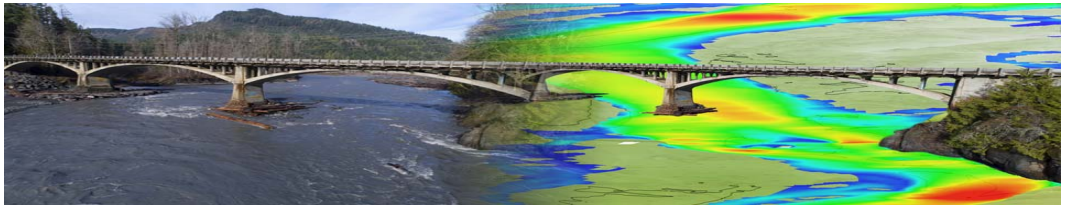
Collaborative **H**ydraulics: **A**dvancing to the **N**ext **G**eneration of **E**ngineering
C.H.A.N.G.E.

U.S. Department of Transportation
Federal Highway Administration



On-Ramp to Innovation
every day counts

EDC-5 Orientation Webinar

September 11, 2018

Image by John Gussman / FHWA

What is *"Every Day Counts"*(EDC)?

State-based model to identify and rapidly deploy proven but underutilized innovations to:

- ✓shorten the project delivery process
- ✓enhance roadway safety
- ✓reduce congestion
- ✓improve environmental sustainability

- EDC Rounds: two year cycles
- Initiating 5th Round (2019-2020) - 10 innovations
- To date: 4 Rounds, over 40 innovations

For more information: ***https://www.fhwa.dot.gov/innovation/***

FAST Act, Sec.1444

Innovation Deployment News

EDC News Weekly Newsletter

Weekly newsletter

INNOVATOR Accelerating Innovation for the American Driving Experience

Bi-monthly magazine

To Subscribe:

Email: https://www.fhwa.dot.gov/innovation/

Text: Send **"FHWA Innovation"** to **468311**

CHANGE Team

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Image Source: FHWA

What is CHANGE?

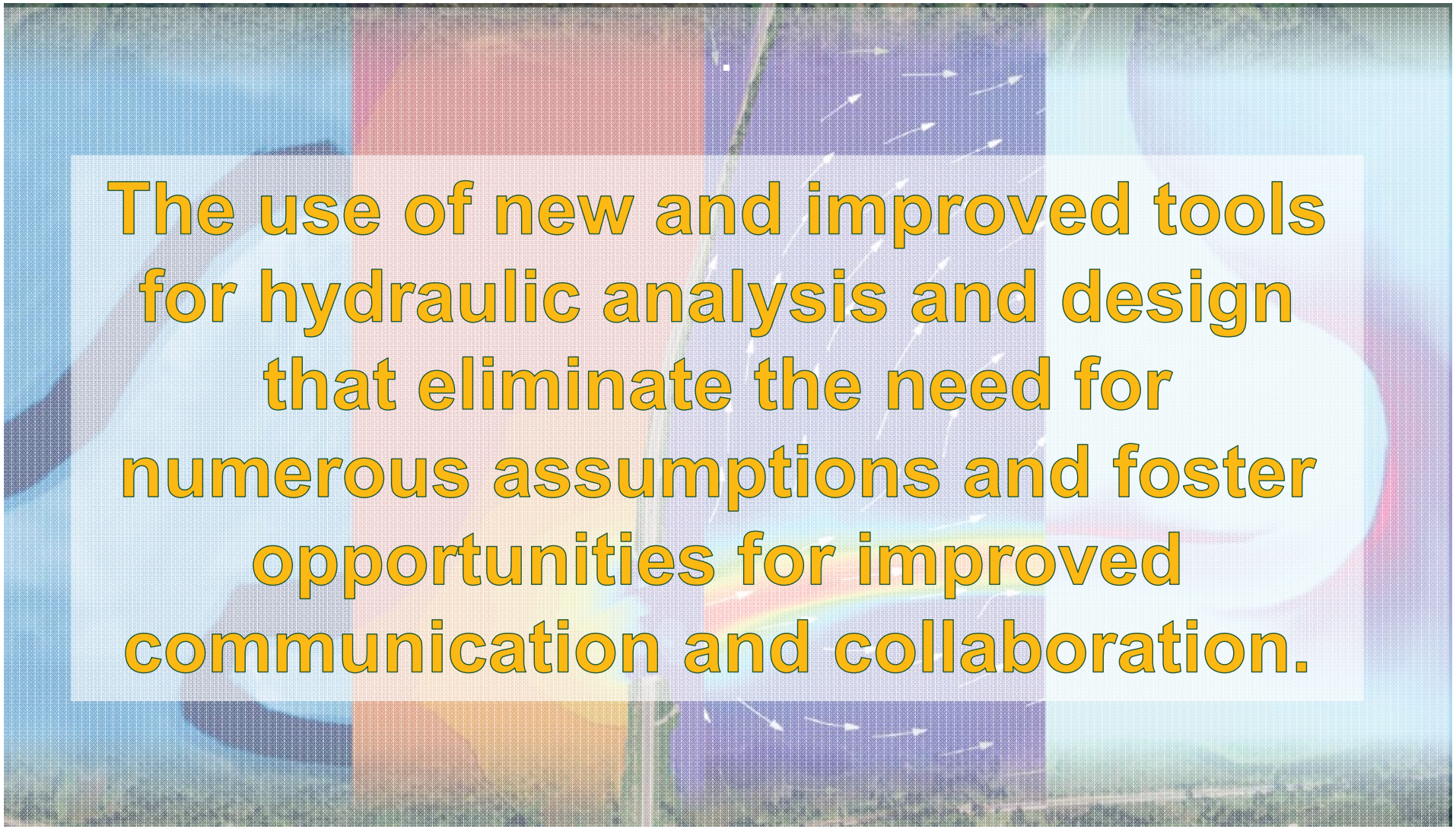


Image Source: FHWA

Why are we concerned about bridge hydraulics?

