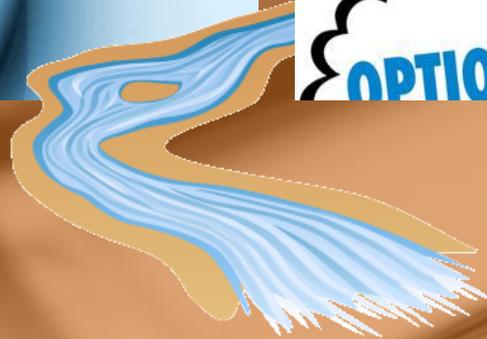
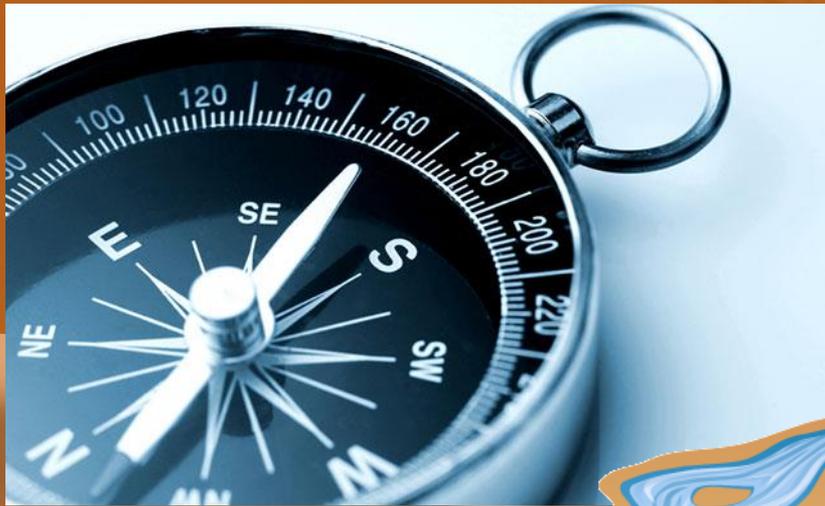


NAVIGATING THE OPTIONS

Which Hydraulic Method is Appropriate To Meet Your Floodplain Management Needs?



PRESENTORS



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Water Resources Project Manager

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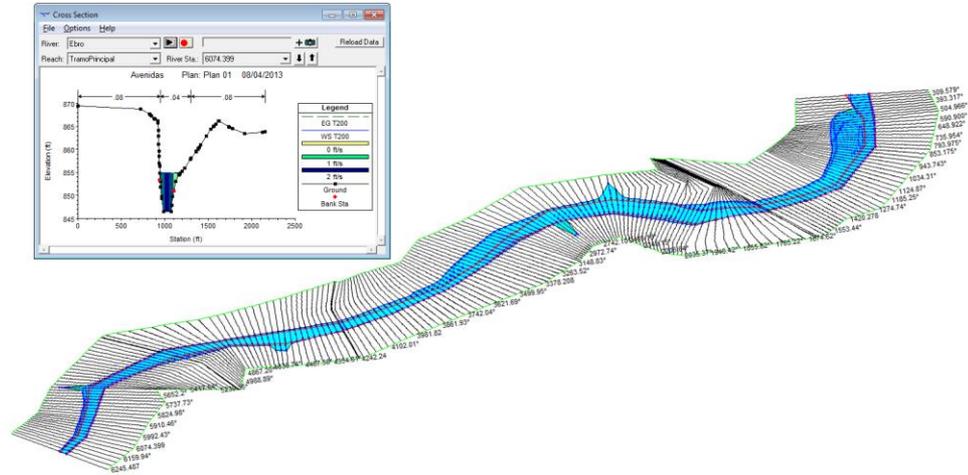
Josh Robbins, P.E., CFM
Water Resources Engineer

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jrobbins@dowl.com

WHY ARE WE HERE?



Perspective of Engineer



Selecting Appropriate Hydrologic & Hydraulic Methods



Things to Consider From the Engineer's Perspective as You Review Floodplain Permit Applications

AGENDA

- 1 Engineer's Perspective on Floodplain Studies
- 2 Process of Evaluating a Project.
- 3 Design Flows – General Overview.
- 4 Example Projects.
- 5 1D vs 2D Modeling Which One to Use?



ENGINEER'S RESPONSIBILITY

- Protect the safety, health, and welfare of the public.
- Perform services only in areas of their competence
- Be a Trusted Advisor for our Clients



Inform Our Client On Floodplain Requirements

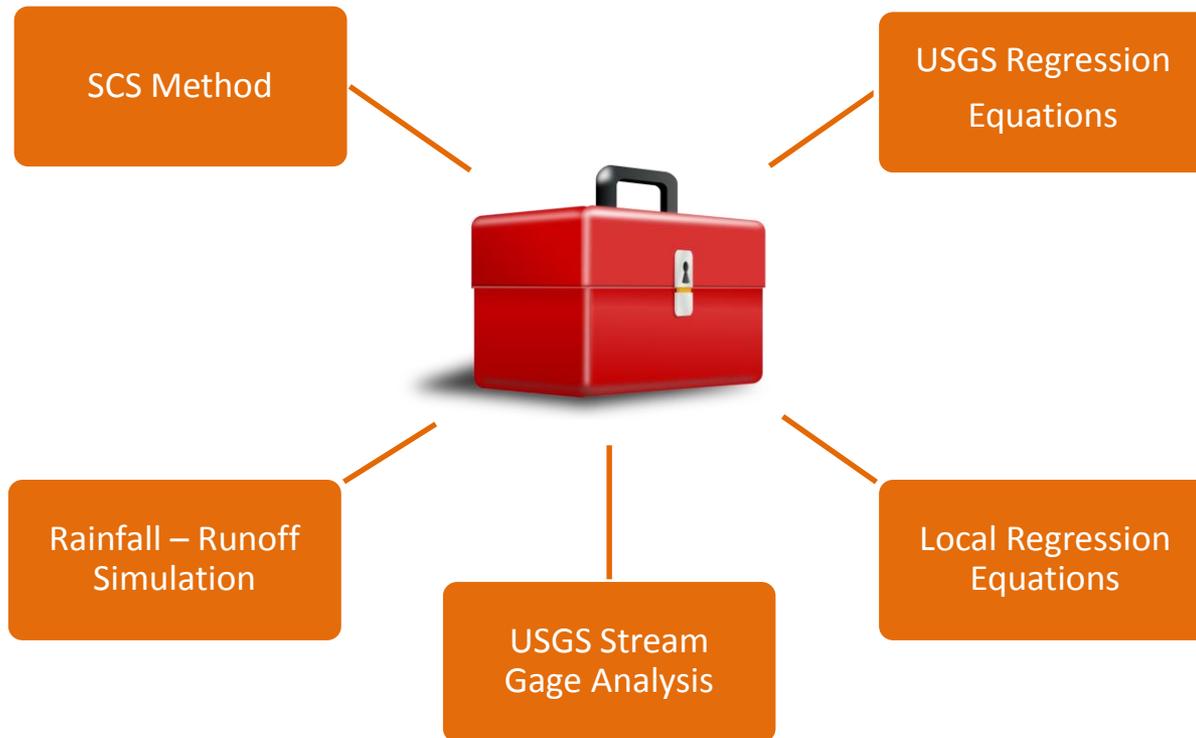
- Risks
- Procedures
- Process
- Cost

EVALUATING A PROPOSED PROJECT

- 1** Understand Details of the Project
- 2** Location of Project - Is a Floodplain Development Permit Needed?
- 3** Engineering Analysis – What’s Needed?
 - A** Ground data – Topography through Survey or LiDAR
 - B** Design Flows – Hydrology Evaluations
 - C** Water Surface Elevations – Hydraulic Evaluations or Modeling
- 4** Are Additional Permits required? e.g. 310, 404

HYDROLOGY

Which Method to Use?



Which is appropriate?

Typically Evaluate
Multiple
Methodologies

WHICH METHOD IS RIGHT?

