Fluvial Hazard Mapping Technical Standards: Preliminary Findings

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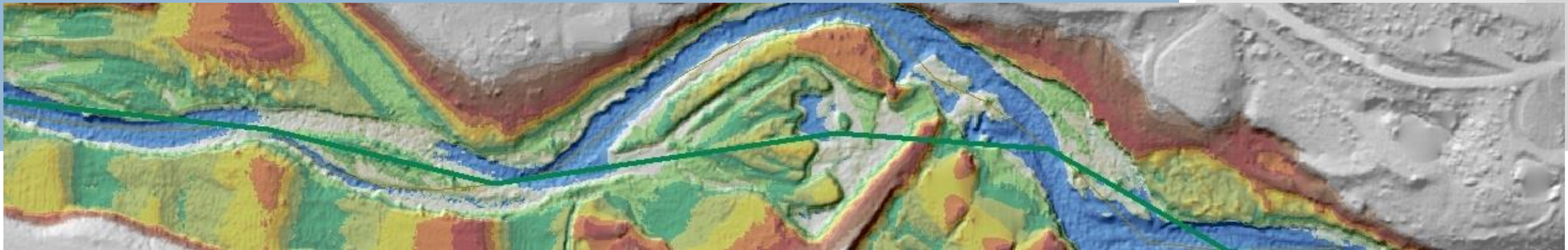


Introduction and Demonstrated Need

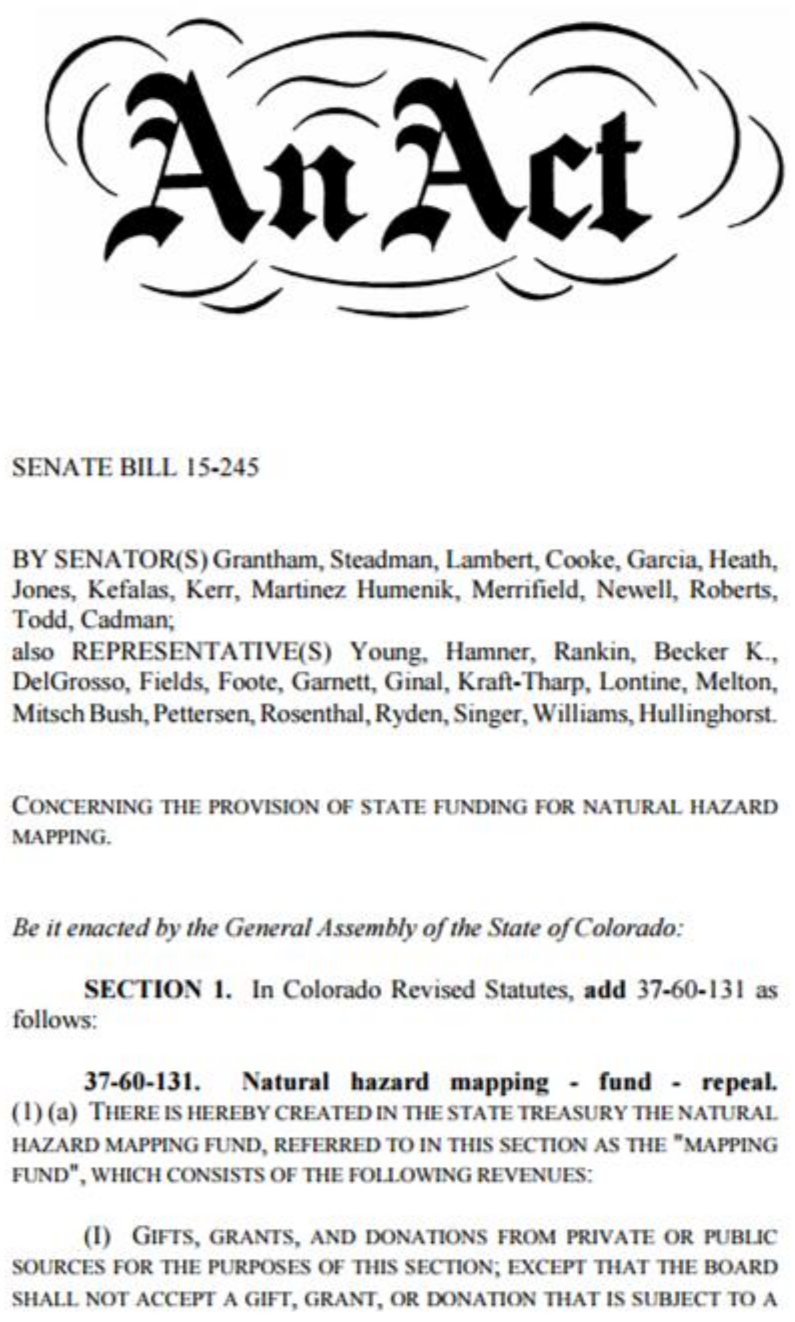
Natural Hazards Mapping Objectives

- reduce property loss and damage
- promote river planning and management on a watershed scale
- increase channel stability by improving floodplain connection and sediment transport
- reduce public expenditures for disaster response and recovery (avoidance is cost-effective in the long run)
- protect riparian habitat
- encourage multiple uses of riparian areas

National Precedence

- 1994 National Flood Insurance Reform Act
  - 1999 Mapping Feasibility Study (Riverine Erosion Hazard)
- Vermont
  - Indiana
  - New Hampshire
- Washington State
  - King County
  - Pierce County
- Southwest Cities and Counties
  - Austin, TX
  - Dallas, TX
  - Albuquerque, NM
  - Maricopa County, AZ
  - St. George, UT
  - El Paso County, CO

Colorado Senate Bill 15-254 “Natural hazard mapping fund”



An Act

SENATE BILL 15-245

BY SENATOR(S) Grantham, Steadman, Lambert, Cooke, Garcia, Heath, Jones, Kefalas, Kerr, Martinez Humenik, Merrifield, Newell, Roberts, Todd, Cadman;
also REPRESENTATIVE(S) Young, Hamner, Rankin, Becker K., DelGrosso, Fields, Foote, Garnett, Ginal, Kraft-Tharp, Lontine, Melton, Mitsch Bush, Pettersen, Rosenthal, Ryden, Singer, Williams, Hullinghorst.

CONCERNING THE PROVISION OF STATE FUNDING FOR NATURAL HAZARD MAPPING.

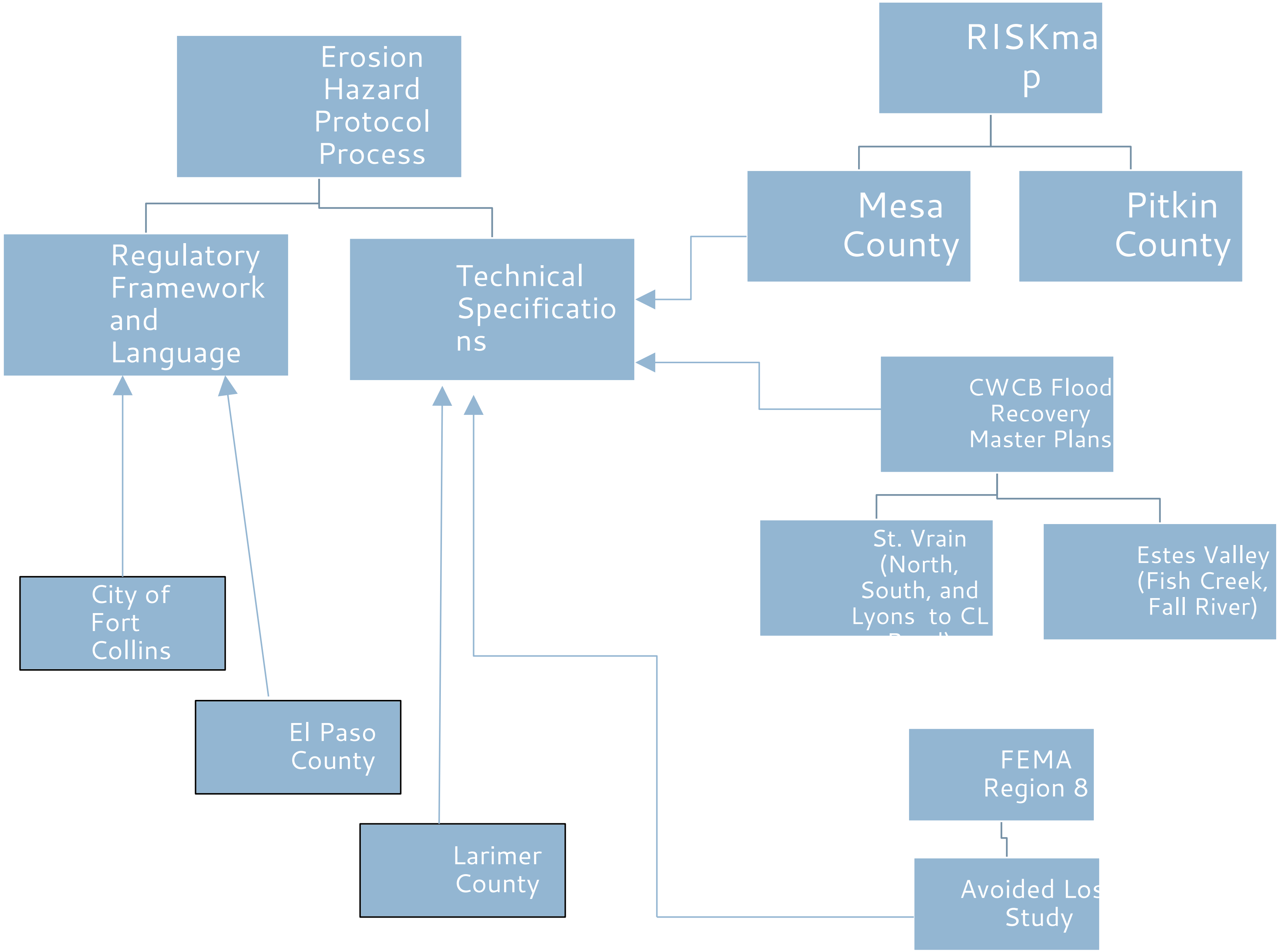
Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. In Colorado Revised Statutes, **add** 37-60-131 as follows:

37-60-131. Natural hazard mapping - fund - repeal. (1) (a) THERE IS HEREBY CREATED IN THE STATE TREASURY THE NATURAL HAZARD MAPPING FUND, REFERRED TO IN THIS SECTION AS THE "MAPPING FUND", WHICH CONSISTS OF THE FOLLOWING REVENUES:

(I) GIFTS, GRANTS, AND DONATIONS FROM PRIVATE OR PUBLIC SOURCES FOR THE PURPOSES OF THIS SECTION; EXCEPT THAT THE BOARD SHALL NOT ACCEPT A GIFT, GRANT, OR DONATION THAT IS SUBJECT TO A

CWCB, FEMA, and Local Studies



Technical Standards—Goals and Objectives

- Scientifically supported and reviewed
- Ability to scale in size, implement cost-effectively on a large scale
- Applicable to any stream, perennial or ephemeral, in the state of Colorado
- Ability to refine in detailed study based on presence of debris flow potential, burn scars, hazardous/critical infrastructure, and/or delineation disputes.

Technical Standards—Driving Factors

1) Definition of Fluvial Hazard Zone:
"The area a stream has occupied in recent history, could occupy, or could physically influence as it stores and transports sediment and debris during flood events."

1) Four primary types of fluvial processes:
    1) Lateral Migration
    2) Downstream Meander Migration
    3) Avulsion (local, reach, and regional)
    4) Slope failures due to toe erosion

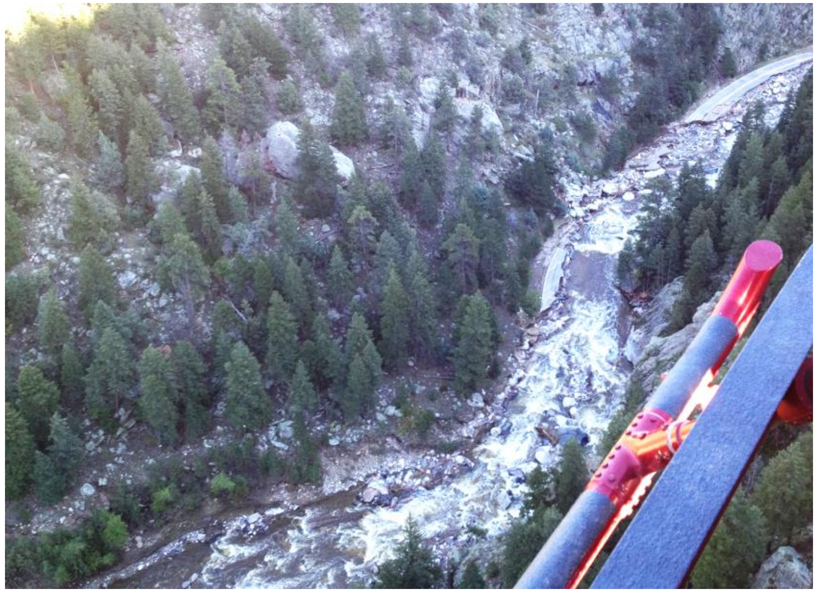
1) Standard built on identifying the locations where each can occur; the combination of the areas defines the fluvial hazard zone.

Ways to Identify Fluvial Hazard Potential

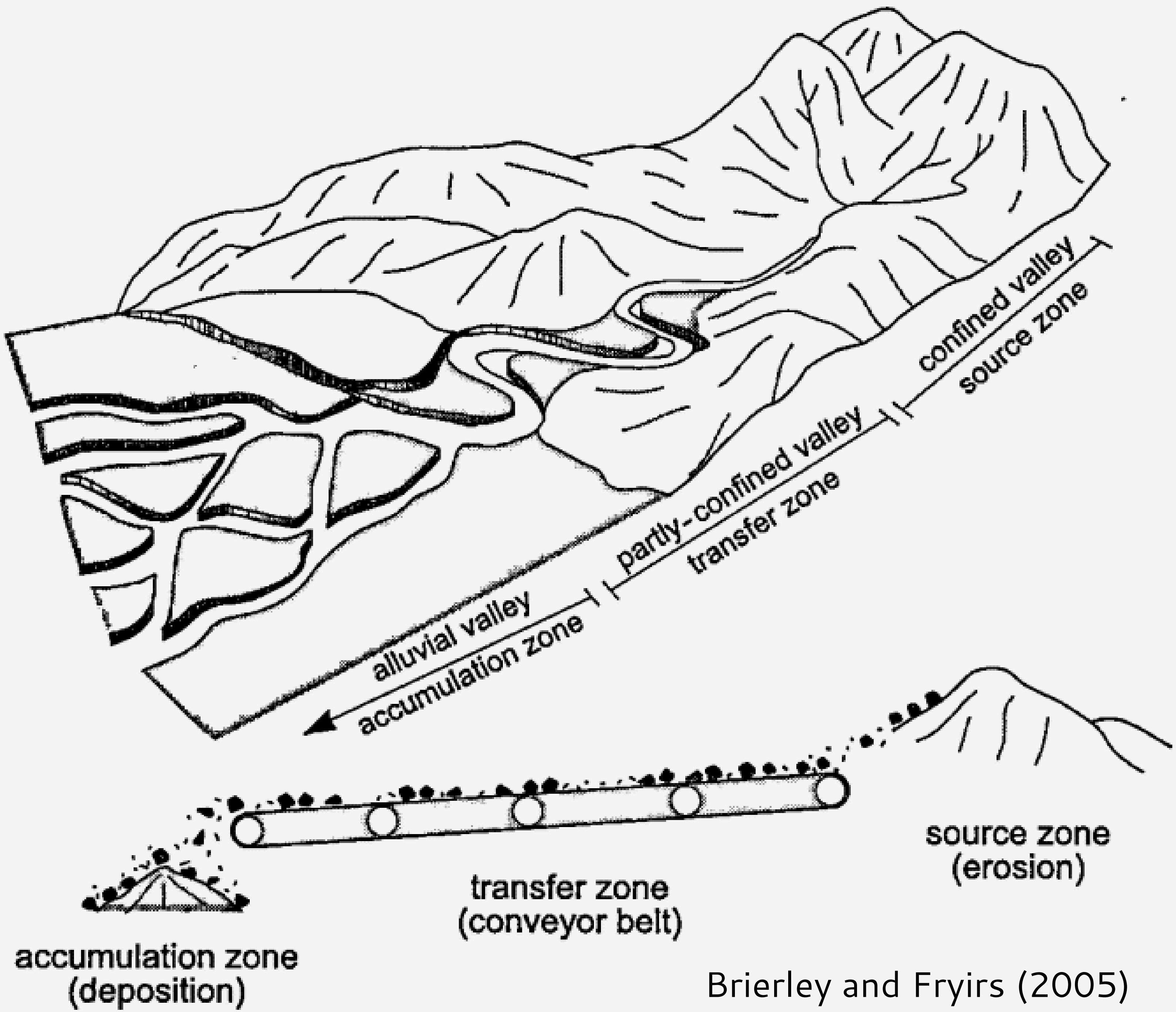
- Geomorphic—ID fluvial landforms and features; assumes indicators of previous river process predict future river process; qualitative river response classification
- Engineering—Calculations for bank stability; misses several types of fluvial hazards
- Numerical Modeling—models run to predict river course. To date, insufficient but progress is being made.