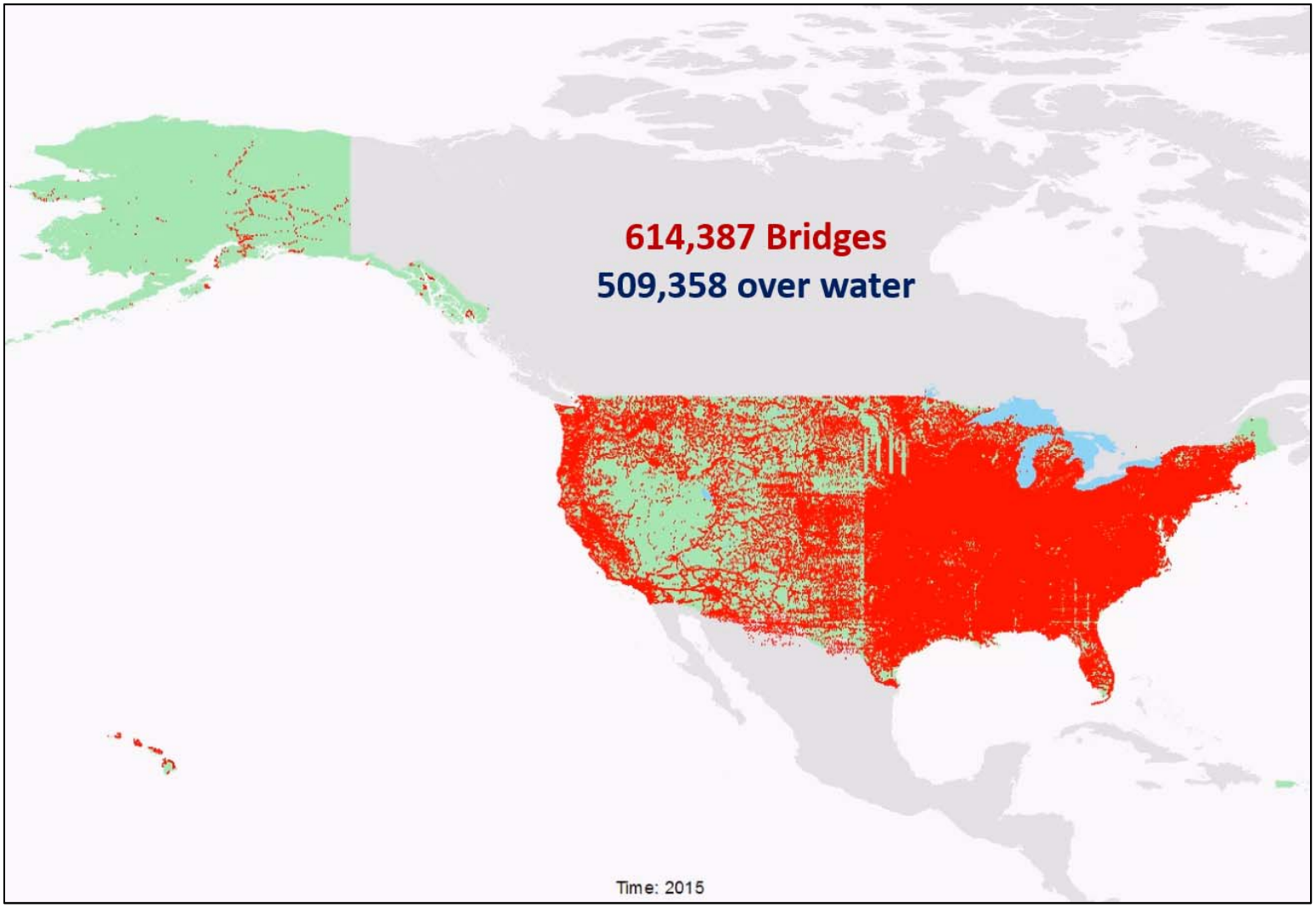
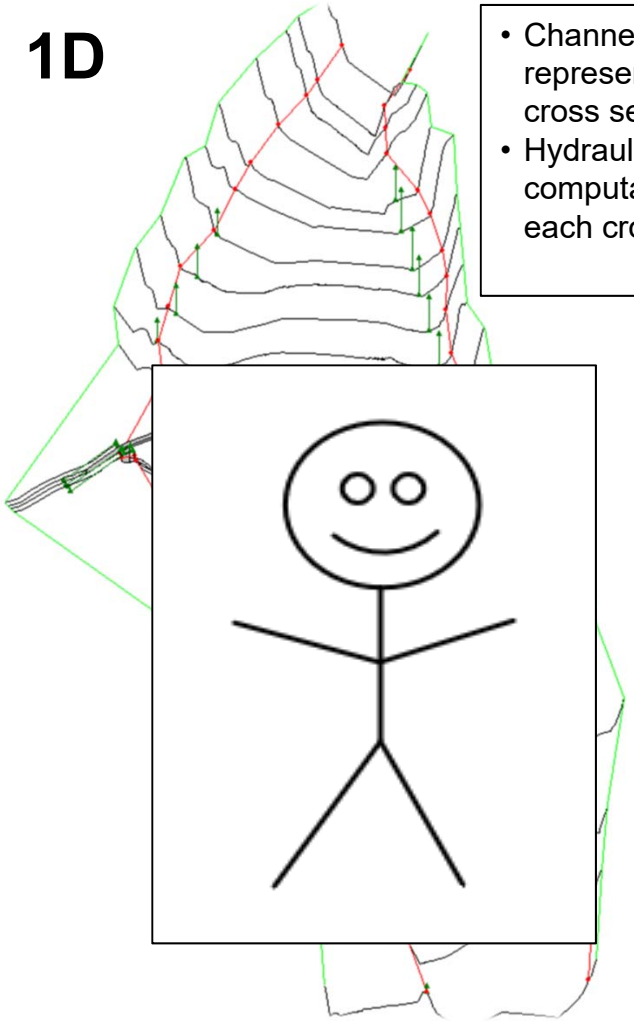


Image Source: FHWA

1D versus 2D Modeling

1D

- Channel geometry represented by cross sections
- Hydraulic computations at each cross section



Flow

2D

- Channel geometry represented by thousands of elements
- Hydraulic computations at each element

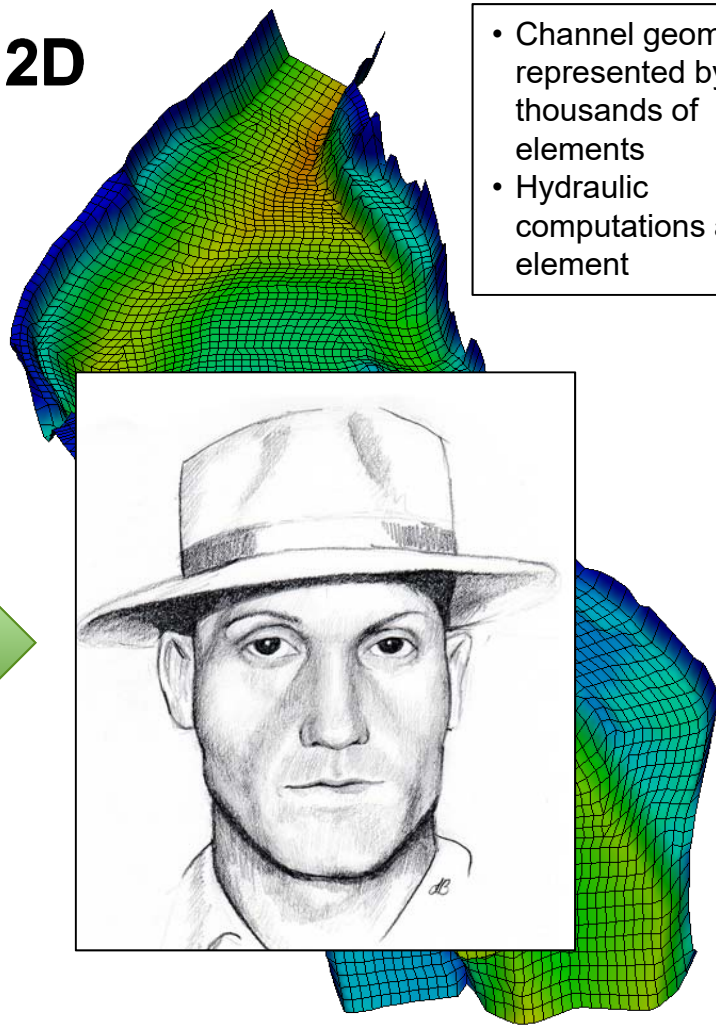
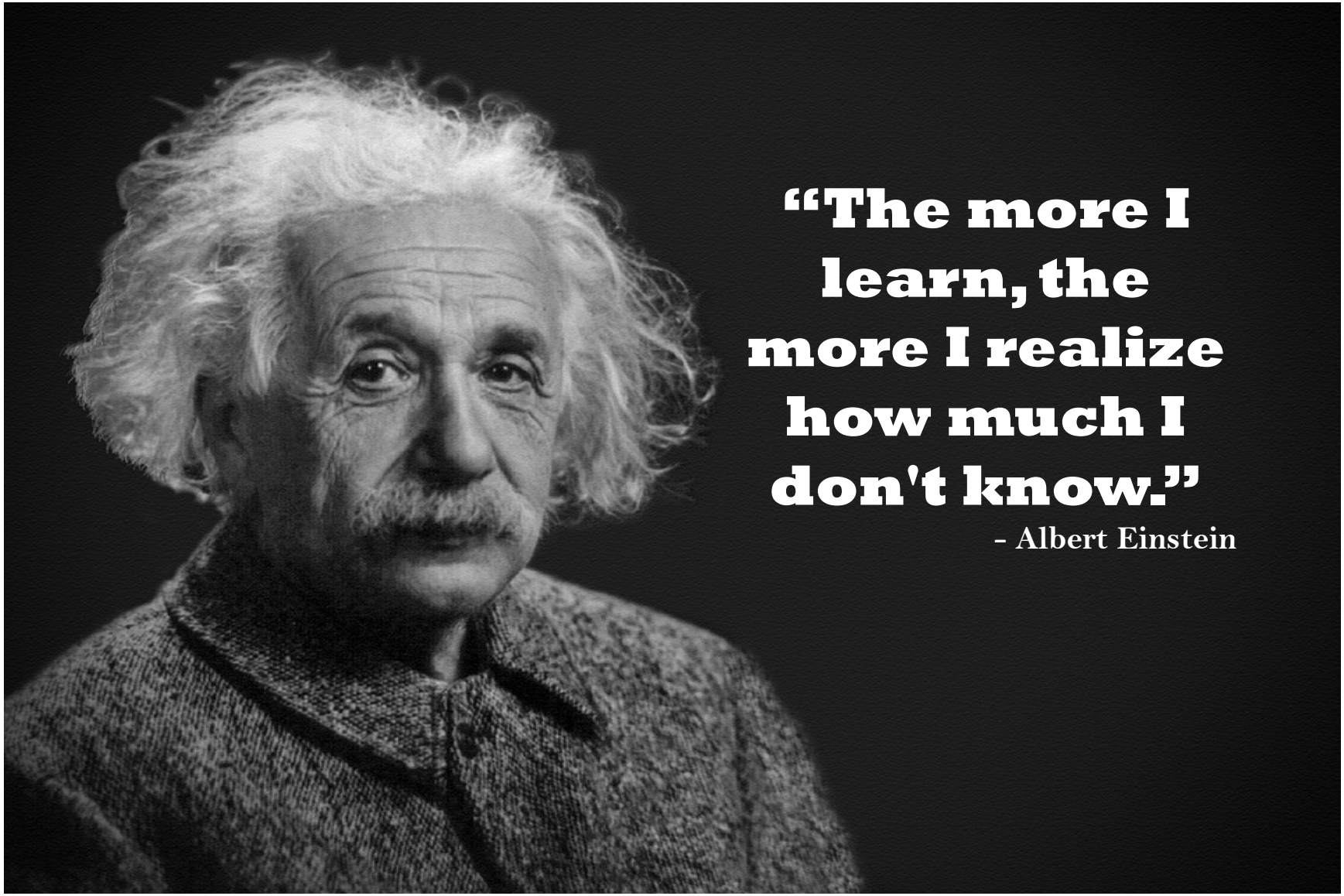