Wide Range of Flow Estimated

Basin Name	Area (mi ²)	USGS Regression Equation	SCS Method	9-Gage Regional Regression	Gage Transfer
		100-year Flood Discharges (cfs)			
Basin 1	1.7	1,498	469	578	1,184



Ranges from 469 cfs to 1,498 cfs?



SELECTING A REASONABLE METHOD

Factors to Consider

- Higher Confidence with Certain Methods
- Observations of Flooding
- Hydraulic Evaluation of Existing Bridge & Culvert Capacities



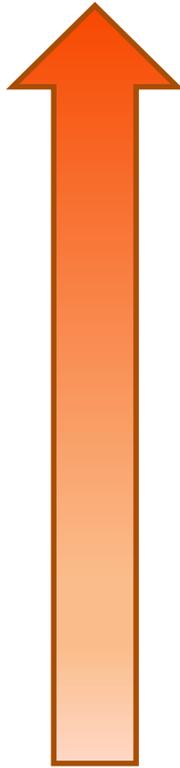
A hydraulic evaluation is only as good as the design flows used.

HYDROLOGIC METHODS

BFE's are dependent on the selected Hydrologic Method



CONFIDENCE



USGS Stream Gage Analysis

Local Regression Equations

USGS Regression Equations

Rainfall – Runoff Simulation

SCS Method

More Years of Record
the High Confidence
Level

Calibrating to Actual
Storm Event Significantly
increases Confidence
Level

EXAMPLE PROJECTS

- 1 New House Developed in Zone A Floodplain
- 2 Bridge Replacement Project in Zone AE Floodplain
- 3 Structure Improvement Requiring No Hydraulic Modeling



DEVELOPMENT IN
FLOODPLAIN

BEAVER CREEK

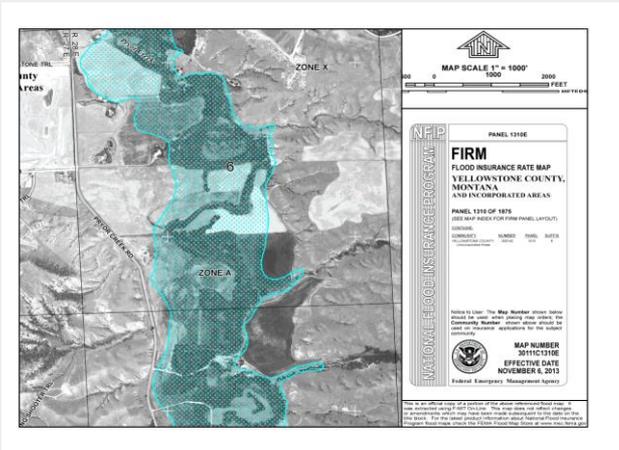
ZONE A
FLOODPLAIN



Project Information



- 1) Construction plans.
 - a) Ready to hire contractor



- 2) House site is in a floodplain.
 - a) Need a floodplain permit.
 - b) Need to consider BFEs

Project Information

- 1) Floodplain Permit should be a simple form, right?
- 2) What's a BFE and where can I find one?

Process is more than a few check boxes.



Engineer gets involved.

ZONE A STUDIES

What information is available?

Project Documentation

- 1) No Flows
- 2) No Model
- 3) No Base Flood Elevation (BFE) to regulate

*** Need information to determine the impacts of our project. ***



Where do we start?

Engineering Analysis

Hydrology

Hydraulics

- Is a model needed?
Maybe, Not Necessarily

- **Manning's Equation**
 - **Fast**
 - **Less Costly than a model**



Engineering Analysis

What is the water surface elevation?



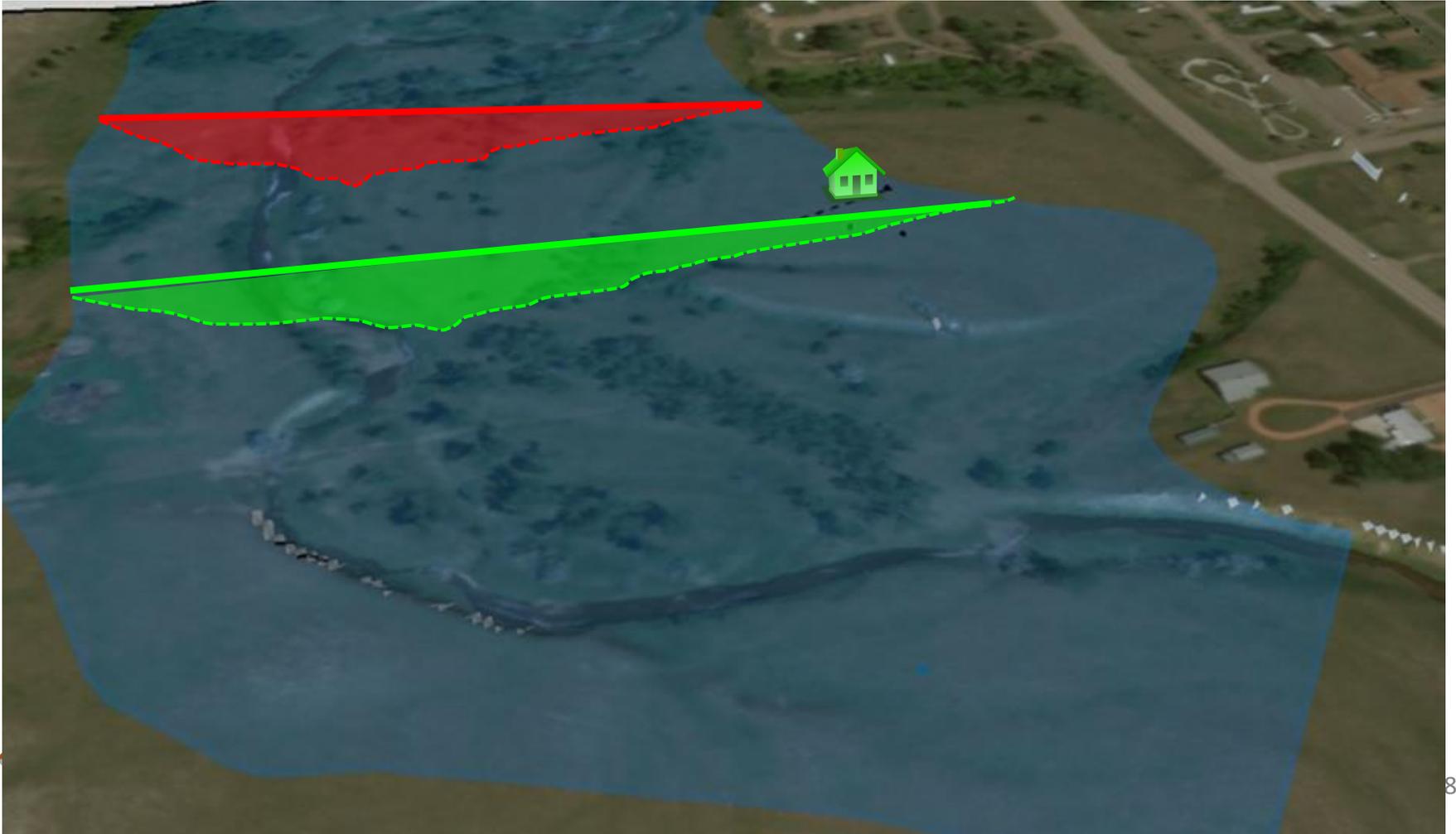
Manning's
Equation:

- ✓ Cross Section
- ✓ Channel Slope
- ✓ Flow
- ✓ Land Cover

We can determine the BFE at the house!

