East Fork of the Carson River at Virginia Rocky Diversion

Hydraulic and geomorphic analysis with implications for bank stabilization

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Douglas COUNTY, NV

Great people. Great places.

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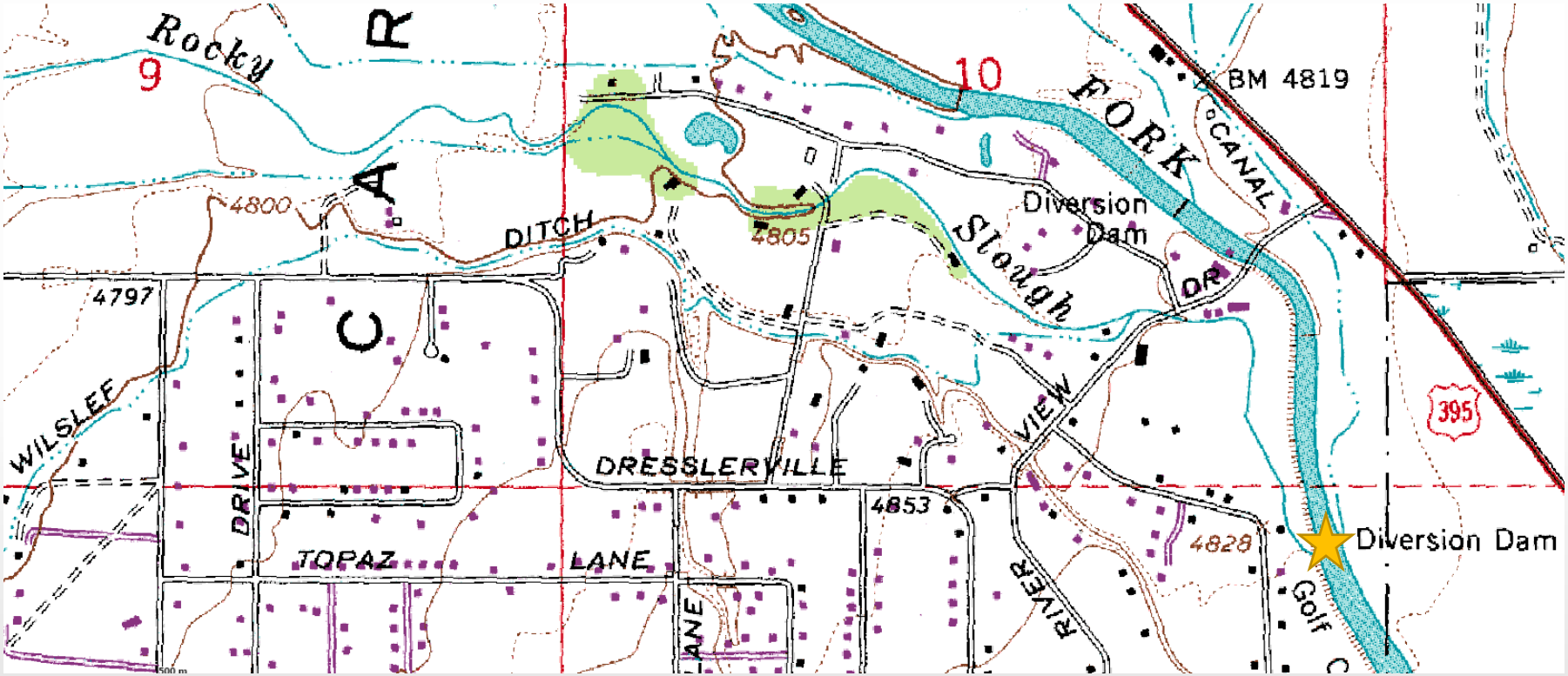
Location and Importance of Diversion Dam



Decreed Irrigated Acreage*:

Virginia Canal – 413

Allerman Canal – 7,543

Rocky Slough – 1,021

Edna Wilself Ditch – 1,365

*River-Operations Model for Upper Carson River Basin, California and Nevada – USGS Report 98-4240

Problem Statement

- The rate of bank erosion upstream of the Virginia Rocky Diversion has increased
- Ongoing bank retreat could lead to avulsion
- Avulsion would affect the community…
  - Flanking the diversion affects the livelihood of irrigators
  - Potential to alter flood patterns and increase flood risk

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Key Questions

- What is the risk of avulsion?

- If the risk is significant, what design/ management alternatives are feasible and consistent with local and regional watershed and floodplain management plans?

