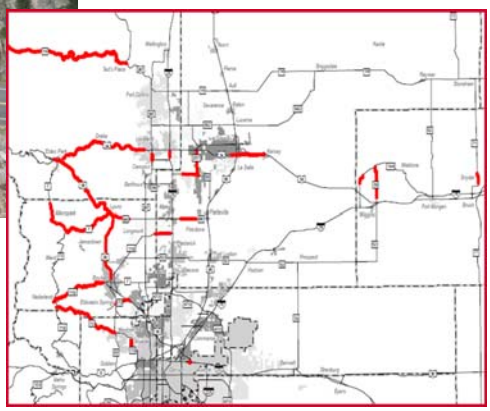

- 2000 Helicopter Evacuations
- Citizens cut-off from basic life necessities
- Loss of Home, Food, Water, Community, Work, and Life

Incident Command Center

- Incident Command System (ICS) System
- Mission, Leadership & Battle Rhythm
- Building the Right Team – CDOT blended team approach
- Identify your structure, staff and logistics plan today

Goal 1: Efficient Project Delivery

Goal 1: Efficient Project Delivery: Emergency Repairs

Goal:

- Restore essential traffic

Best Practices:

- Understanding Scope & Scale of Damages
- Structures Inspections

Lessons Learned:

- Have consultants and contractors on stand-by contracts
- Payments –T&M with Cap/Force Accounts vs. Unit Pricing

Goal 1: Efficient Project Delivery Debris

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Best Practices:

- Rapid mobilization
- Clarified "Map-21" eligibility
- Co-Located in ICC
- Hired specialty contractor

Lessons Learned:

- Understand FEMA pilot programs
- Get Debris Management Plan in place
- Needed contractor with experience in CO's conditions/environment
- Consider standby contractor and debris monitor
- Identify responsibility for debris in waterways

Goal 1: Efficient Project Delivery

Best Practices:

- Met Gubernatorial Directive – Open Roads by 12/1/2013
- Mobilization of Contractors
- Race against winter
- **$90M in construction in fewer than 90 Days**

100%
Reopen
November 26, 2013

Goal 1: Efficient Project Delivery: Permanent Repairs

Goals:

- Smart rebuilding
- Resilient
- Better data collection
- Initiate CDOT/CWCB Hydrology Analysis
- Rebuild PR by 12/17

Best Practices:

- Program planning & budget prioritization
- Normal operations with flood recovery office direction and support
- Environmental Stewardship
- Resiliencies

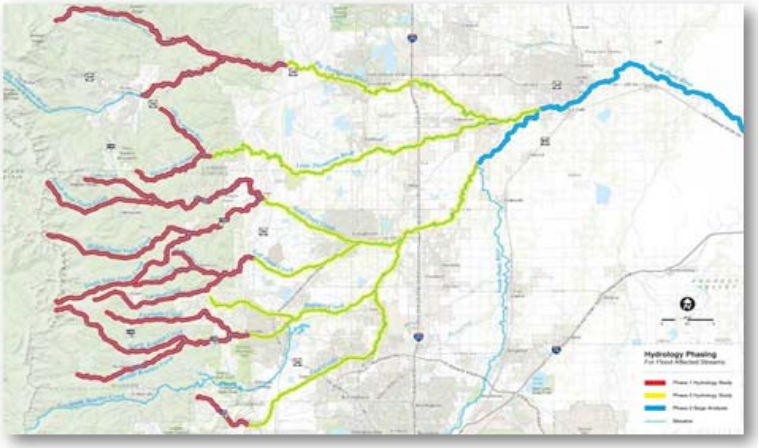
Stream Teams

CWCB - Colorado Water Conservation Board and local communities establish coalitions to develop Watershed Master Plans

CDOT providing hydrologic evaluations for the various watersheds

CDOT and CWCB Hydrology Analysis

Transportation & Watersheds Treated as a System



CDOT and CWCB Hydraulic and Hydrology Analysis

Finding: New Needs Emerged

- Roadway Overtopping
  - "Controlled" overtopping points
  - Anticipate overtopping in Eastern Plains to S. Platte

  What materials can be used to design these overtopping locations to safely convey flows and recover from large storms?