Determining a "Best Fit" Method for Colorado

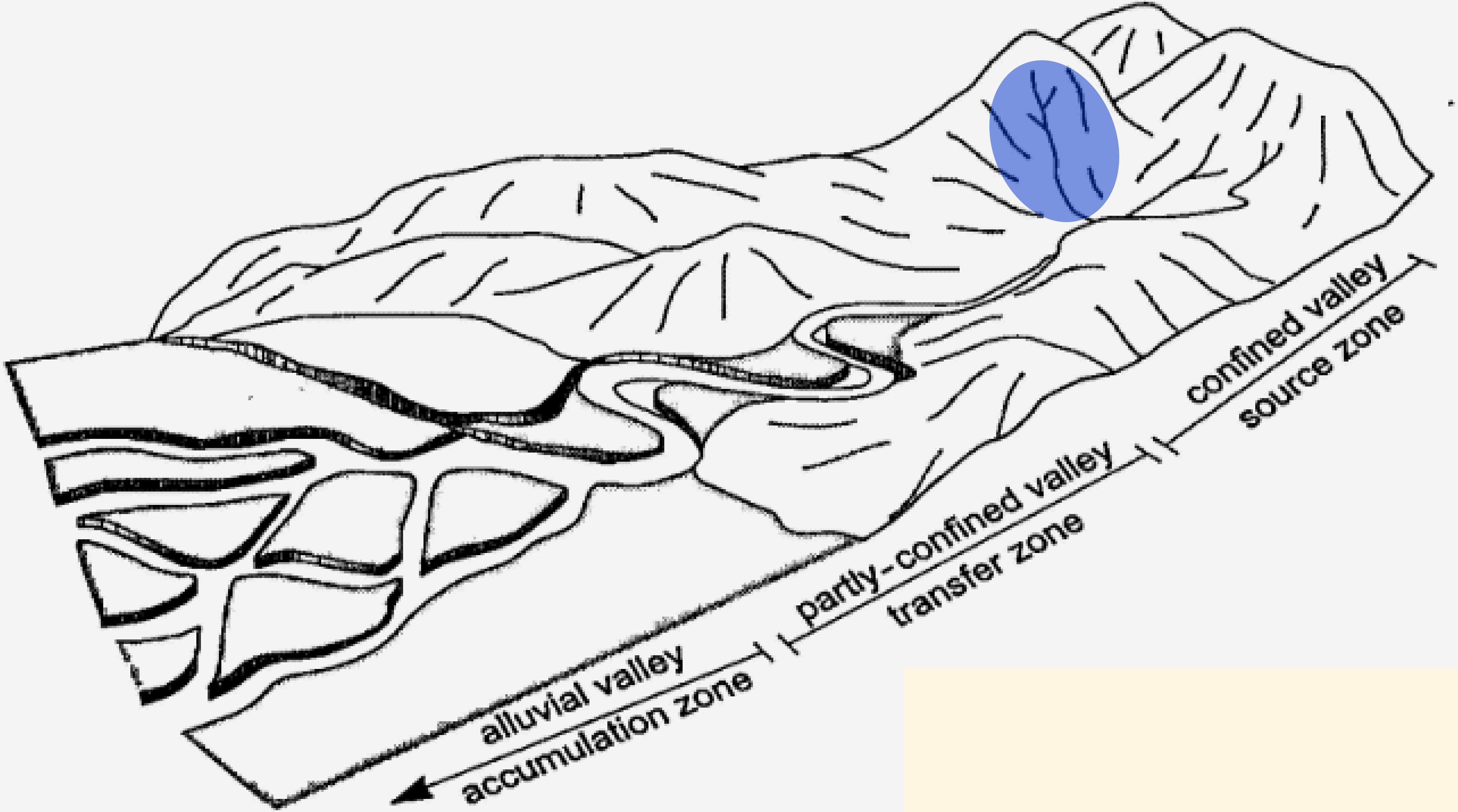
- Diverse topography, geology, and hydrology
  - Geomorphic Framework
- Desire to provide a method that is both cost and time efficient while not being too coarse / conservative
- Identify opportunities for further refinement of the maps based on further detailed studies, observations, and local knowledge.
- Two-tiered approach