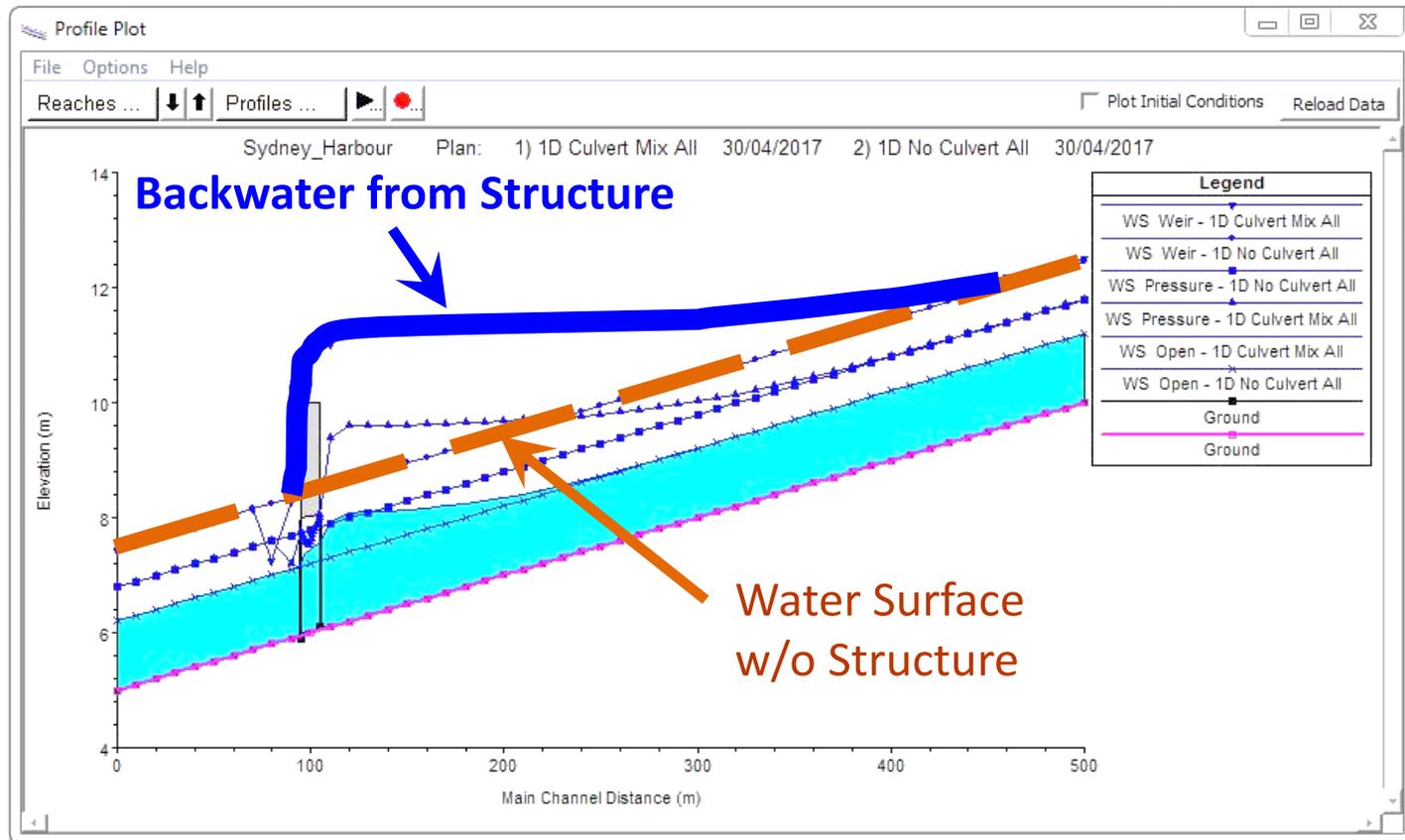
SIMPLIFIED HYDRAULIC METHOD – Manning's

- Cross Section Location



SELECTING THE APPROPRIATE HYDRAULIC METHOD

- Nearby Structures



Structure
Replacement

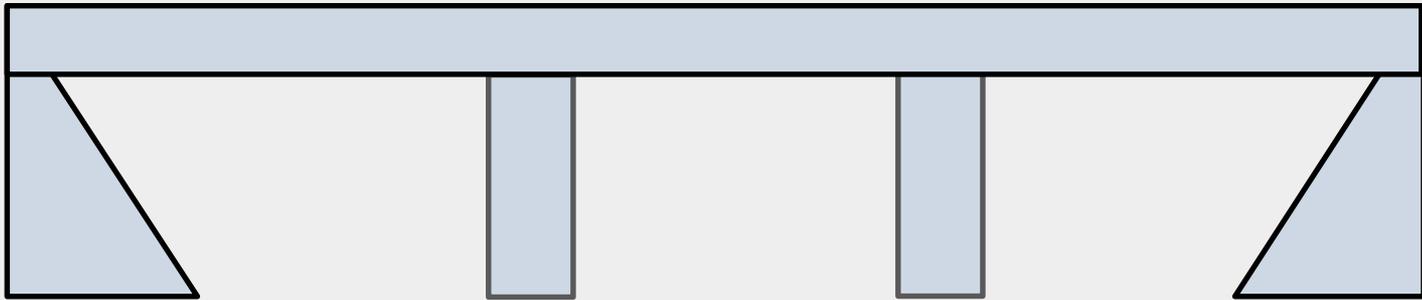
BRIDGE IN ZONE AE

Construction in the
Floodway



Project Information

Existing Structure - 300 ft Three Span Bridge



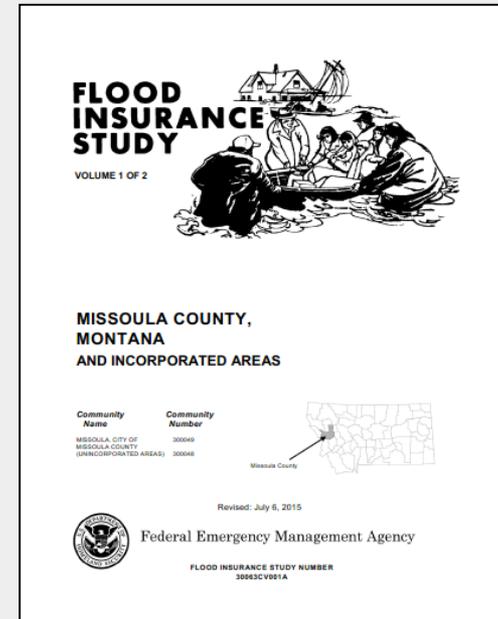
Proposed Structure – 285 ft Three Span Bridge



What Information is Available to Engineer?

FEMA Detailed Study (Zone AE)

- **Hydrology** (Flows)
 - Flood Insurance Study (FIS) Report
- **Hydraulics**
 - Flood Insurance Rate Maps (FIRM)
 - Effective Hydraulic Model (HEC-RAS)
 - FEMA Library
 - DNRC



When was the study completed?

Hydrology

- This study was completed in 1998.
- Validate FIS flows
 - Independent Hydrology Evaluation
 - Will likely adopt FIS flows if within reason
- If not, the updated hydrology is used
 - Frequently requires LOMR

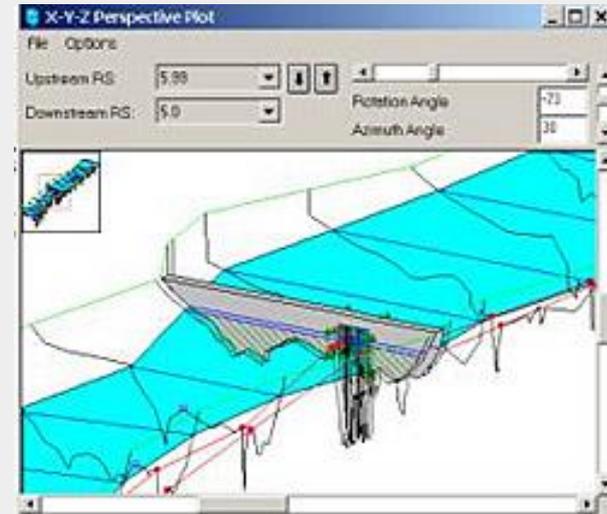


Hydraulic Analysis

- Zone AE
 - Project impacts the floodway, encroachment analysis (modeling) required

- FEMA requires **4** models:
 - Duplicate Effective Model
 - Corrected Effective
 - Existing Conditions
 - Post-Project Conditions

- Assess Impacts
 - ‘No-Rise’ Certification
 - Otherwise, a FEMA map revision may be required (CLOMR, LOMR)



FEMA Required Models

Evaluate Impacts of the Project

DUPLICATE EFFECTIVE

- Reproduce Effective models using latest software.
- Required to ensure that the data of the Effective model has been transferred correctly.