Image Source: New Hampshire DOT/ Wikimedia Commons stick figure by Jleedev / CC by 2.0 1940 mugshot | by Ask A Forensic Artist

1D versus 2D Modeling

Hydraulic Variables	One-dimensional (1D) Modeling	Two-dimensional (2D) Modeling
Flow direction	Assumed by user	Computed
Flow paths	Assumed by user	Computed
Channel roughness	Assumed constant between cross sections	Computed at every element
Ineffective (blocked) flow areas	Assumed by user	Computed
Flow contraction and expansion through bridges	Assumed by user	Computed
Flow velocity	Averaged at each cross section	Computed at each element
Flow distribution	Assumed based on conveyance	Computed based on continuity



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1D versus 2D Modeling

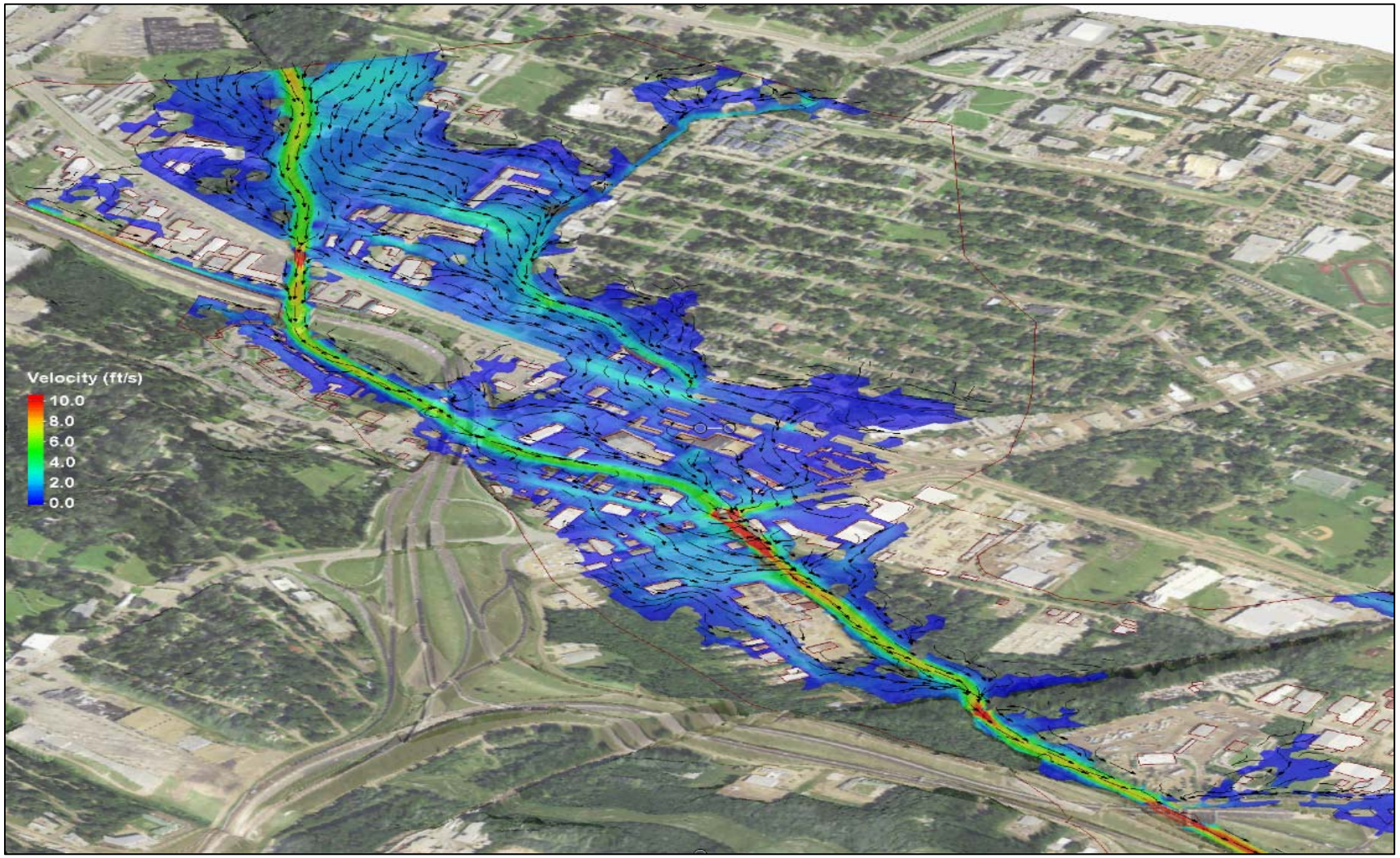

Image Source: Mississippi DOT / Earthstar Graphics

GOAL for EDC CHANGE

Widespread use and application of two-dimensional hydraulic modeling and tools to advance project delivery by improving quality and promoting collaboration within an organization and with stakeholders.

EDC CHANGE Outcomes

- Improved design efficiency
- Greater reliability
- More effective communication
- Enhanced infrastructure safety and resilience

Target Audience

- DOT hydraulic engineers and their consultants
- Project design team members including structural engineers, roadway designers and environmental specialists
- Counties and municipalities
- Resource agencies
- Floodplain administrators

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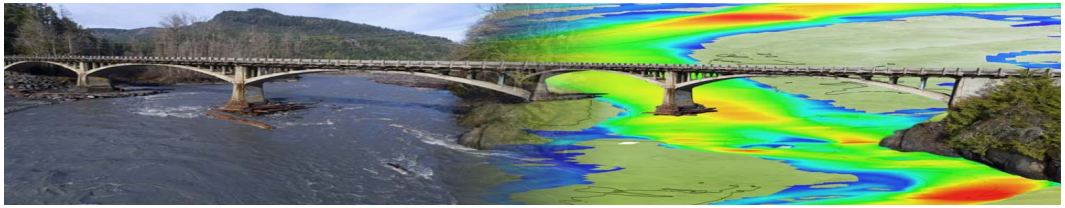

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EDC-4 CHANGE Recap

Image by John Gussman / FHWA

States Participating in CHANGE (EDC-4)