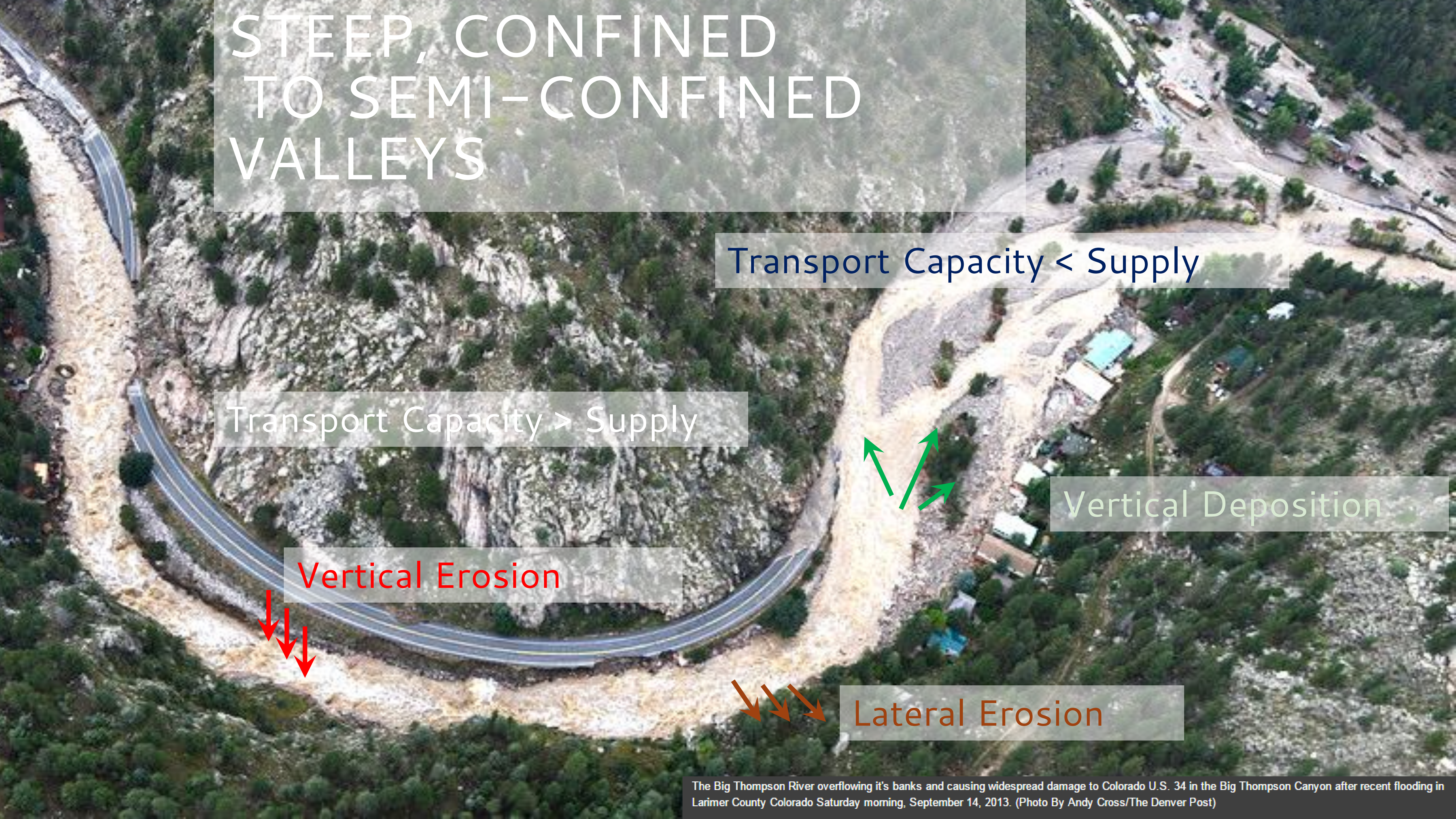
Geomorphic Context for River Response



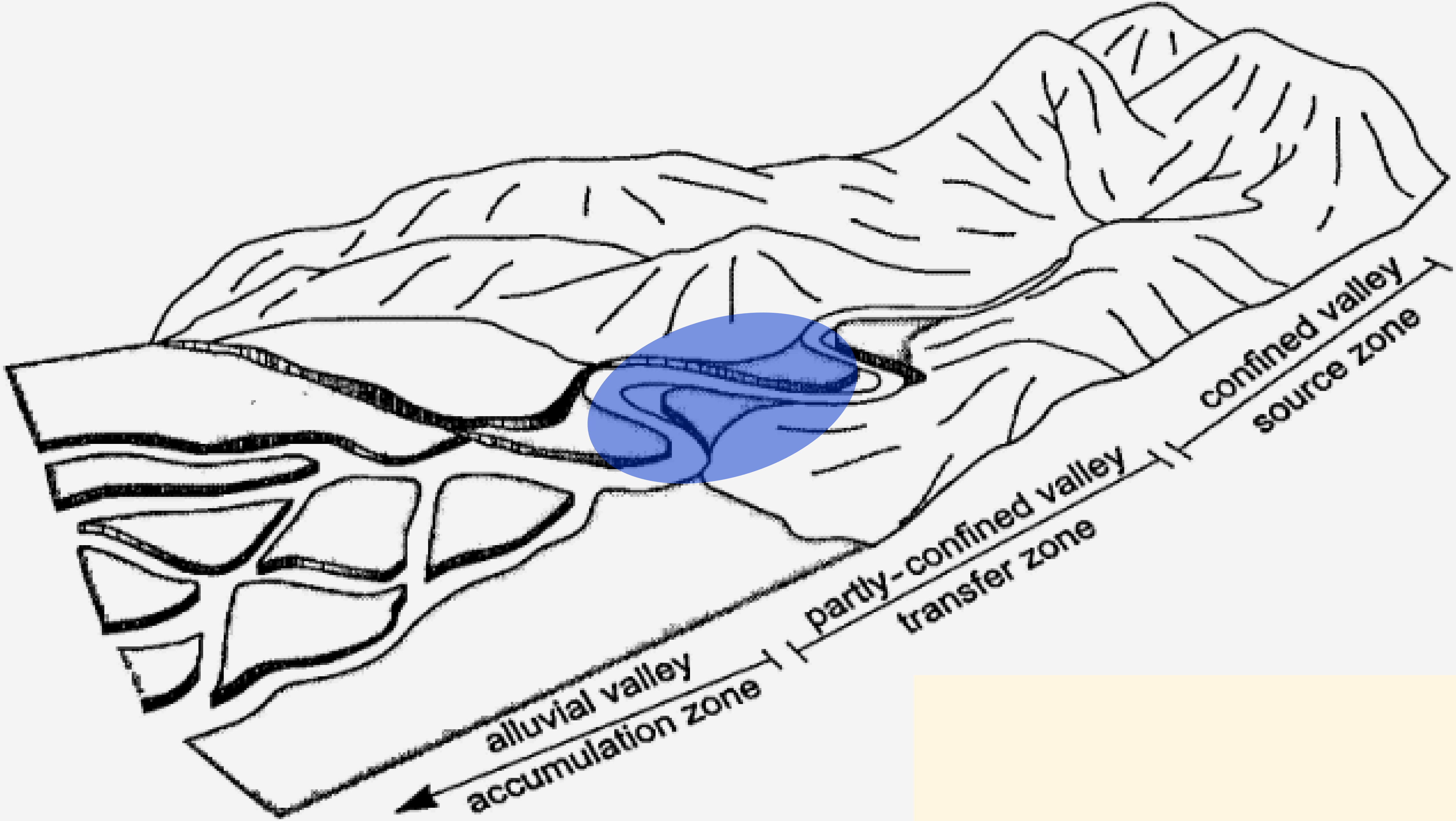
Brierley and Fryirs (2005)


confined valley
source zone
partly-confined valley
transfer zone
alluvial valley
accumulation zone

STEEP, CONFINED TO SEMI-CONFINED VALLEYS



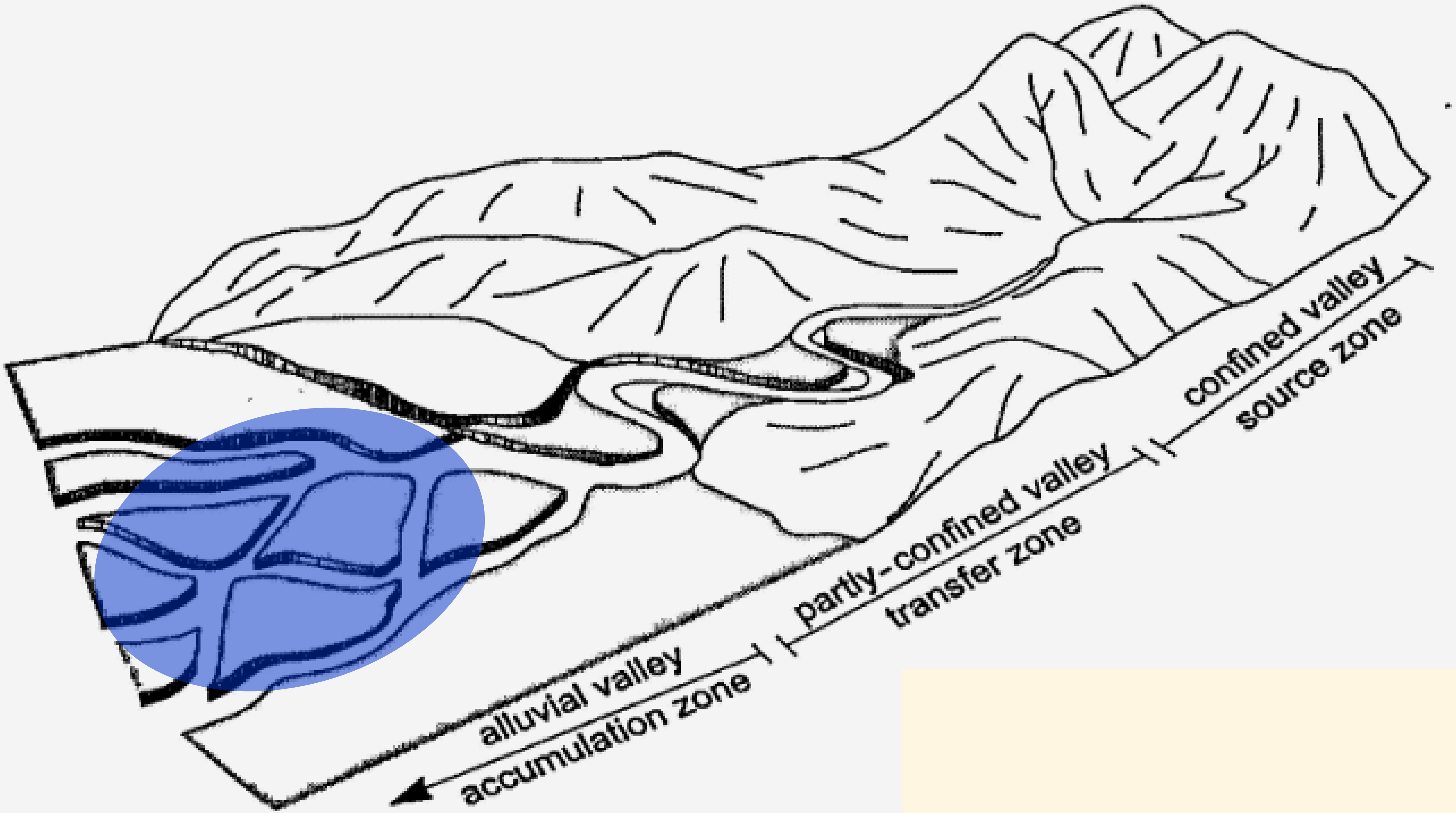
The Big Thompson River overflowing it's banks and causing widespread damage to Colorado U.S. 34 in the Big Thompson Canyon after recent flooding in Larimer County Colorado Saturday morning, September 14, 2013. (Photo By Andy Cross/The Denver Post)


confined valley
source zone
partly-confined valley
transfer zone
alluvial valley
accumulation zone

MODERATELY STEEP, UNCONFINED

MODERATELY STEEP, UNCONFINED

Transport Capacity << Supply


confined valley
source zone
partly-confined valley
transfer zone
alluvial valley
accumulation zone

MILD SLOPE, UNCONFINED

U.S.34 outside Greeley is ripped apart by the South Platte River on Monday, September 16, 2013. (Photo By Tim Rasmussen/The Denver Post)