CORRECTED EFFECTIVE

- Corrects any errors in the Duplicate Effective Model
- Adds additional cross sections
- More detailed topographic information.

EXISTING CONDITIONS

- Modifies the Corrected Effective Model
- Reflects any man-made changes that have occurred in the floodplain since the date of the effective model.
- **Baseline used to determine project impacts**

POST-PROJECT CONDITIONS

- Modifies the Existing Conditions Model
- Reflect any physical changes that result from the project.

FEMA Required Models

Evaluate Impacts of the Project

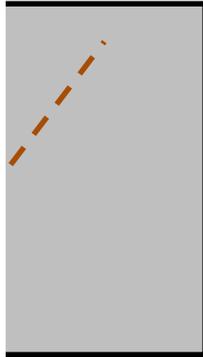
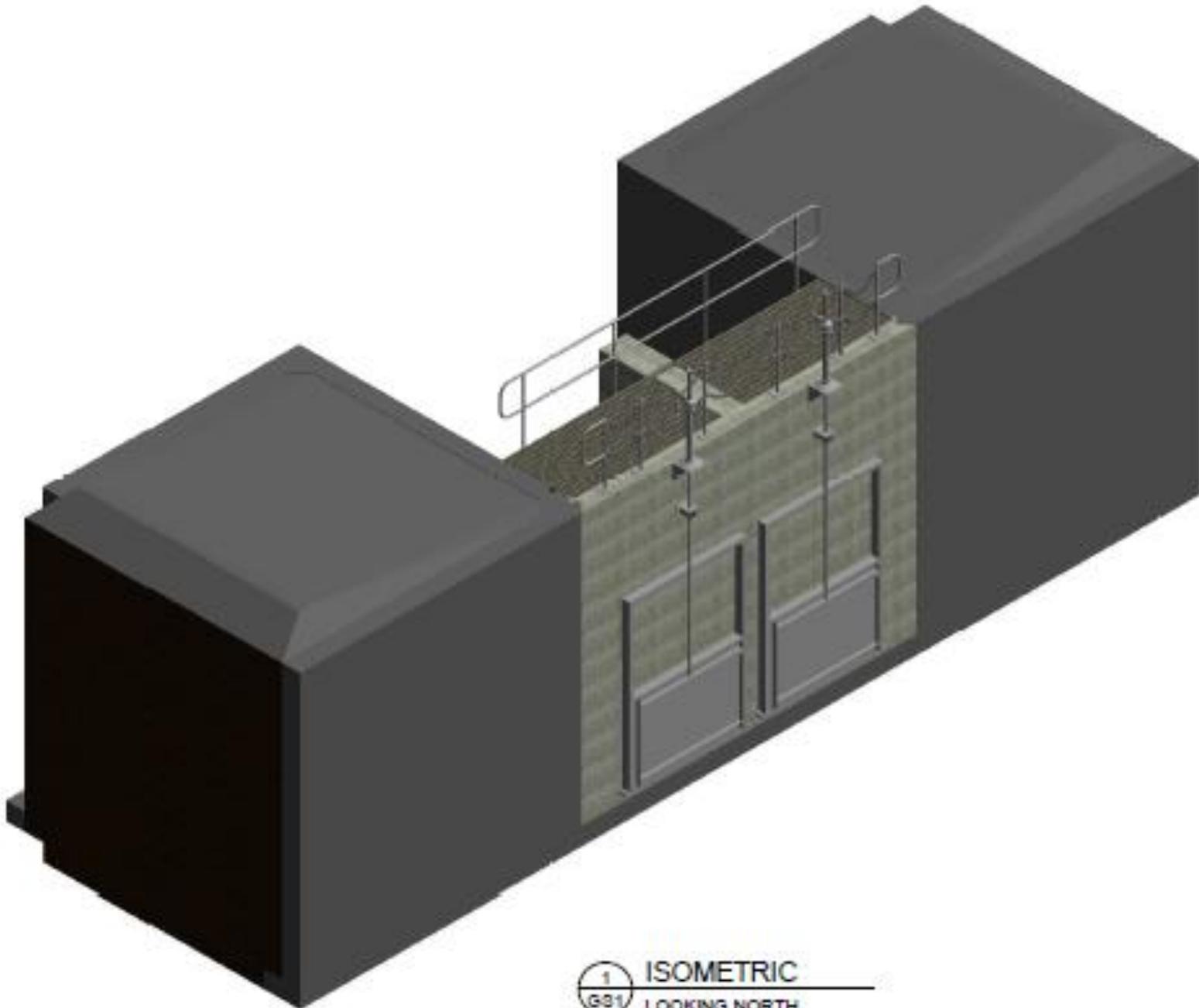
- Engineer completes modeling
- Comparison
 - Existing vs. Proposed
- Do we have impacts?
 - ‘No Rise’ = 0.00 ft
 - Rise = CLOMR
 - Lower Significantly = LOMR

FEMA XS ID	HEC-RAS River Sta.	100-Year Water Surface Elev.		
		Existing Conditions (ft)	Post-Project Conditions (ft)	Change (ft)
I	5663	2,647.83	2,647.83	0.00
H	5223	2,647.23	2,647.23	0.00
G	4903	2,646.57	2,646.57	0.00
Proposed Bridge				
F	4820	2,645.87	2,645.87	0.00
E	4300	2,645.57	2,645.57	0.00
D	4160	2,644.40	2,644.40	0.00

Our project required a ‘No-Rise’ certification.

STRUCTURE
IMPROVEMENT
**CANYON
CREEK
DITCH**
ON THE
YELLOWSTONE RIVER



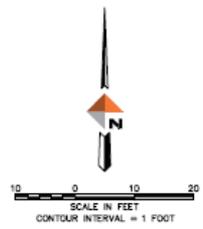


1 ISOMETRIC
G81 LOOKING NORTH



C:\dtd_30\Projects\2017\17-10-24_16.47_SAVED_DATE_2017-10-24_15:24_USBR_genderson

CONTROL POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	504666.097	2146918.906	3300.54	SURV 1.25 INCH RPC
2	504825.894	2148857.872	3299.44	SURV CP 2 1.25 INCH RPC
3	504744.490	2146969.005	3300.33	SURV CP 3 600 NAIL
4	504690.454	2146940.710	3300.39	SURV CP 4 600 NAIL
5	504764.492	2146932.235	3302.92	SURV CP 5 600 NAIL



**PRELIMINARY
NOT FOR CONSTRUCTION**

Need a temporary cofferdam to perform the replacement

- GENERAL NOTES:
- OWNER WILL SUPPLY TWO WATERMAN STAINLESS STEEL SLIDE GATES. THE CANAL GATES WILL BE MANUFACTURED AND SHIPPED TO 2530 GOODMAN ROAD, BILLINGS, MT NO EARLIER THAN X/XX/XXXX.
 - CONTRACTOR WILL INSTALL THE CANAL GATES PER MANUFACTURER DRAWINGS AND SPECIFICATIONS.
 - CONSTRUCTION OF THE PROJECT WILL BE COMPLETE BY APRIL 1, 2018.