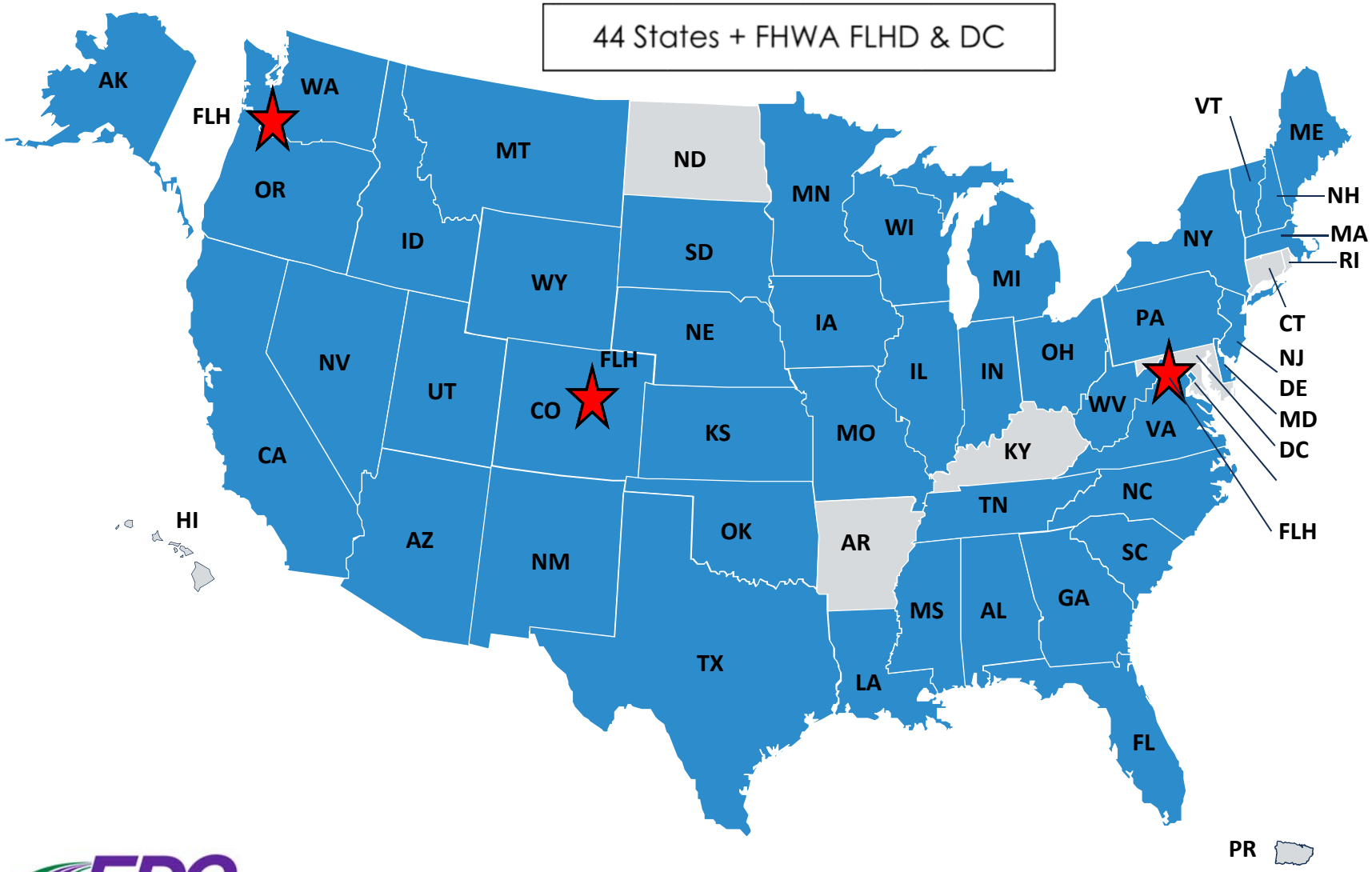

Image Source: FHWA

What was accomplished through EDC-4?

- Training – NHI 2D hydraulic modeling course #135095
  - 40 courses taught, over 900 participants
- Advanced online training – NHI courses #135095 A&B
  - 10 courses, over 200 participants
- 2D Hydraulic Modeling User's Forum webinars
  - Webinars presented bi-monthly, over 500 current participants
- Technical support
  - Through the EDC CHANGE Team and our consultants

What was accomplished through EDC-4?

- Examples of graphical visualization tools
- Sample scope of work and policy verbiage for 2D modeling
- Showcase presentations
- 2D Hydraulic Modeling Fact Sheet ***(Coming soon)***
- Case studies (example applications) ***(Coming soon)***
- Benchmark studies ***(Coming soon)***
- Reference document for Bridge Hydraulic and Floodplain Analysis ***(Coming soon)***
- College level curriculum for 2D hydraulic modeling ***(ETA 2019)***

What are other states saying?

- Training opportunities have been great
- Web meetings have been helpful
- Communications with stakeholders are improved
- Struggling with data collection
- Improved hydraulic results have improved constructability of projects
- Experiencing cost savings in countermeasure design
- Improved bridge scour results

What do you say?

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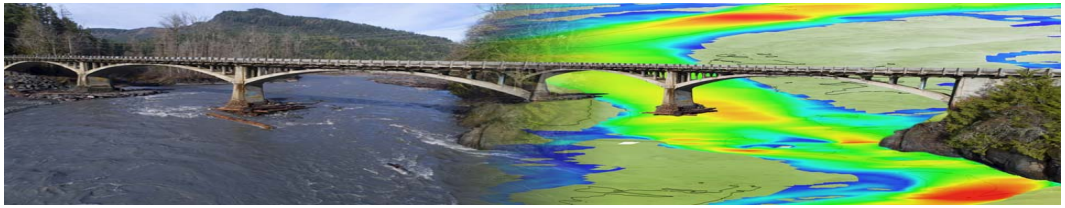

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State DOT perspective

Image by John Gussman / FHWA

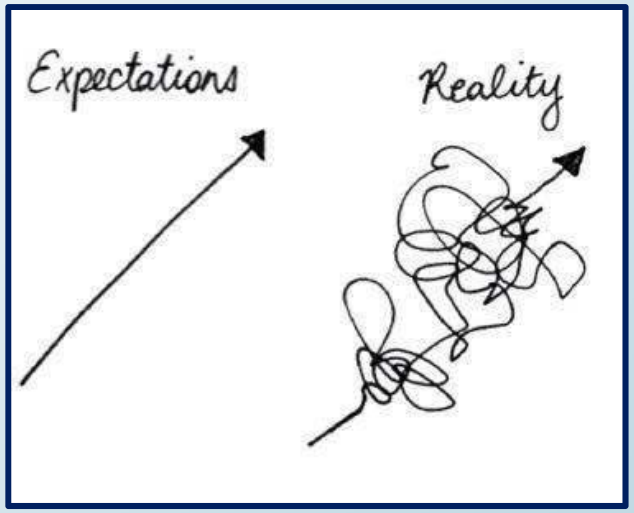
COLORADO
Department of Transportation

Project Savings Using 2D Hydraulics

CDOT Region 4 Central Program Hydraulics Unit

Find the Gaps; Manage the Change

Room to Improve (*change management*):