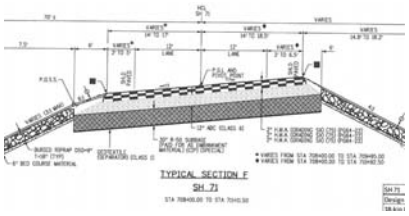
- Bridge Replacements
  - New risks have been identified post 2013 flood
  - Aging Infrastructure: More work will likey take place in the future to replace structures and reduce risk

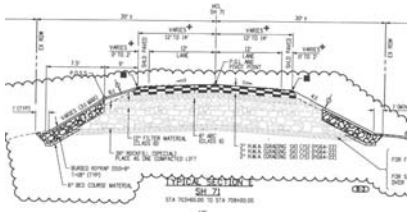
  How can we utilized pre-cast and other construction techniques to reduce downtime and roadway closures?

2015 High Water

SH 71

Best Practice Established





Goal 2: Optimize Eligible Funding

Best Practices:

- Build Good Relationships with Federal Partners
- Understand Eligible Funding/Scope
- Document Damages
- Align Project Delivery to Eligible Funding
- Memorialize Policy Decisions
- Ensure Compliance

Lessons Learned:

- Build systems to support compliance now

Goal 3: Mitigate Audit Risks

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Best Practices:

- Procurement
- Contracting/Pricing
- Compliance: NEPA, EEO, Buy America, Davis Bacon, Form 1273
- Local Agency Education & Support

Lessons Learned:

- Establish Disaster Policies and Procedures Today
- Train and Exercise Plan

Goal 3: Mitigate Audit Risks: Buy America Rules

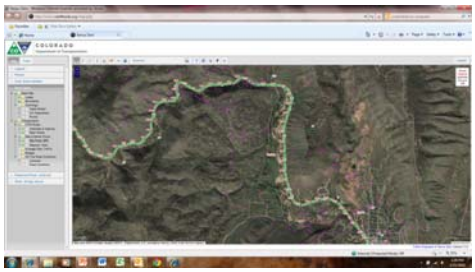
Lessons Learned:

- Buy America Compliance:
  - *Stricter Federal rules* on steel and iron
  - Complete paper trail required from sourcing and fabrication through installation for Federal reimbursement
  - Applies to all Federally funded jobs including FHWA Emergency Relief & FEMA funds

Goal 4: Data/Document Management

Best Practices:

- Inbound data from the flood
- GIS platform & maps
- Program management dashboard
- Photo management
- Document control
  - System selection
  - Documents aligned to compliance



Lessons Learned:

- Identify and test systems today

Goal 5: Effective Communications

Best Practices:

- Understand your role to report to the public
- Importance of reporting to governor, congressional delegation, federal, state, & local partners
- Cultivate meaningful partnerships

Lessons Learned:

- Identify staff and procedures for situation reports and other damage and response/recovery reporting

US 34 Big Thompson Canyon
Permanent Repair Collaboration Partners

- US Federal Highway Administration
- US Forest Service
- US Fish & Wildlife Service
- US Army Corps of Engineers
- US Bureau of Reclamation
- Larimer County
- City of Loveland
- Town of Estes Park
- Big Thompson River Restoration Coalition
- Colorado Parks & Wildlife
- Colorado Department of Natural Resources
- Colorado State Historic Preservation Office

Goal 6: Build Back Better – Risk and Resiliency

What is Resilience?

Resilience *is the ability of communities to rebound, positively adapt to, or thrive amidst changing conditions or challenges – including disasters and climate change – and maintain quality of life, healthy growth, durable systems, and conservation of resources for present and future generations*

- Definition of Resilience by the State of Colorado

Resilience: the *New* Business as Usual

- Includes extreme weather events, human-caused threats and accidents, and climate change
- Incorporated in infrastructure and buildings nationwide and worldwide
- ***Colorado Resiliency Framework*** signed by Governor Hickenlooper in May 2015