- INSTALL COFFERDAM
- 2-yr WSEL = 3297.75
 - 10-yr WSEL = 3299.44
 - 50-yr WSEL = 3300.28
 - 100-yr WSEL = 3300.58

REV	DATE	DESCRIPTION

DOWL

222 N. 23rd Street, #700
Billings, Montana 59101
406-253-5000

CANYON CREEK DITCH IMPROVEMENT PROJECT
YELLOWSTONE COUNTY, MONTANA

GENERAL NOTES AND SITE PLAN

PROJECT 4036 21520.01
DATE AUGUST 2017

© DOWL 2017
SHEET

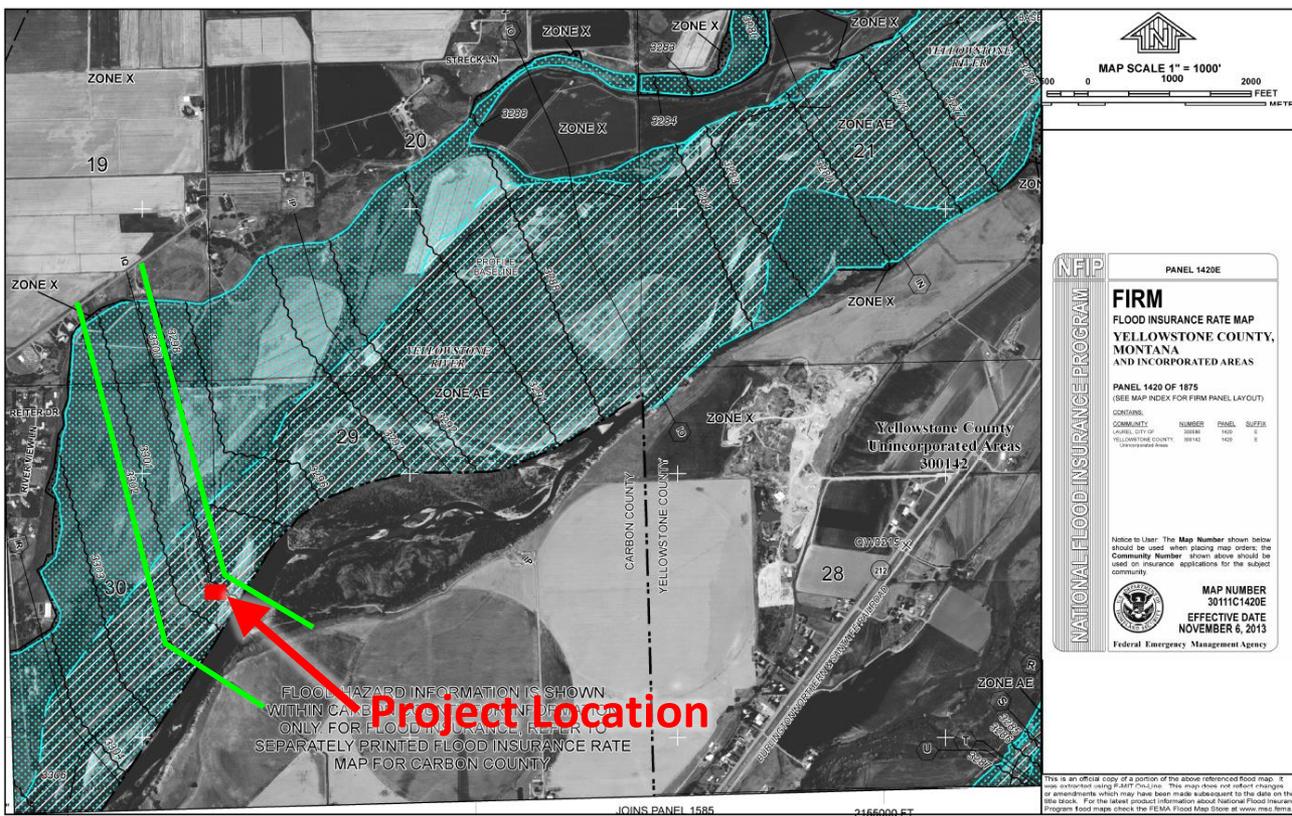
P1



PROJECT LOCATION

- In Zone AE Floodplain of Yellowstone River
- No Information on Canyon Creek Ditch in the FIS
- Had a Copy of the Effective Model
 - No modeling of the diversion structure.

Is updating the hydraulic modeling required?