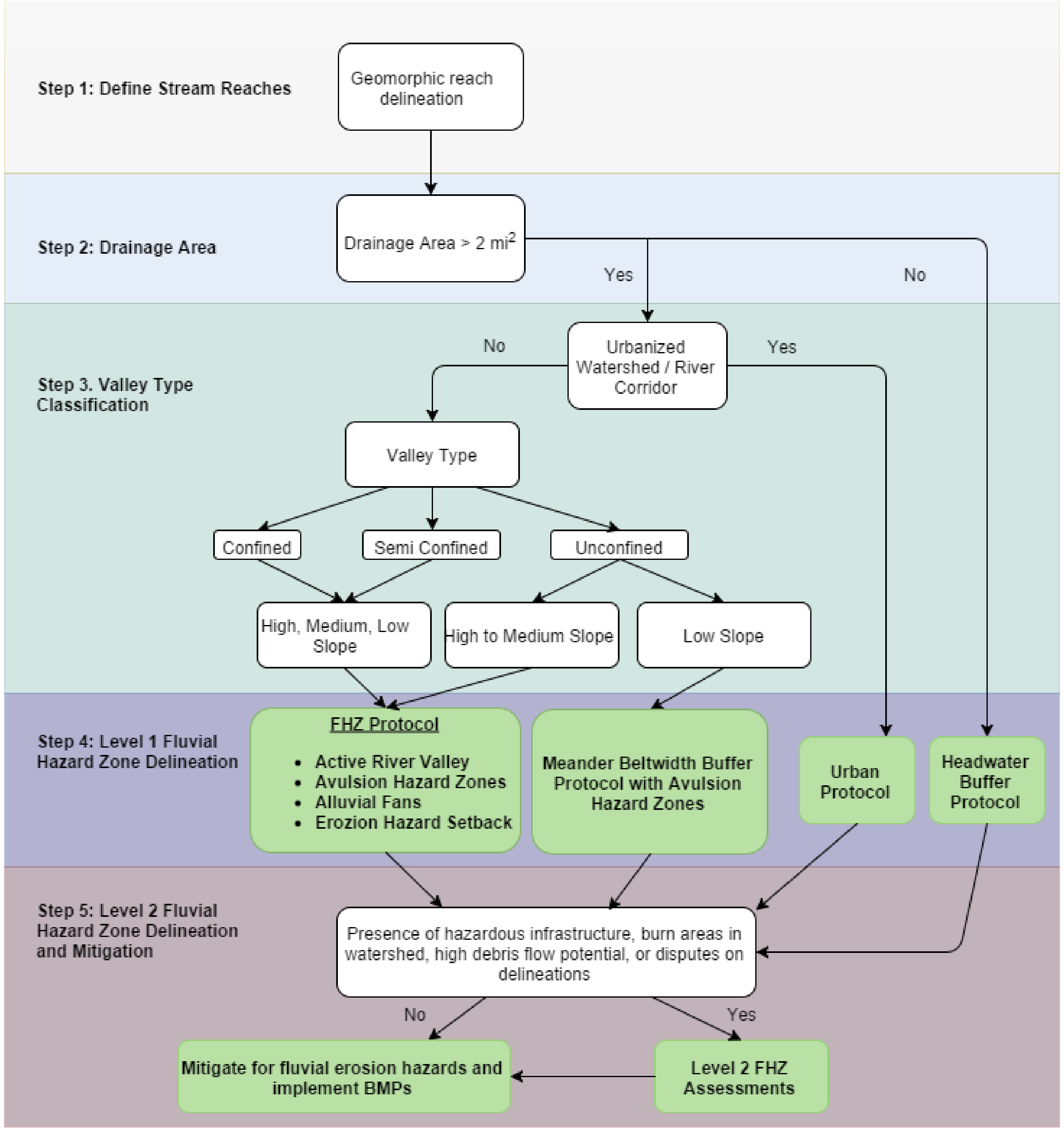
Geomorphic Classification Tools

1. River Styles (Brierley and Fryirs, 2005)
2. Process Domains (Montgomery and MacDonald, 2002)
3. Hydro-Geomorphic Valley Classification (Carlson, Baker, and Bledsoe, 2014)

Desired Outcome

- Qualitative link between geomorphic setting and river response to flood and associated fluvial hazards.
- Ongoing CSU Study
- Valley Classification framework for FHZ Protocols
  - Valley confinement
  - Slope