Extreme Weather & Climate Impacts

- Anticipated changes
  - Major events: intensity, scale and magnitude
  - Massive rainfall (20" in 24 hrs Powell, TX from Patricia 10/24/15)
  - Extreme flooding (CO 2013 flood)
  - Droughts (2012 North American Drought)
  - Extreme Winter Storms (NE "Snowmageddon" 2014)
  - Extreme high-heat conditions (AZ 30 consecutive 100° days)
  - Hurricanes (Sandy, Katrina, 2004 Florida season)
- Continued development in high-hazard areas
  - Example: Erosion in canyons outside existing floodplain

So What?
Implications for Material Performance

- Concrete or Asphalt needs to perform regularly in extreme heat and cold conditions
- Concrete needs to tolerate more force than current design codes and standards
- Structures not designed to sit in water need to tolerate weeks and months underwater
- Concrete needs to perform with weeks and months of brackish water inculcation without loss in strength or rebar failure
- Concrete or Asphalt needs to tolerate extreme conditions for long periods of time

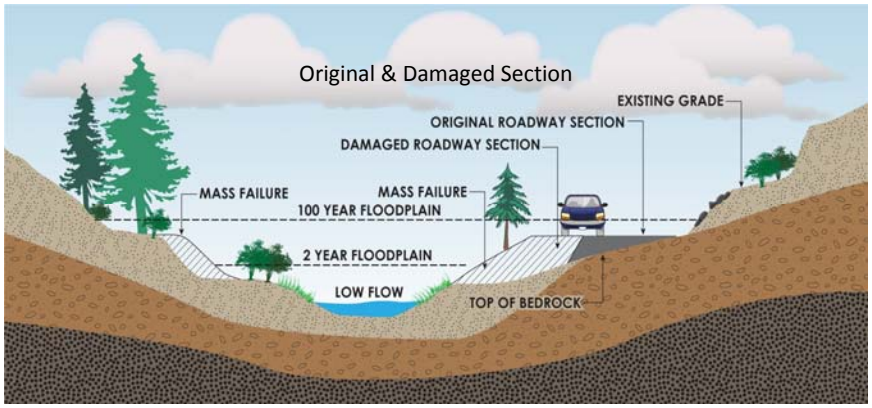
What existing and new methods can be used by the industry to help solve these pressing challenges?

Trends in Resilience

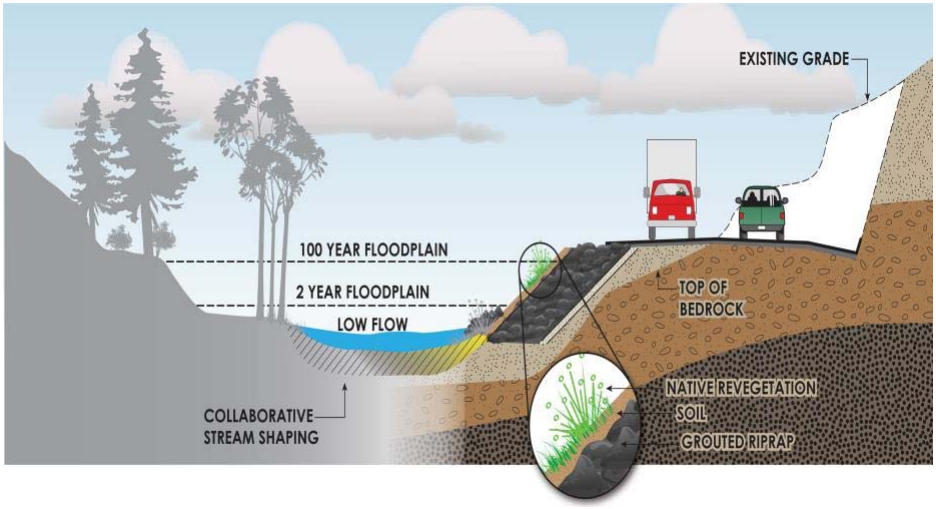
- Interface between infrastructure and the natural environment
  - Systems approach to reconstruction - Looking at the roads, bridges, rivers, and natural environment as a system
  - Making room for the water
  - Requires a more natural and integrated approach to design solutions (not just concrete drop structures, etc.)

How can the construction industry move the needle forward on tying into natural solutions that accommodate larger events?