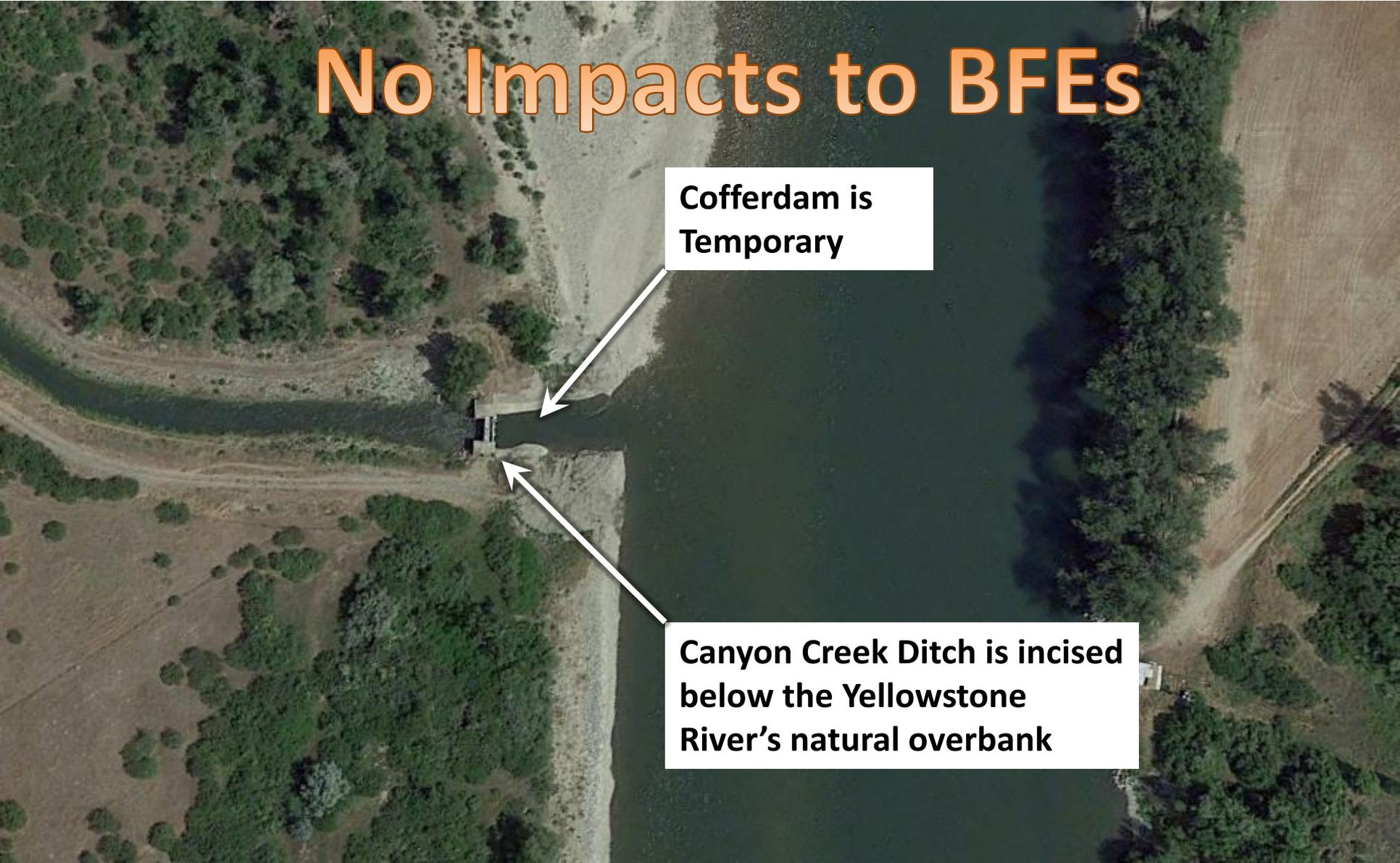


CANYON CREEK

No Impacts to BFEs

**Cofferdam is
Temporary**

**Canyon Creek Ditch is incised
below the Yellowstone
River's natural overbank**



STILL NEED A FLOODPLAIN PERMIT

C. PROJECT INFORMATION		
1. TYPE OF PROJECT (check all that apply)		
<input type="checkbox"/> Bridge/Culvert/Ford Construction	<input type="checkbox"/> Fish Habitat	<input type="checkbox"/> Mining
<input type="checkbox"/> Bridge/Culvert/Ford Removal	<input type="checkbox"/> Recreation (docks, marinas, etc.)	<input type="checkbox"/> Dredging
<input type="checkbox"/> Road Construction/Maintenance	<input type="checkbox"/> New Residential Structure	<input type="checkbox"/> Core Drill
<input type="checkbox"/> Bank Stabilization/Alteration	<input type="checkbox"/> Manufactured Home	<input type="checkbox"/> Placement of Fill
<input type="checkbox"/> Flood Protection	<input type="checkbox"/> Improvement to Existing Structure	<input type="checkbox"/> Diversion Dam
<input type="checkbox"/> Channel Alteration	<input type="checkbox"/> Commercial Structure	<input type="checkbox"/> Utilities
<input checked="" type="checkbox"/> Irrigation Structure	<input type="checkbox"/> Wetland Alteration	<input type="checkbox"/> Pond
<input type="checkbox"/> Water Well/Cistern	<input checked="" type="checkbox"/> Temporary Construction Access	<input type="checkbox"/> Debris Removal
<input type="checkbox"/> Excavation/Pit	<input type="checkbox"/> Other _____	

- Fill out the Joint Application Form
 - Document the reasons why no impacts to BFE
- Still need to meet other permits
 - 404 & 310

Received floodplain construction permit after approval from Army Corp and Conservation District

Other Projects that require updating the modeling:

- Mill and Overlay
- Minor Construction Projects
- Landscaping Projects
- Replace In Kind

1D vs 2D Hydraulic Modeling

APPLICATIONS



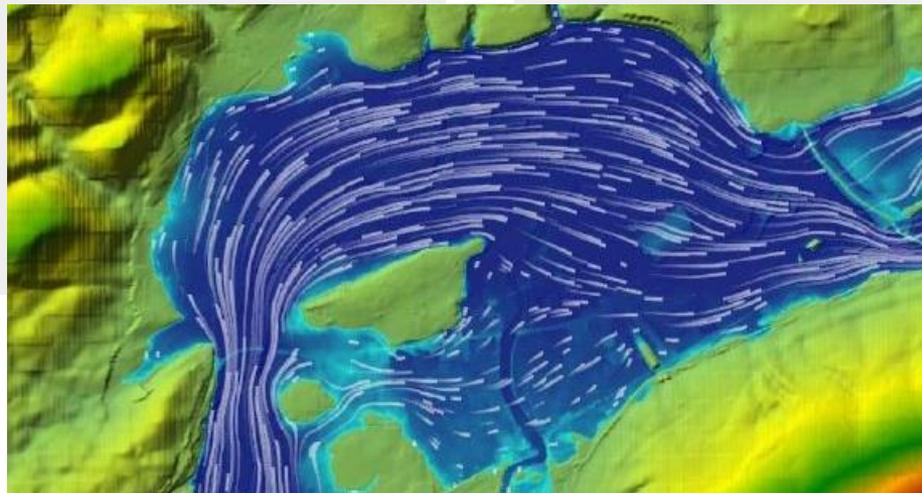
GENERAL APPLICATIONS FOR 1D & 2D MODELING

1D Modeling Applications

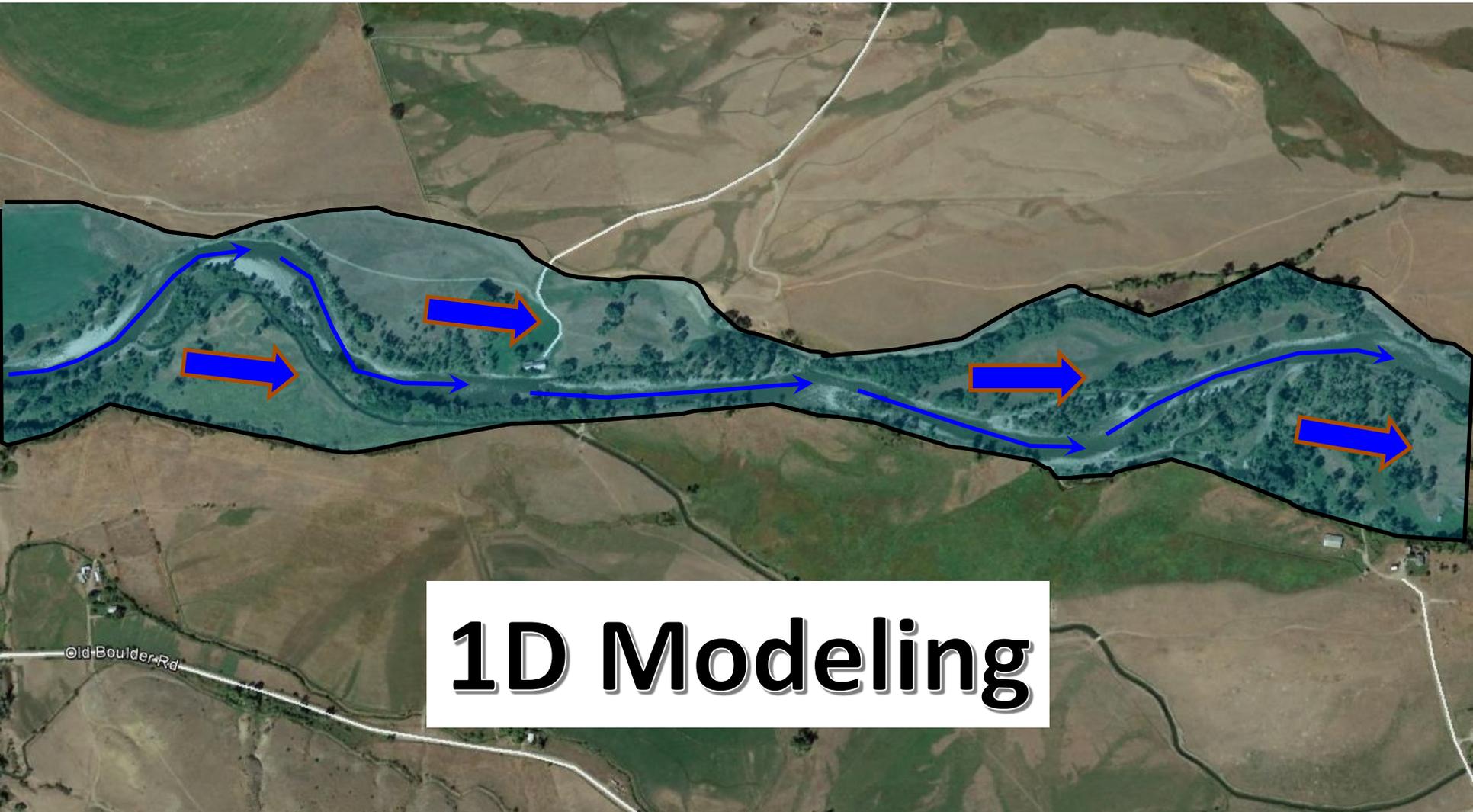
- Simple Flow Situations
 - Consistent Topography
 - All flood flow is in one direction
 - No Meandering Low Flow or High Flow Conditions
- Limited Topography Data
- Floodway Modeled