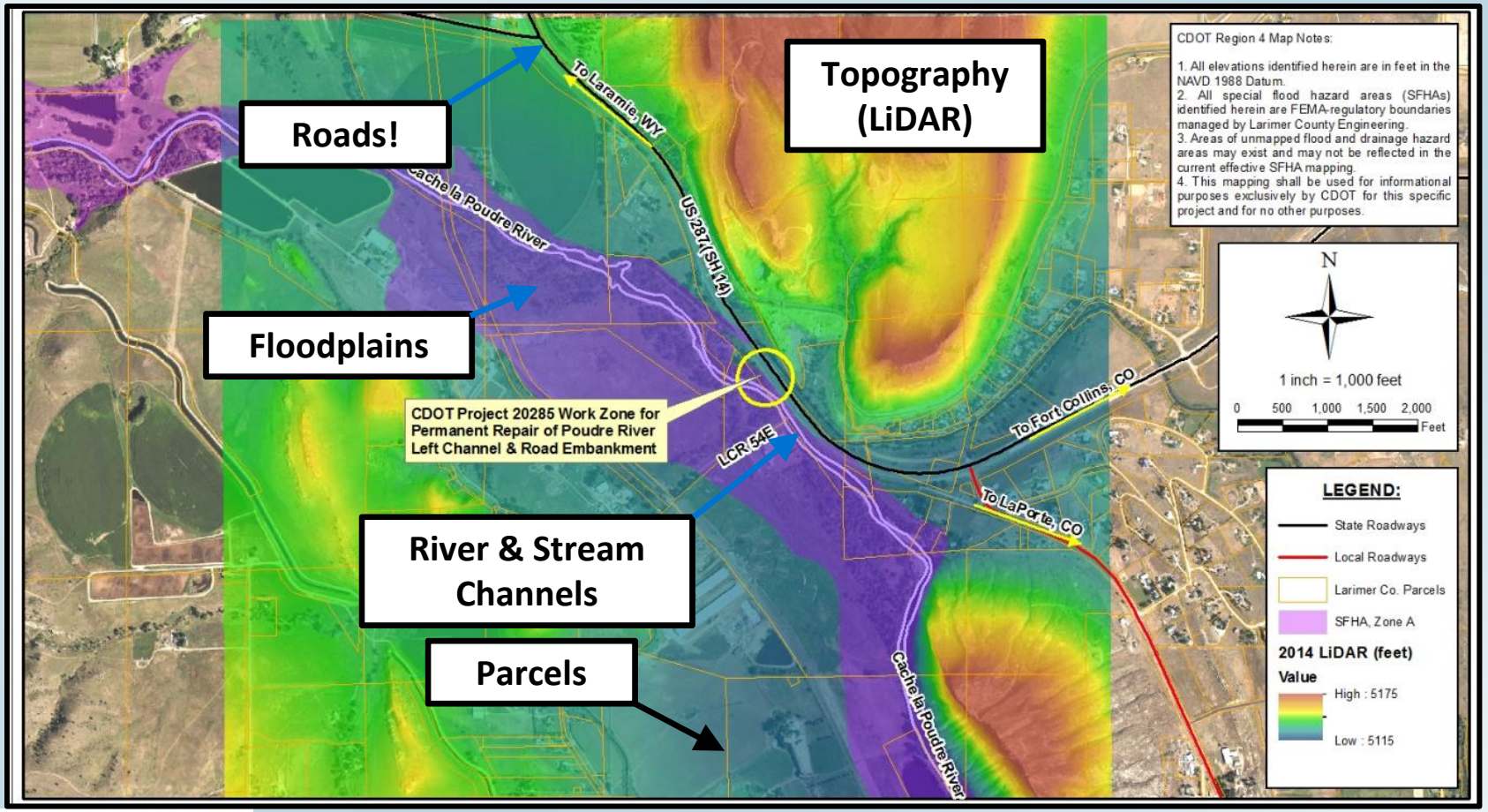


Doodle by Jessica Hagy, *@Jessicahagy,* from "*This Is Indexed*"

- No existing CDOT protocol for as-built surveys
- Floodplain permits; none until 2009
- Data & background info not carried to next project(s)
- 3-years of quotable quotes
  - *"Hydraulics doesn't drive project decisions."*
  - *"All models are wrong, so whatever."*
  - *"I don't have budget for modeling."*

The Colorado DOT Data Experiment

Data-Rich Environment since 2013 Flood…



The Colorado DOT Data Experiment

…but we are too busy to try new methods (2017).

- 62 = CDOT Projects Supported *($620 million in value)*
- 53 = Agency & Development Reviews
- 13 = Maintenance Activities

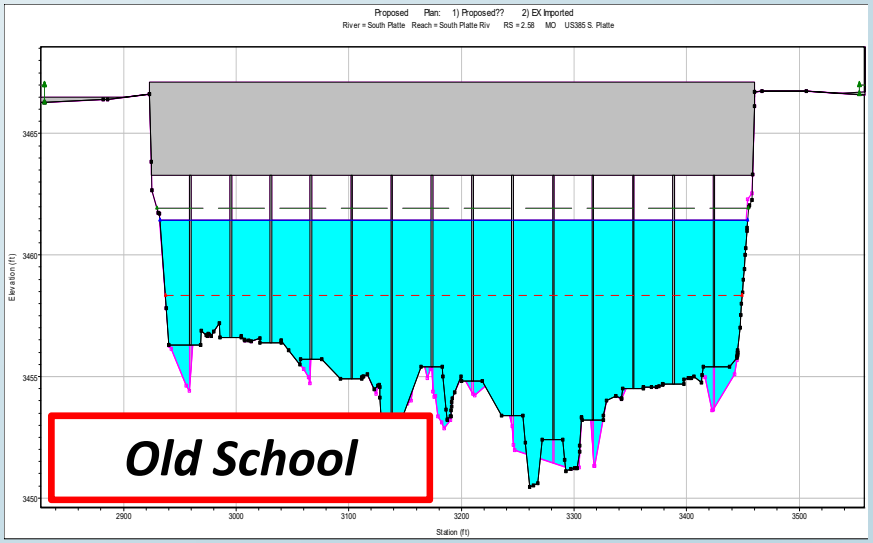
$\sum$ = 128 Total R4 Projects…

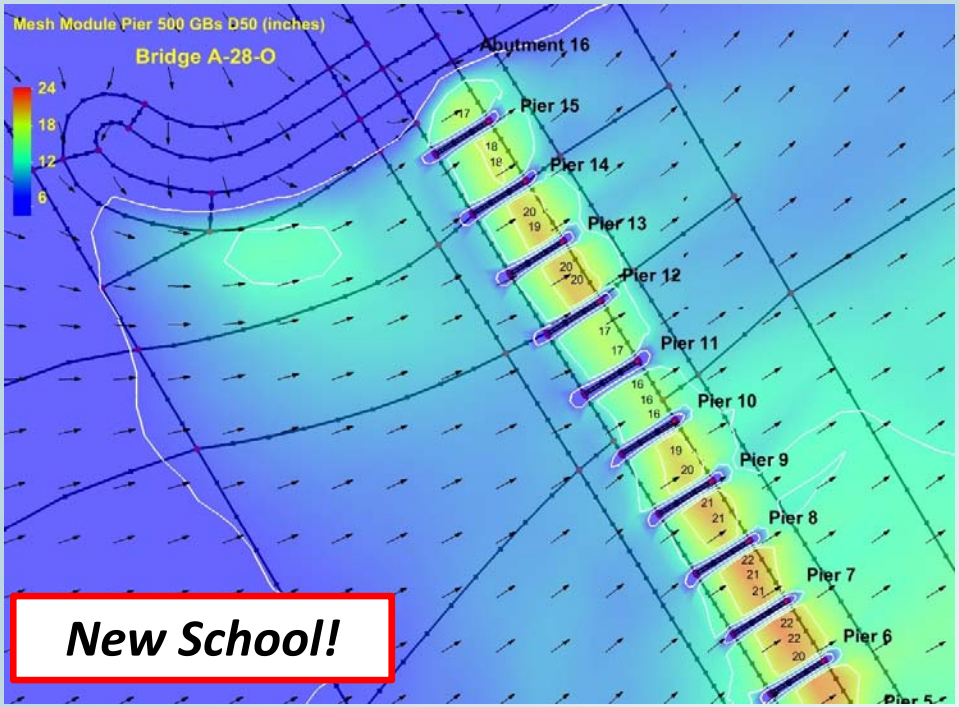
and 3.0 FTEs in Hydraulics

2D Hydraulic Model Successes

Shifting from 1D to 2D on CDOT Projects:

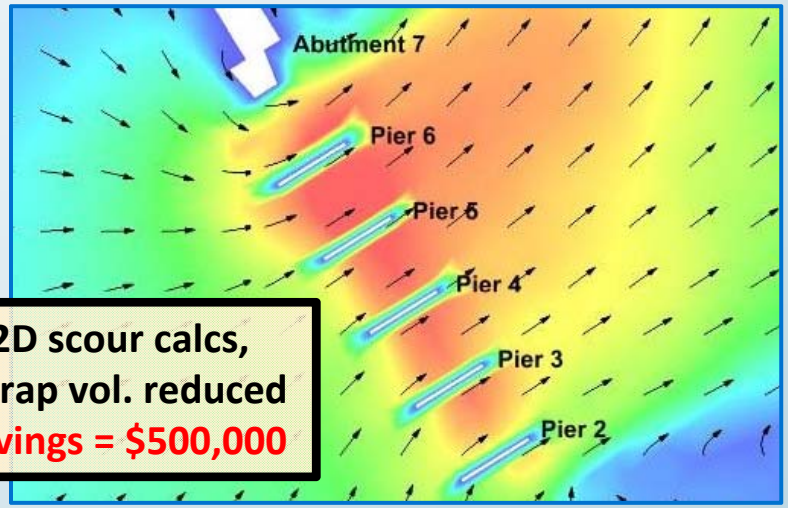
- Requires our contractors get new software & training
- Local permitting agencies are nervous *(old school)*
- 2D perception = *expen$ive*