Repair Philosophy



Repair Section



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Example: US 36 Stream Work

- Moved road over
- Moved river back
- Room for river to spread out
- Reinforced banks
- Root wads

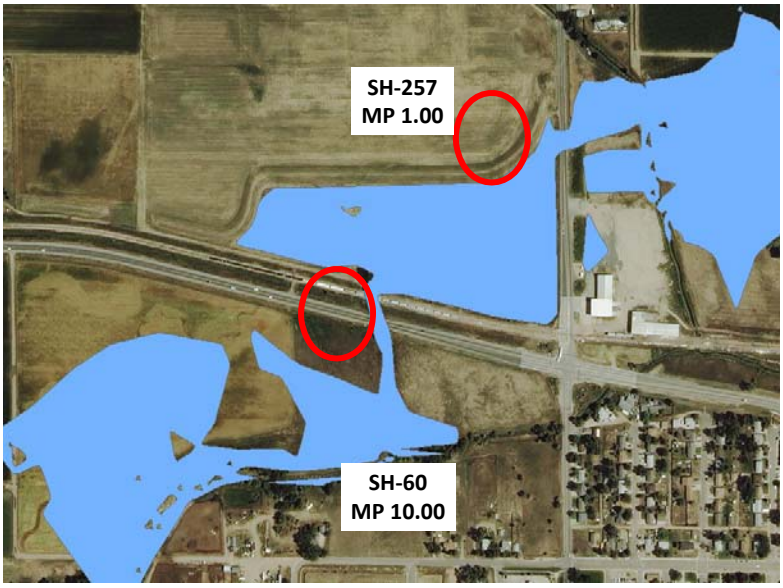
CDOT's Approach to Risk & Resiliency (RnR)

- CDOT pilot with FHWA
- Annualized monetary risk to each asset from identified threats
- Measure vulnerability of each asset
- Measure asset criticality to prioritize investments

CDOT Risk & Resiliency (RnR) Pilot

- For management and decision making purposes **risk** is best reflected as a annualized monetary expected loss from threats based on asset design, characteristics and vulnerability
  - Simplifies decision making
  - Allows for assets to be analyzed/assessed with similar metric
  - Easy for non-technical staff and decision makers to understand
- **Resilience** is reflected as a measure of loss of service
  - Can be quantified in revenues lost or economic impact from the loss of essential traffic

100yr Flood Zone for SH-60/257 Corridor (HEC-RAS)



SH-60 & SH-257 System Analysis
MP 10.00 (SH-60) to MP 1.00 (SH-257)

SH-257 bridge over Little Thompson River

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Risk and Resiliency Approach

Requirements to Monetarily Assess Risk

- Vulnerability – how vulnerable is an asset to an identified threat?
- Factors affecting vulnerability:
  - Asset age and condition
  - Countermeasures implemented to reduce vulnerability
  - Interdependence between CDOT and non-CDOT assets

Example

Bridge asset withstood threat, however, approach roadway failed. *Is this acceptable?*

Resilience Measure

- Able to compare the expected loss of service between design alternatives for any given year for any specific threat
- Resilience is a measure of the future impact to the asset

Pay now, or pay later!

Risk and Resiliency Findings

- RnR process provides one important piece of information used in the decision making process
- Other considerations include:
  - CDOT long range plan
  - Availability of funding match
  - Severe vs. non-severe damage designation
  - Engineering judgment
  - Inclusion of resiliency standards into a DOT's Asset Management Plan

Building a Culture of Resilience

How can you help? **Questions facing the industry**

- Innovations in materials – what is the industry developing that can improve infrastructure resilience?
- Green Infrastructure – As Colorado and other states move toward blending infrastructure improvements with the natural environment, what industry adaptations are necessary to support the changes?
- Affordability of mix designs in the RnR discussion – what products are available that support the RnR objectives?
- How do our infrastructure assets fair in peak flows and prolonged water exposure?

Building a Culture of Resilience

- Colorado Adopts *Statewide Resiliency Framework*, May 2015
- Preparing for probabilistic and maximum credible events & reducing downtime for systems and critical assets
- Regional model of resilience
- Leveraging wins by aligning policies and resources
- Having a Risk Based Asset Management Program
- Resilience initiatives yield triple-bottom line benefits
  - Impacts to people and community
  - Environmental sustainability (above NEPA)
  - Economic stabilization & growth

Thank you

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