2D Modeling Applications

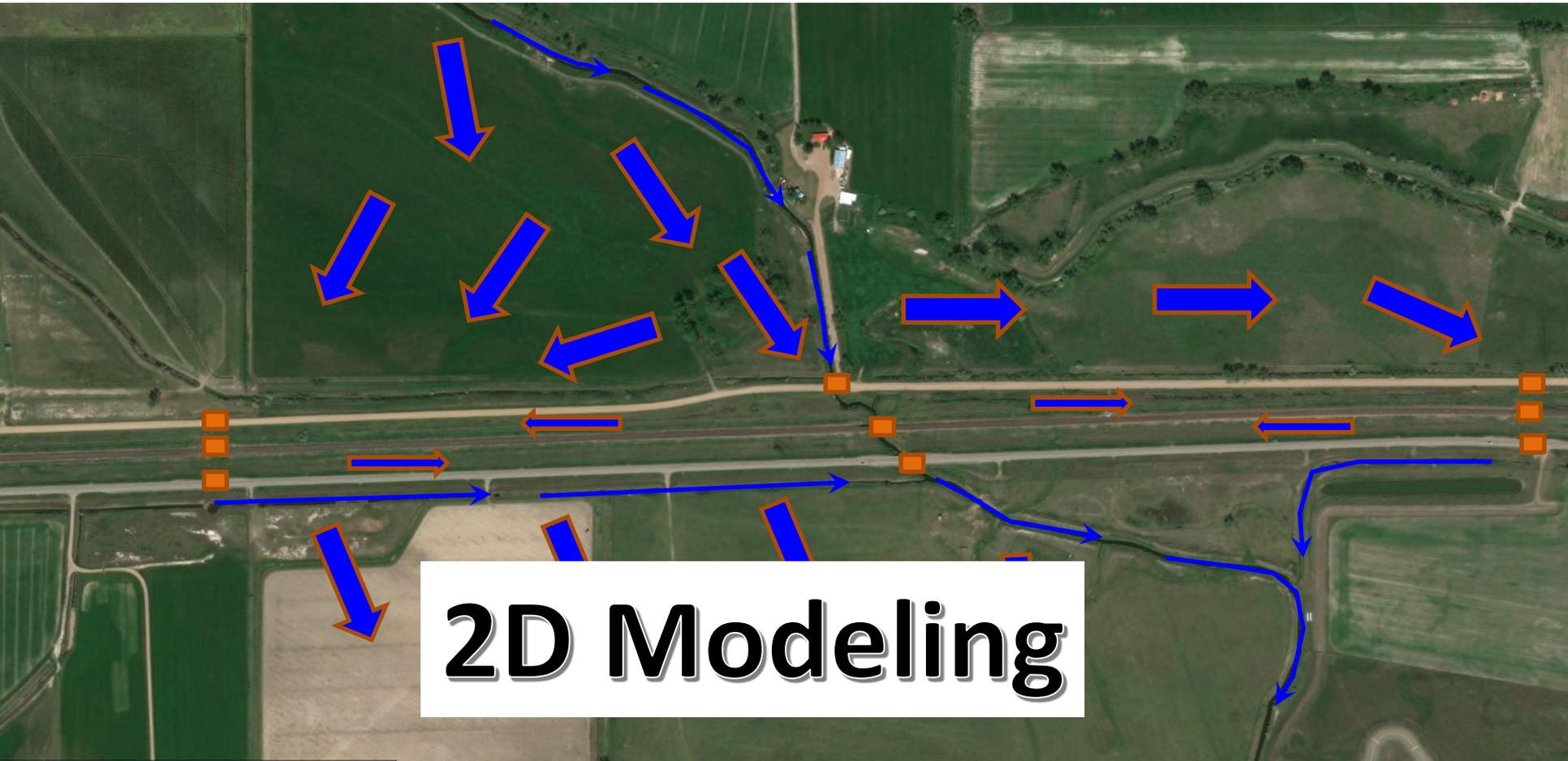
- Complex Flow Situations
- Split Flows
- Flows in Multiple Directions
- Braided Rivers with Shallow Flows
- Need for more Detailed Evaluation
 - Bridge Scour