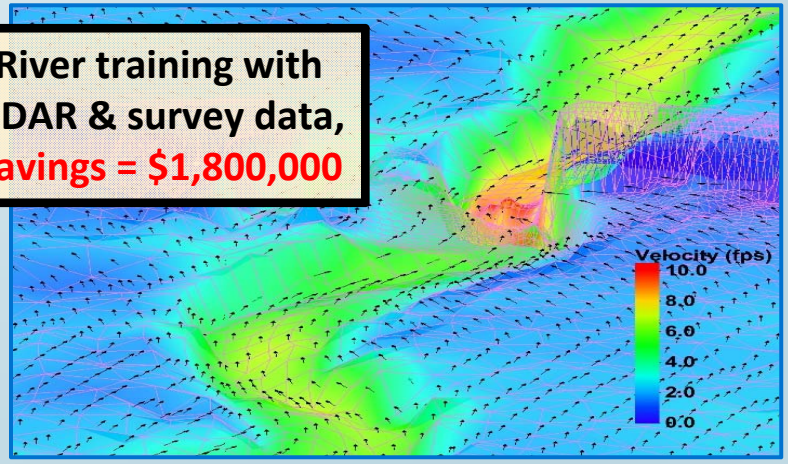


2D Hydraulic Model Successes

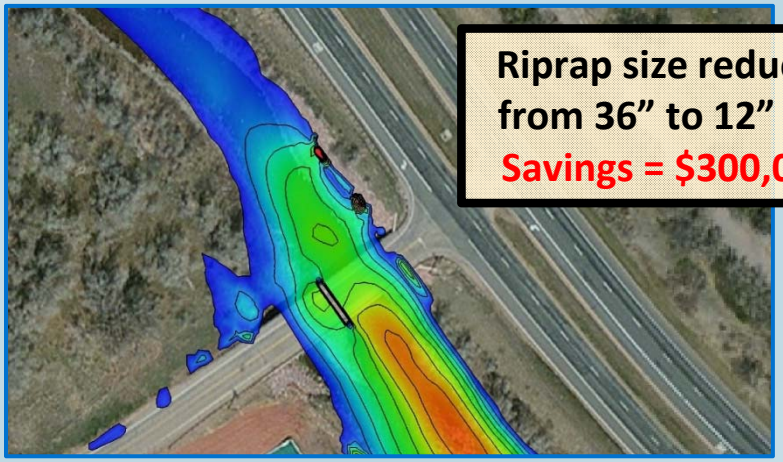
One Software Platform; Many Applications



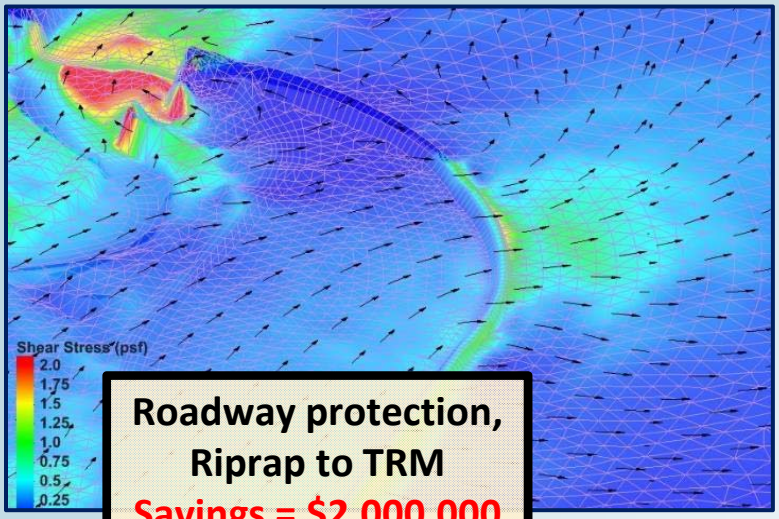
2D scour calcs, riprap vol. reduced
Savings = $500,000



River training with LiDAR & survey data,
Savings = $1,800,000



Riprap size reduced from 36" to 12" D_{50}
Savings = $300,000



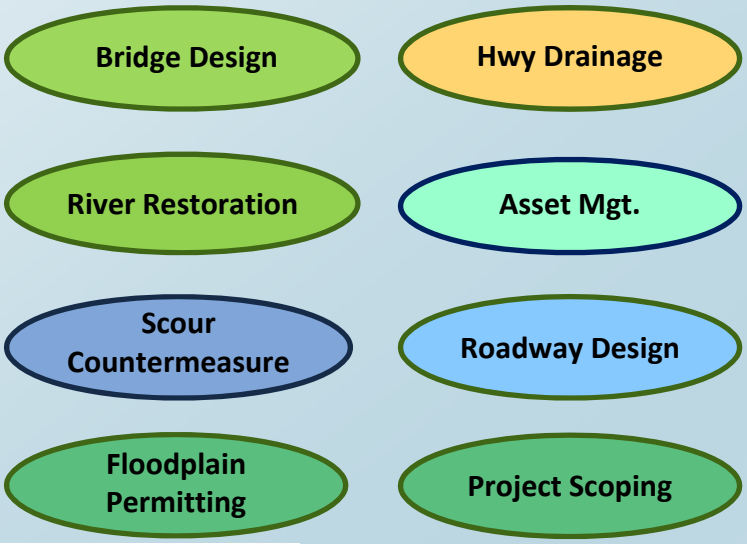
Roadway protection, Riprap to TRM
Savings = $2,000,000

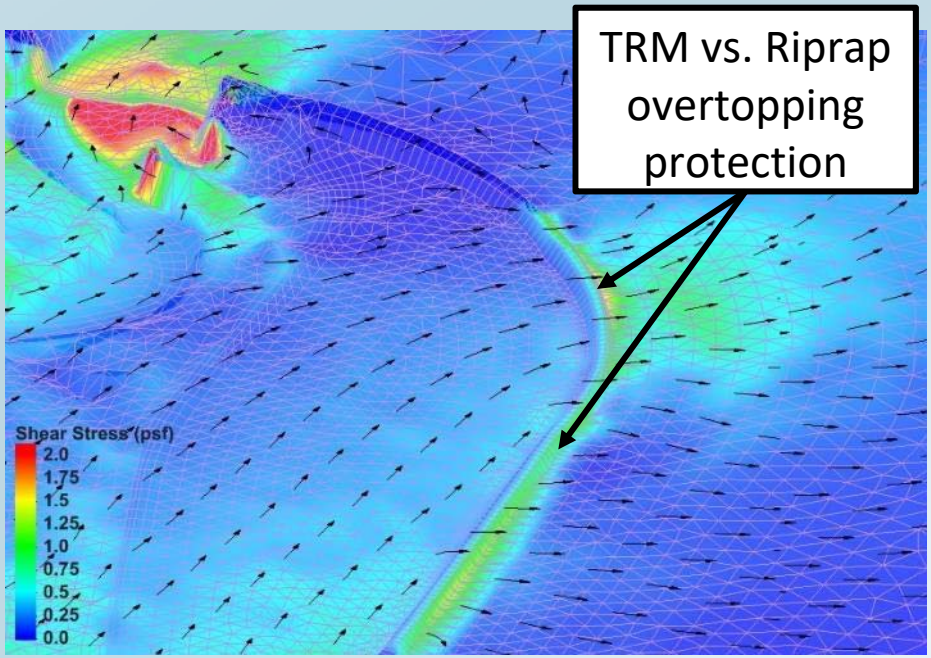
EDC

2D Hydraulic Model Successes

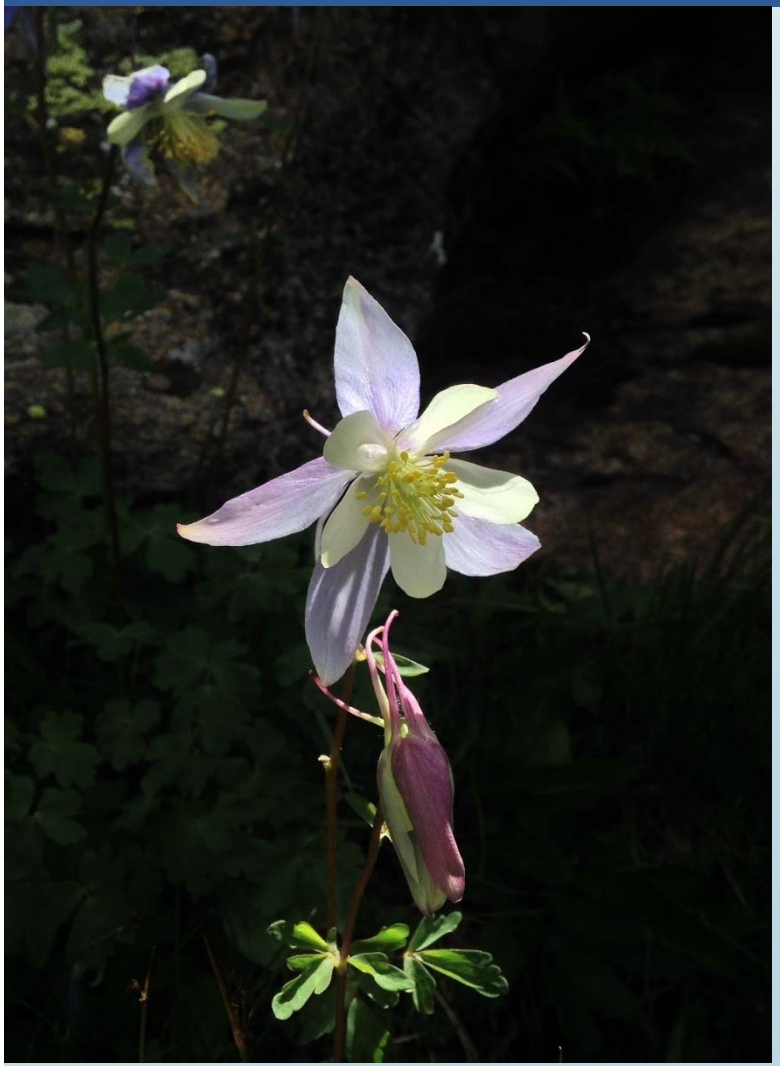
2D is saving CDOT time & money:

- **Return on investment** for 4 demo projects
  - Project savings during design = **$4,400,000** (*minimum*)
  - Per-hour savings (staff time) = **$20,000 / hr.** (*in-house*)
- **CDOT Projects Applied;**





The Future of 2D Modeling at CDOT



"Process improvement is an evolution."

Heather Paddock, P.E.
CDOT Region 4 Program Mgr.

- Standard procedures are changing
  - Using 2D for pre-scoping
  - Invest 20-40 hrs → refine scope
- More data = more 2D models
  - Statewide LiDAR is coming
  - Thanks FHWA & FEMA (*partners!*)
- Try it → Stumble → Improve!

Project Savings with 2D Hydraulics

Thank You!

Brian K. Varrella, PE, CFM

Colorado Dept. of Transportation
Region 4 Hydraulics Unit Lead

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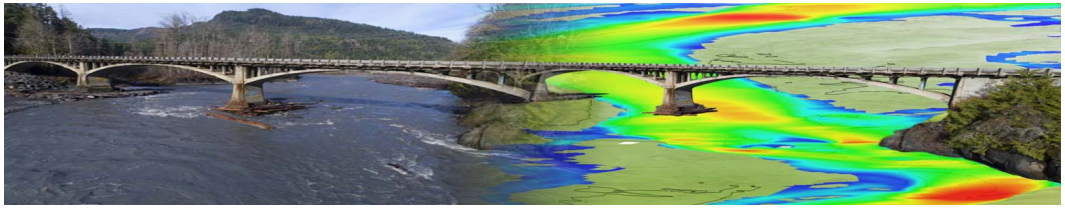

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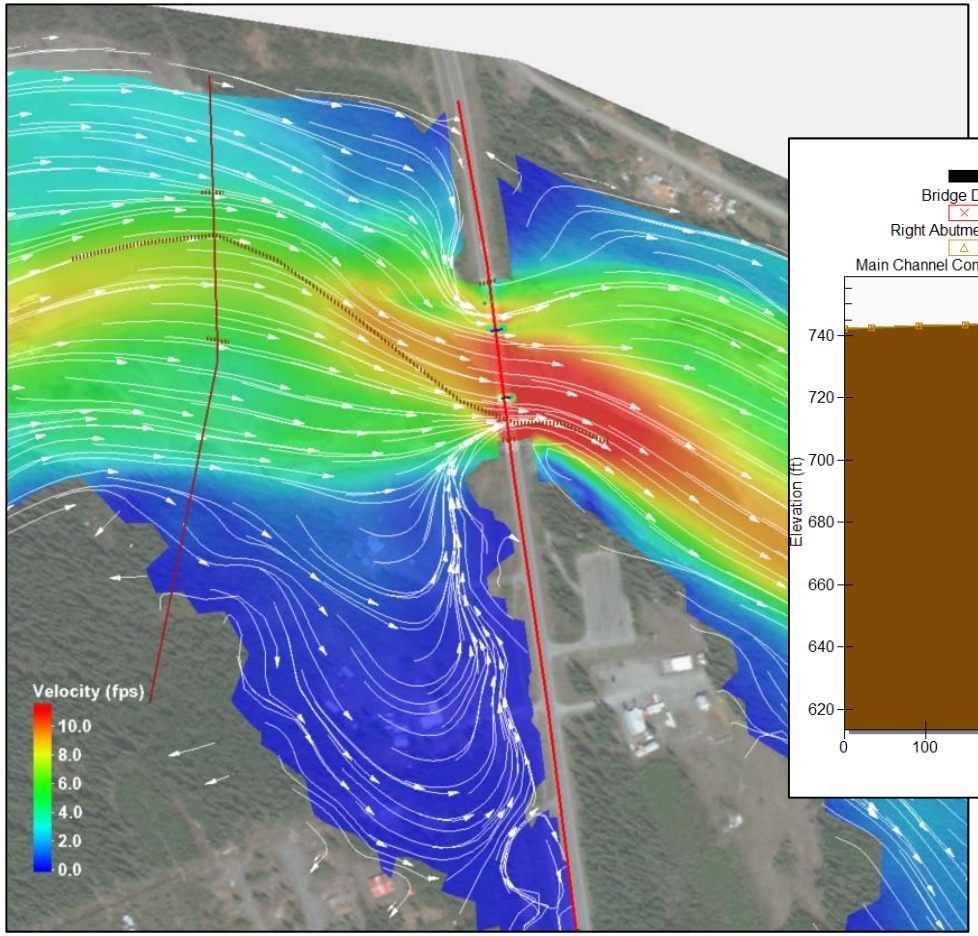
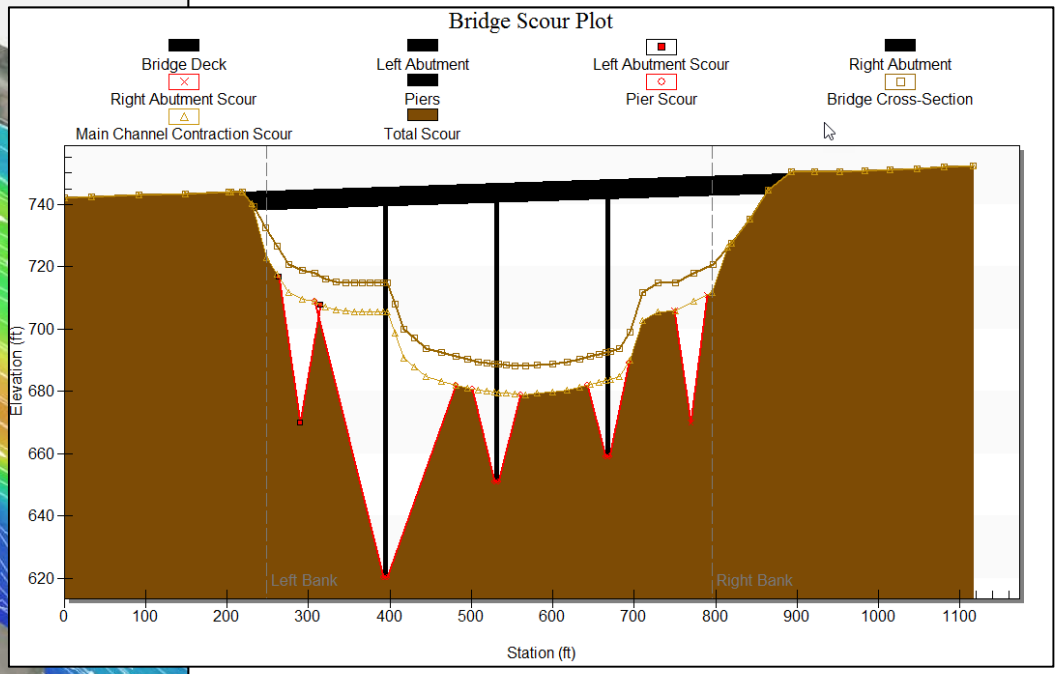
EDC-5 CHANGE Activities