FHZ Delineation Decision Tree



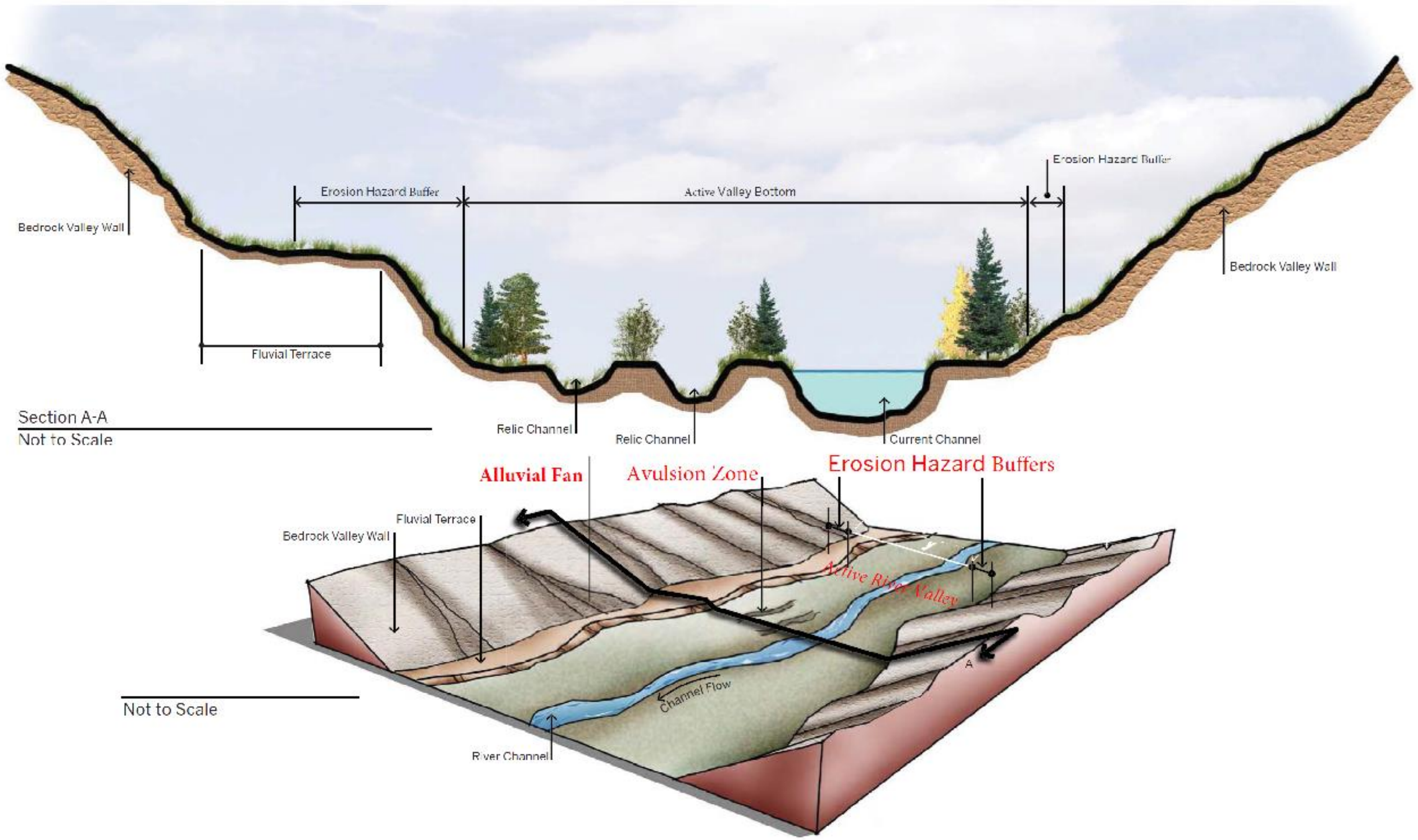
Level 1 Headwaters

Level 1 Headwaters

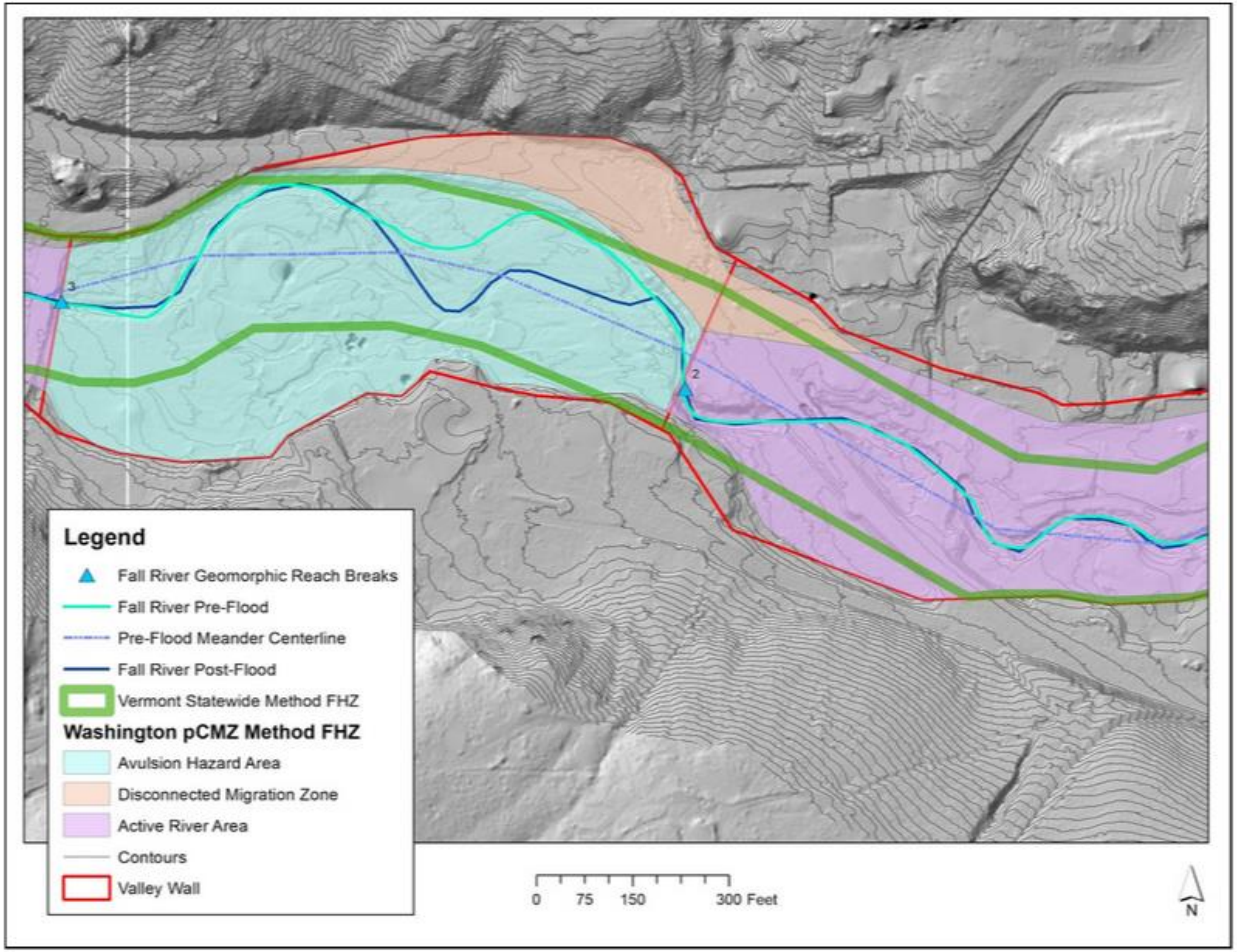
Level 1 FHZ—most alluvial rivers

- 1) The ***active river valley***, where the river has occupied in the past and is likely to occupy again in the future
- 2) The ***erosion hazard buffer*** that generalizes the slope areas prone to erosion as a result of river lateral migration or toe erosion.
- 3) ***Channel avulsion zones*** are those where the channel can dramatically change its position on the valley floor
- 4) ***Alluvial fans*** are depositional features that generally form at the transition from confined to unconfined reaches. An alluvial fan is highly susceptible to avulsion and bank erosion during all peak flow events.