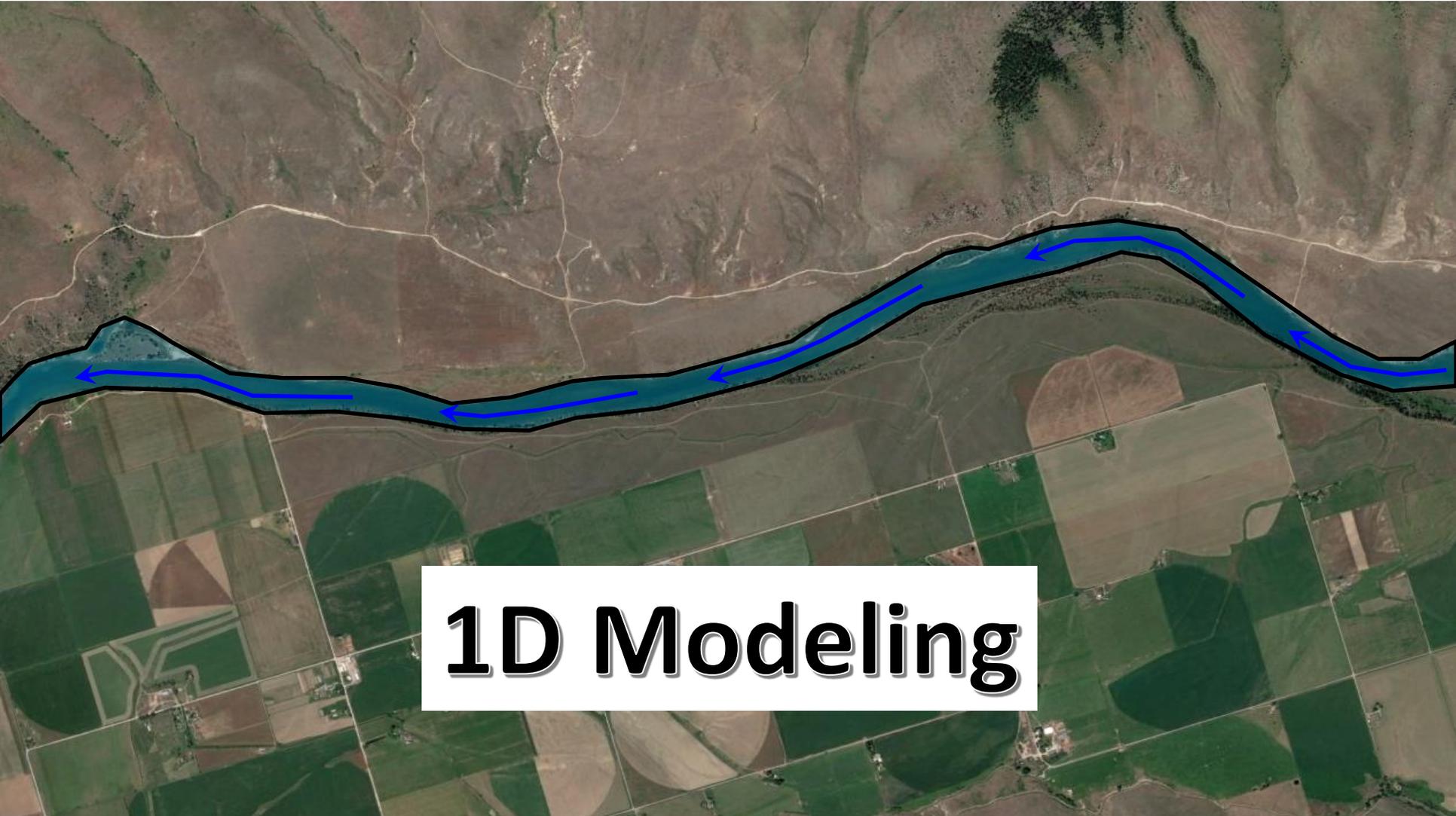
EXAMPLE #1 – BOULDER RIVER



EXAMPLE #2 – REDROCK COULEE

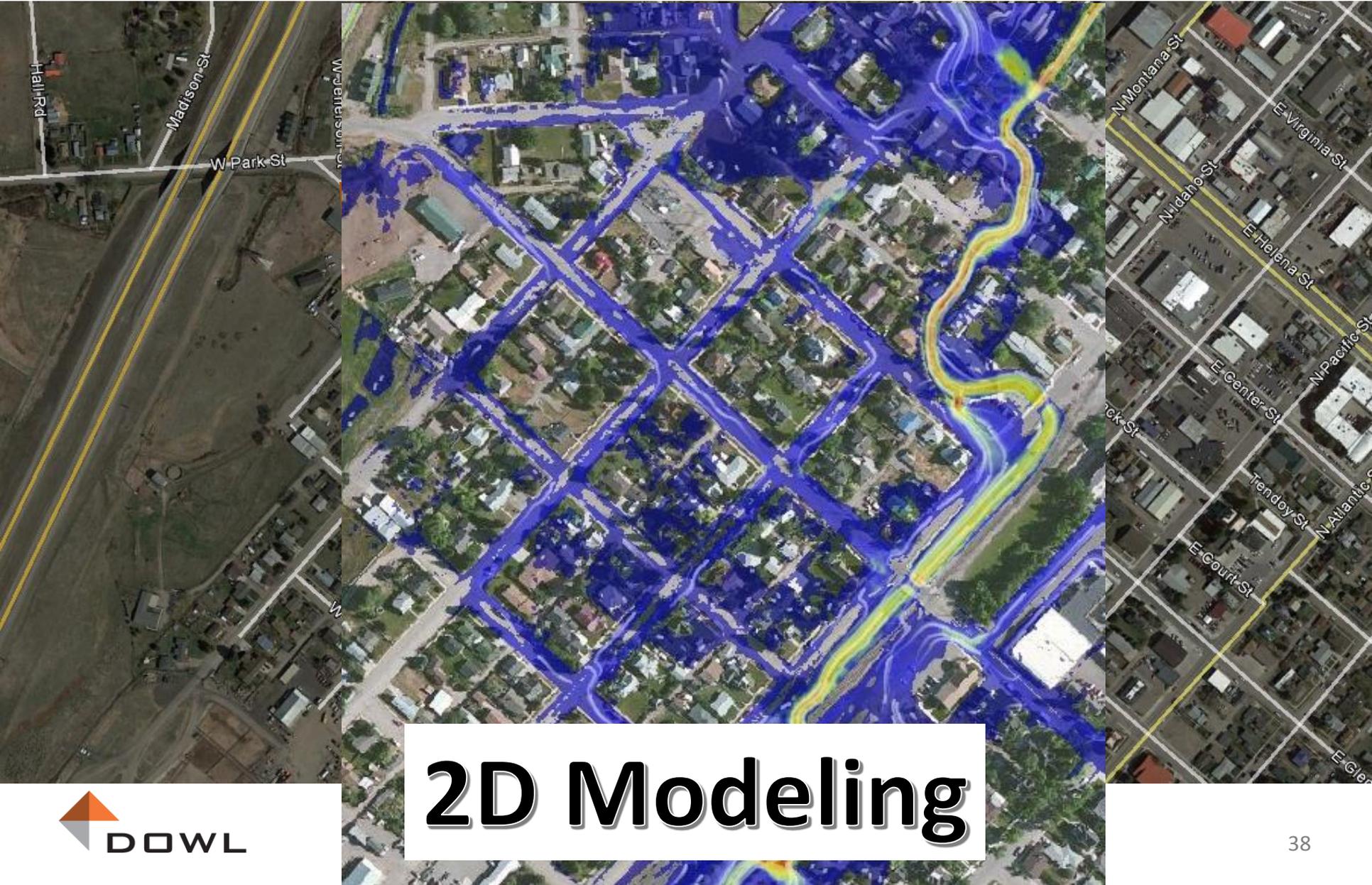


EXAMPLE #3 – FLATHEAD RIVER



1D Modeling

EXAMPLE #4 – BLACKTAIL DEER CREEK



2D Modeling

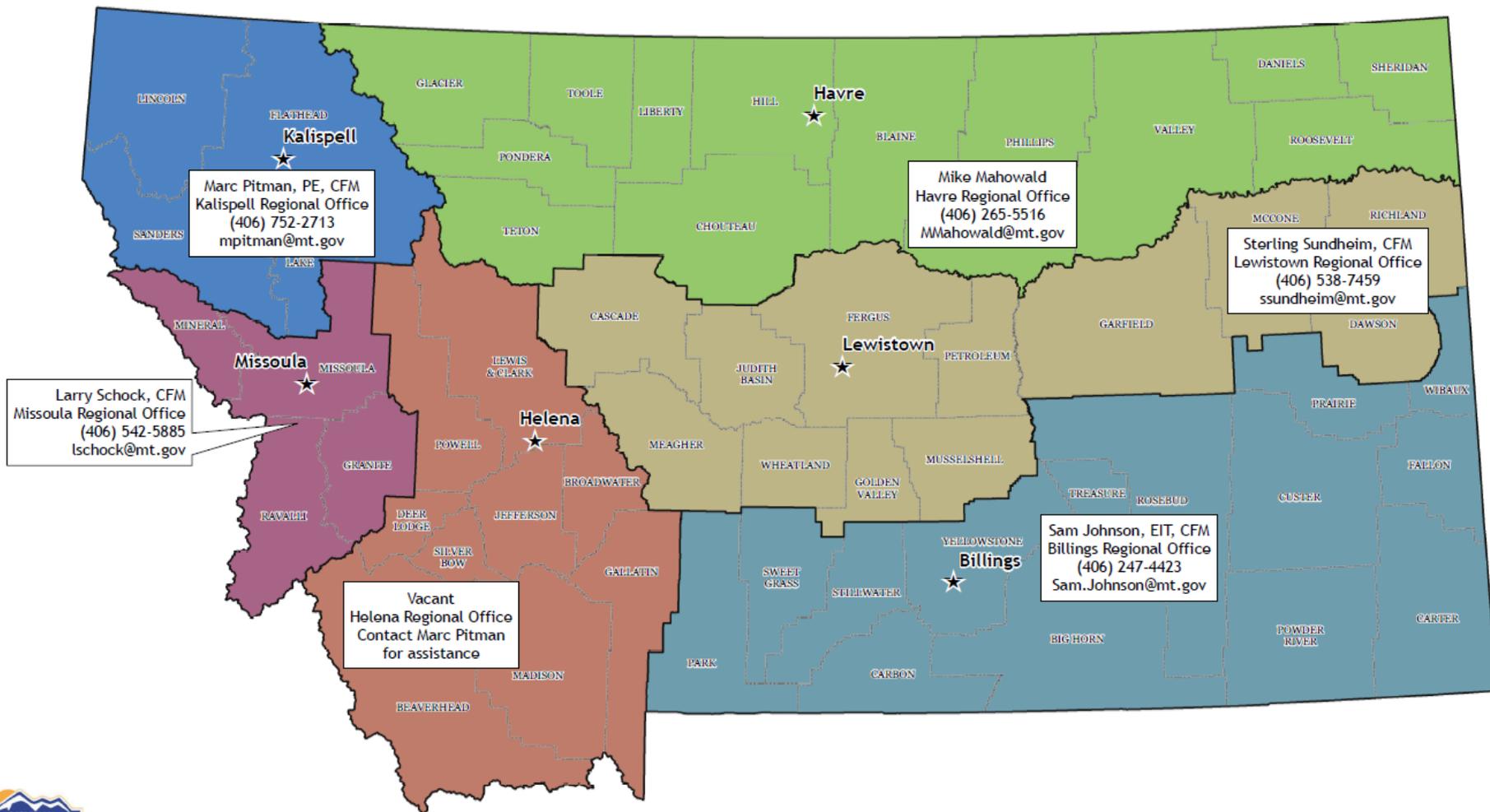
SUMMARY

- Engineer's Perspective
- Selecting the Appropriate Hydrologic Method
- Types of Hydraulic Evaluations
 - Simplified - Manning's Equation
 - Modeling
 - 1D vs 2D
 - No Hydraulic Evaluation

**Things to Consider From the Engineer's
Perspective as You Review Floodplain Permit
Applications**

Technical Review Assistance

DNRC FLOODPLAIN PROGRAM Regional Engineering Specialist Boundary Map



A man in a dark suit, light blue shirt, and dark tie is holding a white sign. The sign contains the text "Thank you for your attention!" and "Questions?".

Thank you for your attention!

Questions?