Image by John Gussman / FHWA

More CHANGE is coming…

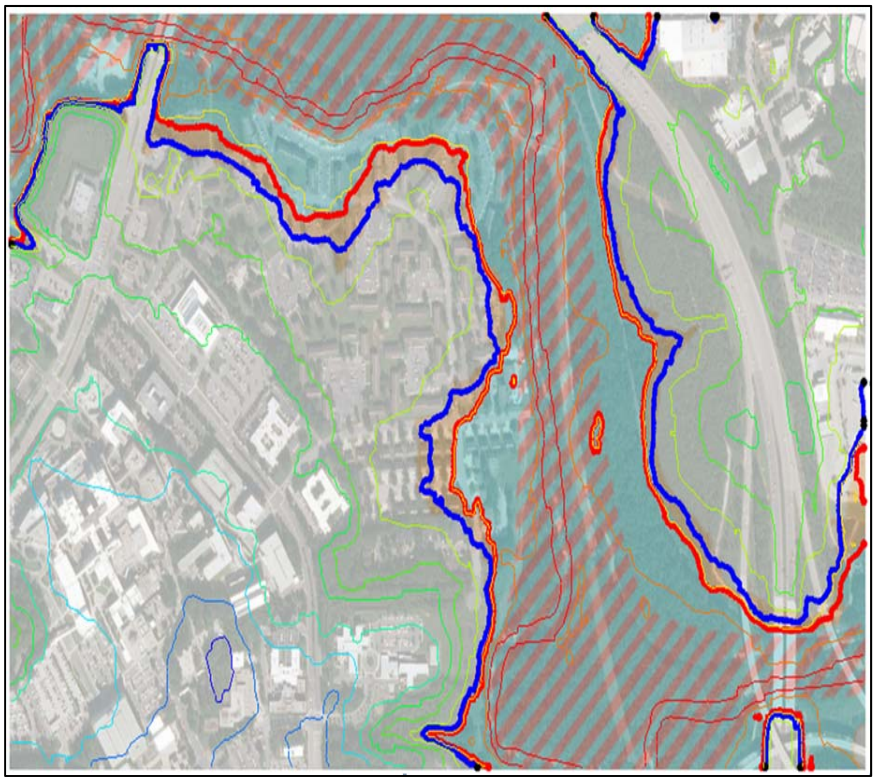
- Deployment of new scour tools and tutorials

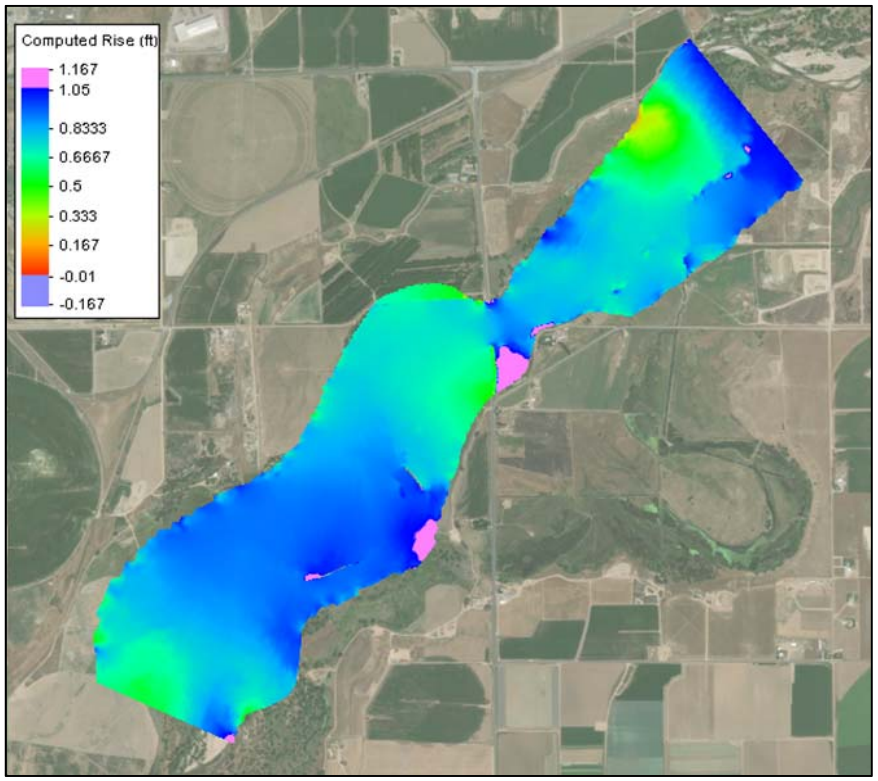




More CHANGE is coming…

- Deployment of new scour tools and tutorials
- Tools/methods for 2D hydraulic modeling floodplain and floodway analyses





More CHANGE is coming…

- Deployment of new scour tools and tutorials
- Tools/methods for 2D hydraulic modeling floodplain and floodway analyses
- Resources for fully integrating 2D modeling into your program
- Showcase presentations / peer exchanges
- Additional training (basic and advanced)
- On-going technical support
- Informational webinars
- Additional case studies

Strategies to advance CHANGE through EDC-5

- Raise awareness of EDC-4 developments
- Continue to develop 'Champions' in each state
- Promote awareness/use by local agencies
- Continue to cultivate a modeling community
- Promote more widespread use of CHANGE tools
- Coordinate with other federal agencies and address regulatory limitations

EDC-5 Funding Opportunities:

- ***State Transportation Innovation Council (STIC) Incentive***
  - ✓ Up to $100,000 per STIC per year to standardize an innovation
  - ✓ https://www.fhwa.dot.gov/innovation/stic/

- ***Accelerated Innovation Deployment (AID) Demonstration***
  - ✓ Up to $1 million available per year to deploy an innovation not routinely used
  - ✓ https://www.fhwa.dot.gov/innovation/grants/

You may be asking…

If we participated in EDC-4 is there a reason to participate in EDC-5?

Absolutely!

You may be asking…

If we did not participate in EDC-4 or got a slow start, is it to late to benefit from this innovation?

It is not too late! You can jump right in with:

- Pre-recorded User's forums
- NHI Training

And be just in time for:

- 2D modeling reference manual
- Program development support

You may be asking…

Can we still get support to train our staff?

Absolutely!

- NHI training courses
- Continued 2D Hydraulic Modeling User's forum webinars
- Additional training

You may be asking…

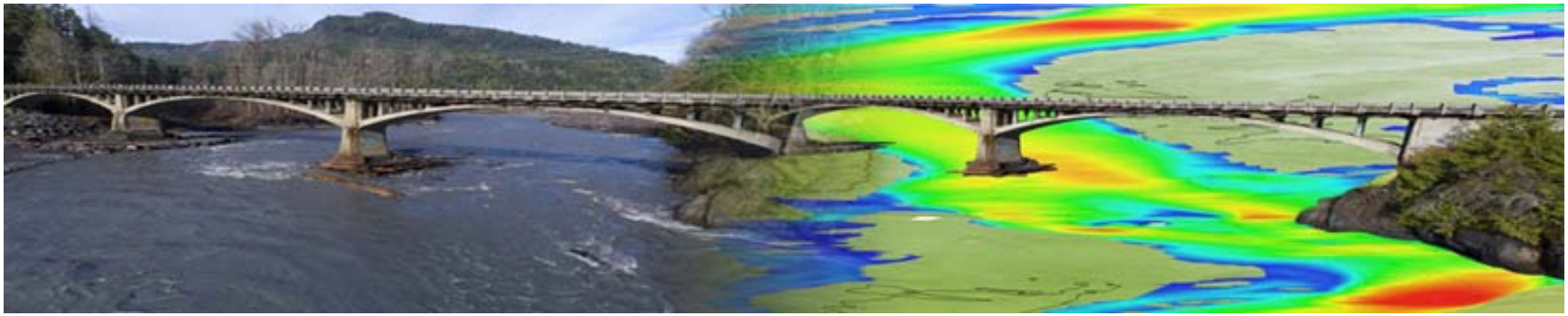
How can local agencies get involved?

- Coordinate with states where appropriate
- Help identify training needs
- Participate in regional NHI training courses
- Participate in the 2D Hydraulic Modeling User's forum webinars
- Review and contribute to CHANGE resources

You may be asking…

What can we do to help promote CHANGE?

- Organize peer exchanges with stakeholders and other states
- Share your experiences with FHWA
- Help identify any additional needs
- Review and contribute to CHANGE resources
- Participate in the 2D Hydraulic Modeling User's forum webinars



THANK YOU!

Please contact us with any questions

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