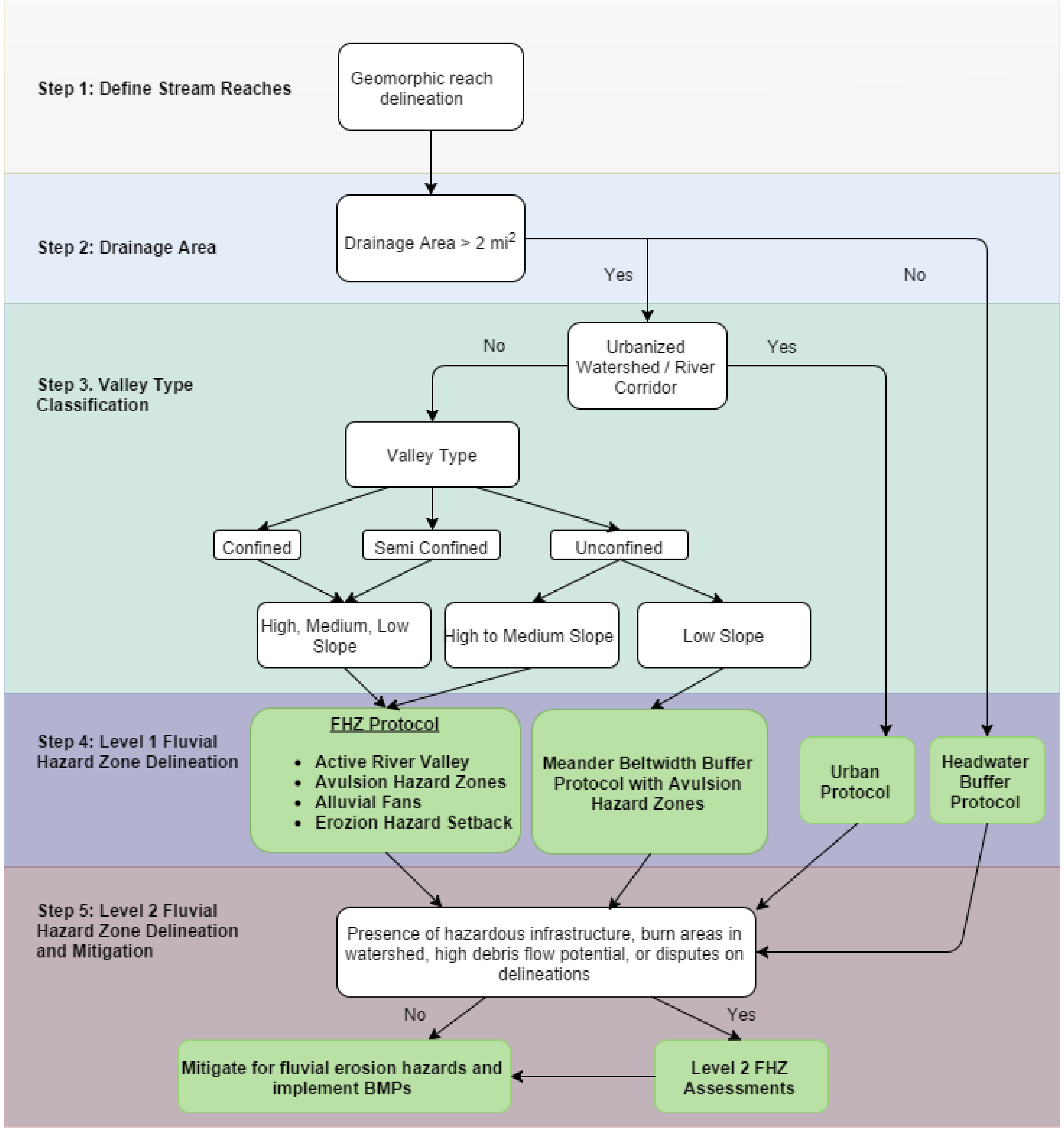
Level 1 FHZ—most alluvial rivers



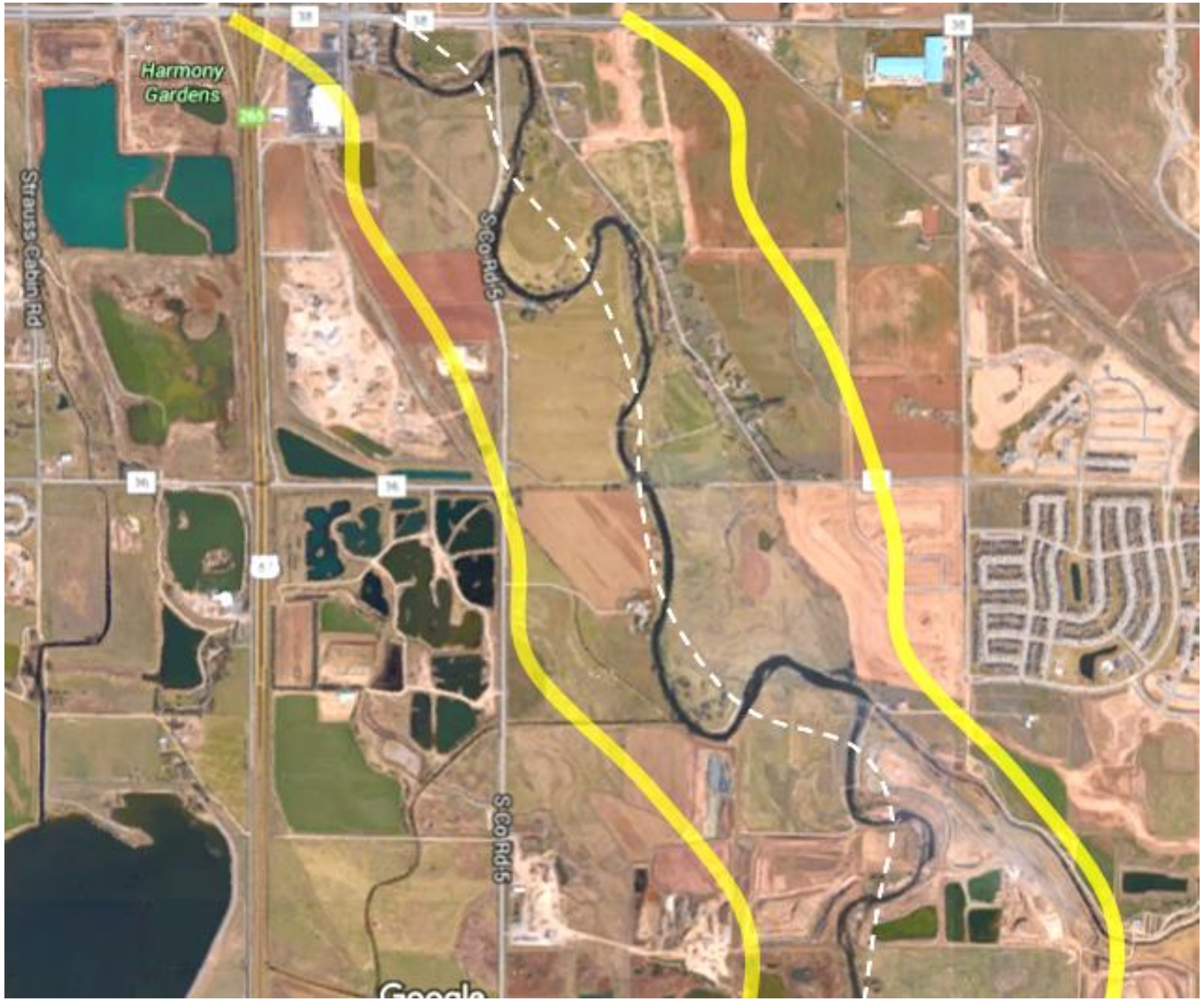
Level 1 FHZ—most alluvial rivers



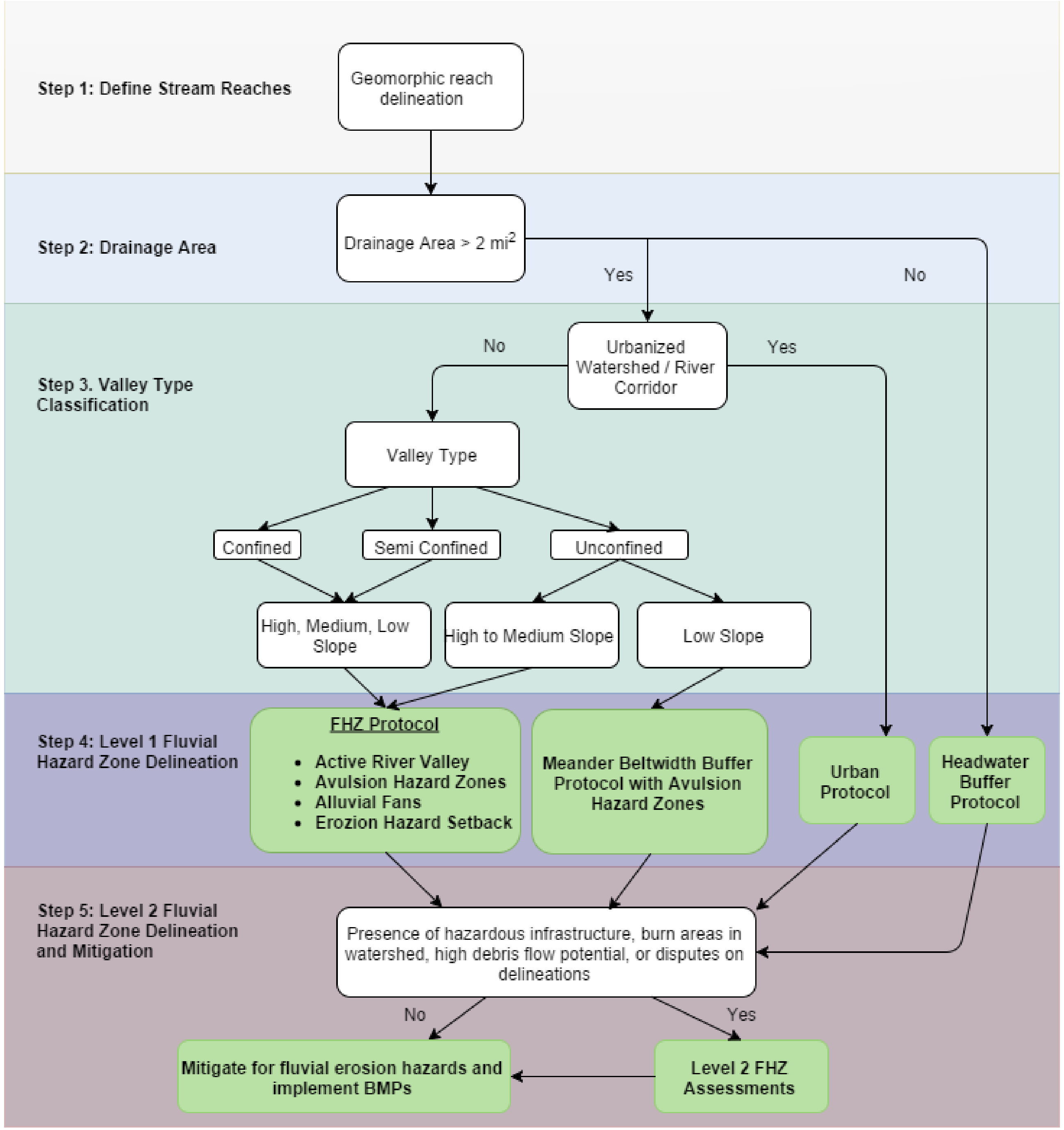
FHZ Delineation Decision Tree



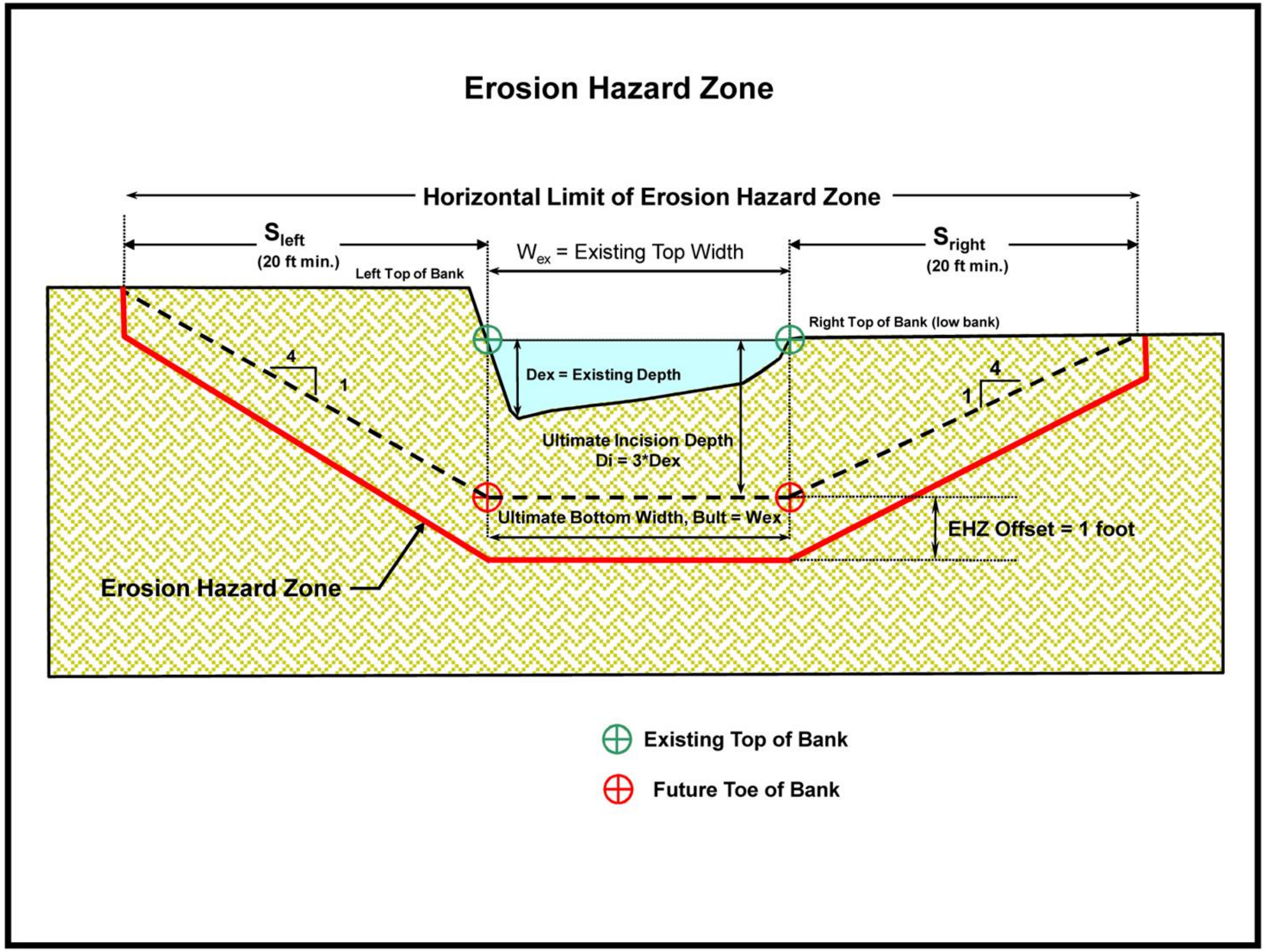
Level 1 Meander Beltwidth



FHZ Delineation Decision Tree

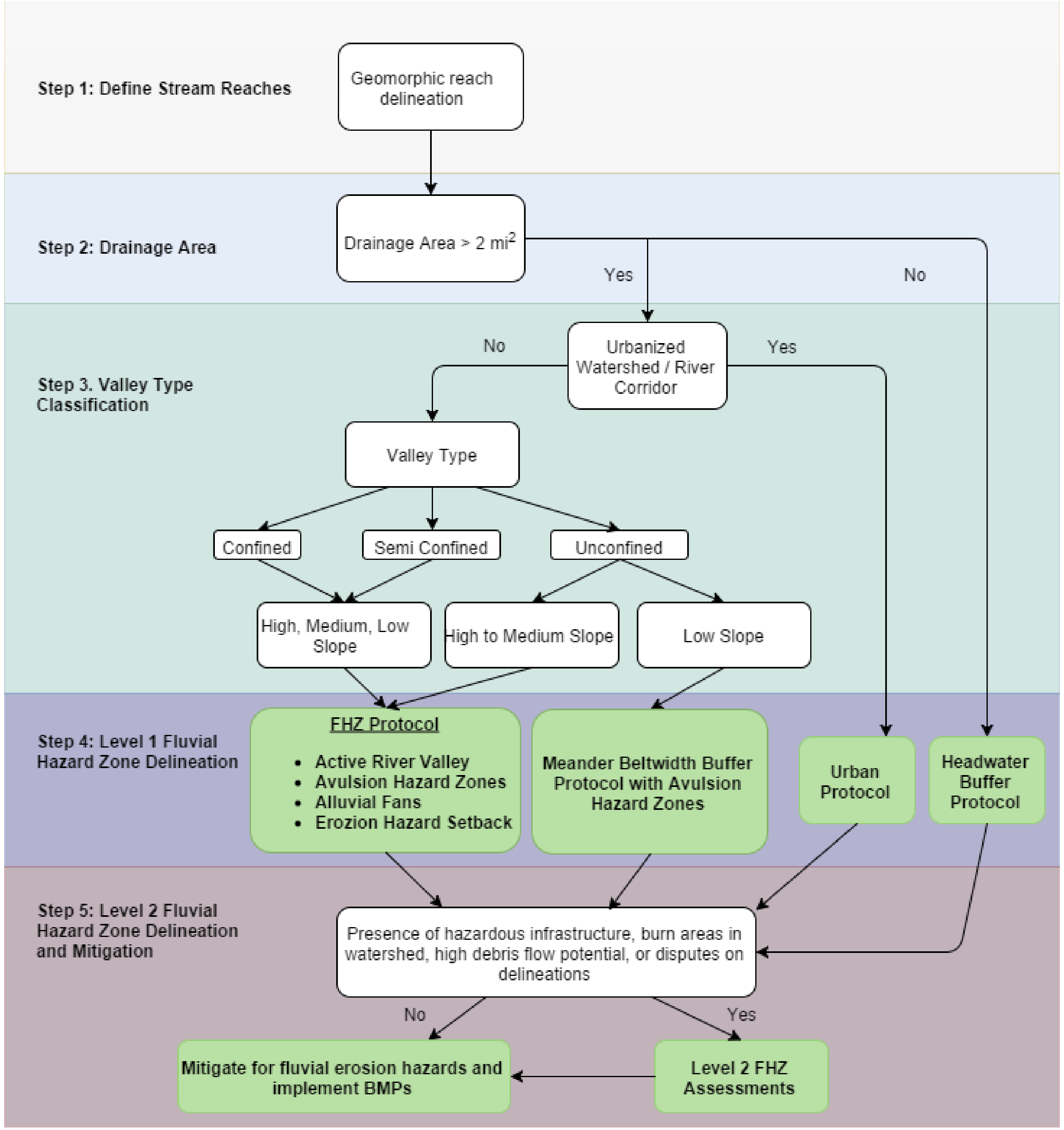


Urban Protocol



City of Austin

FHZ Delineation Decision Tree



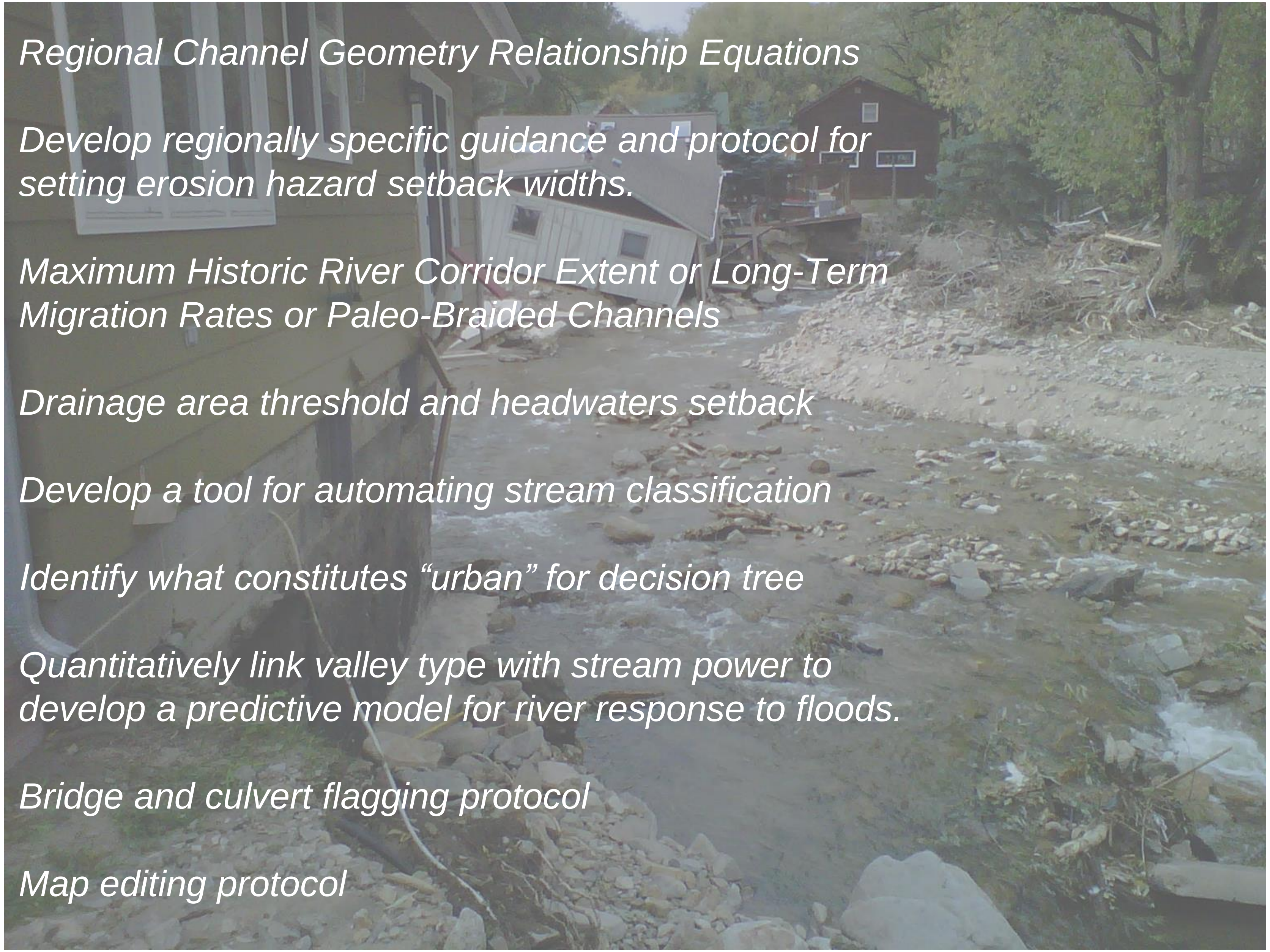
Level 1:
Rapid Field
Verification

Level 2:
Detailed
Analysis

Key Factors in our decision making process

- Level 1 and Level 2 Delineation for rapid planning and refined analysis
- Adopt revised version of all three types of methods used in the United States ➔ could be considered a new method
- Recommend geomorphic classification as framework for FHZ methodologies
- No relative (or absolute) probabilities of hazard within an FHZ
- Time and effort required to develop new and/or refine proposed protocol

Additional Research Needs



Regional Channel Geometry Relationship Equations

Develop regionally specific guidance and protocol for setting erosion hazard setback widths.

Maximum Historic River Corridor Extent or Long-Term Migration Rates or Paleo-Braided Channels

Drainage area threshold and headwaters setback

Develop a tool for automating stream classification

Identify what constitutes “urban” for decision tree

Quantitatively link valley type with stream power to develop a predictive model for river response to floods.

Bridge and culvert flagging protocol

Map editing protocol