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Our Approach

- Define project goals and objectives (i.e. key questions)
- Review background reports/data
- Characterize key processes
- Fill in gaps with additional site-specific work
- Assess the risk of channel avulsion
- Preliminary design/management approaches

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Location

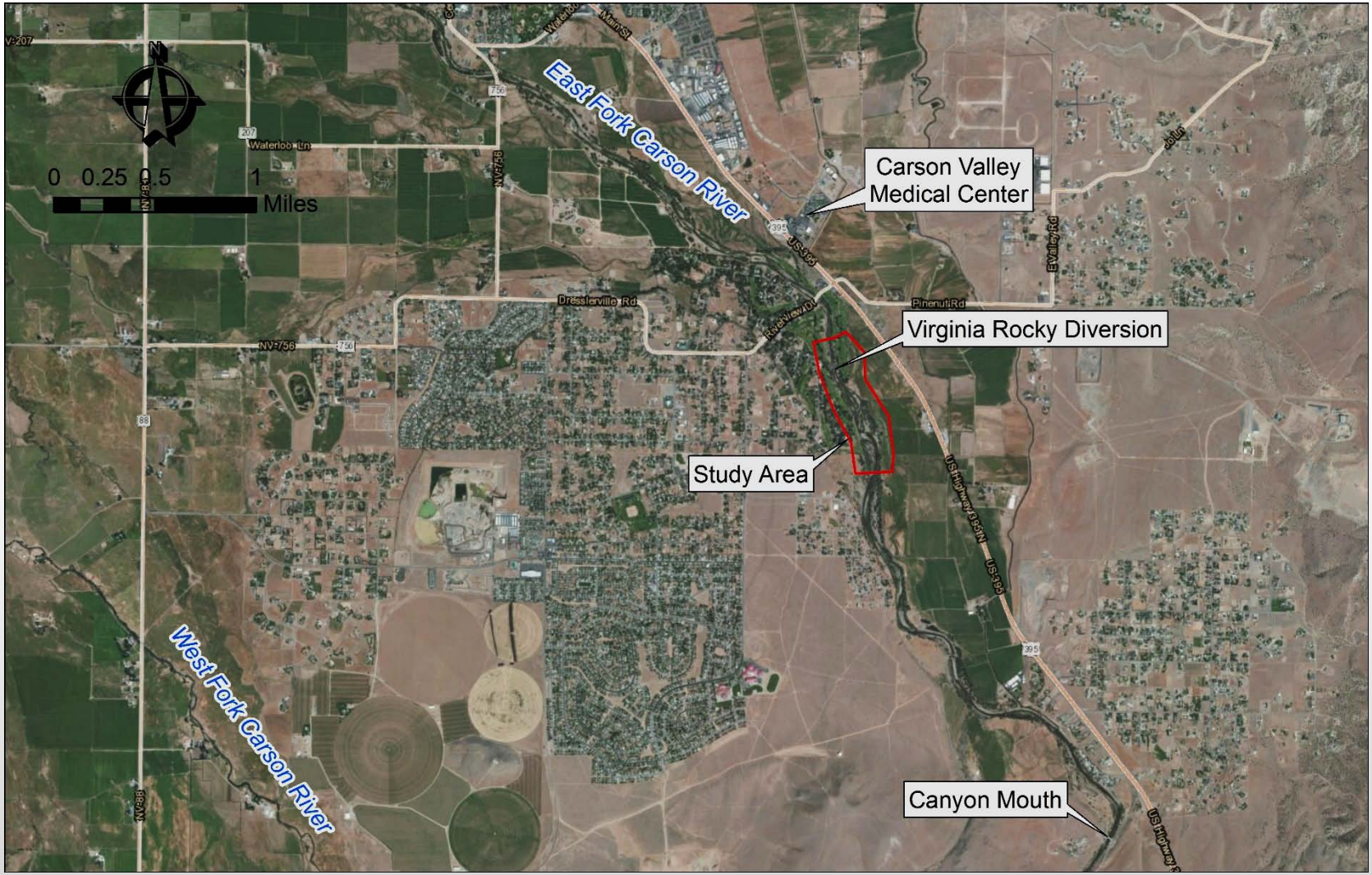
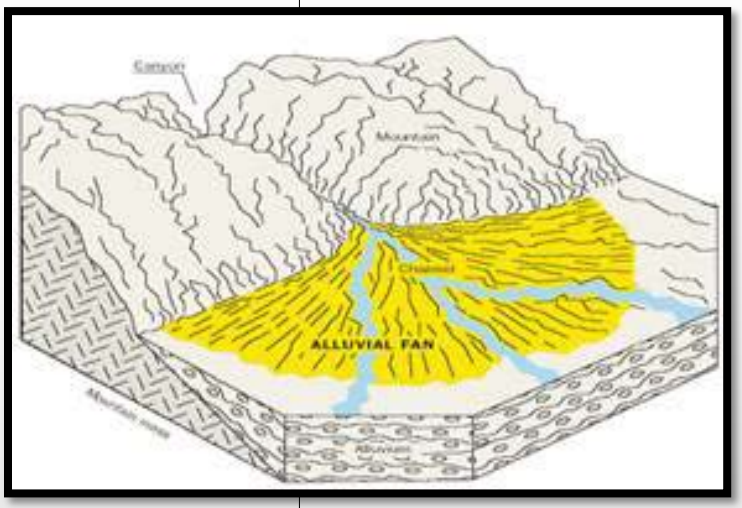


Image credit: ESRI ArcGIS Online and data partners

Geology and Soils



Virginia Rocky Diversion

Unstable bank

Map credit: de Polo and others (2000)

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Sediment Transport

- The study reach is characterized by aggradation
- High sediment supply from steep, narrow canyon
- Abrupt slope transition at canyon mouth (2% to less than 0.5%)
- Diversion enhances aggradation

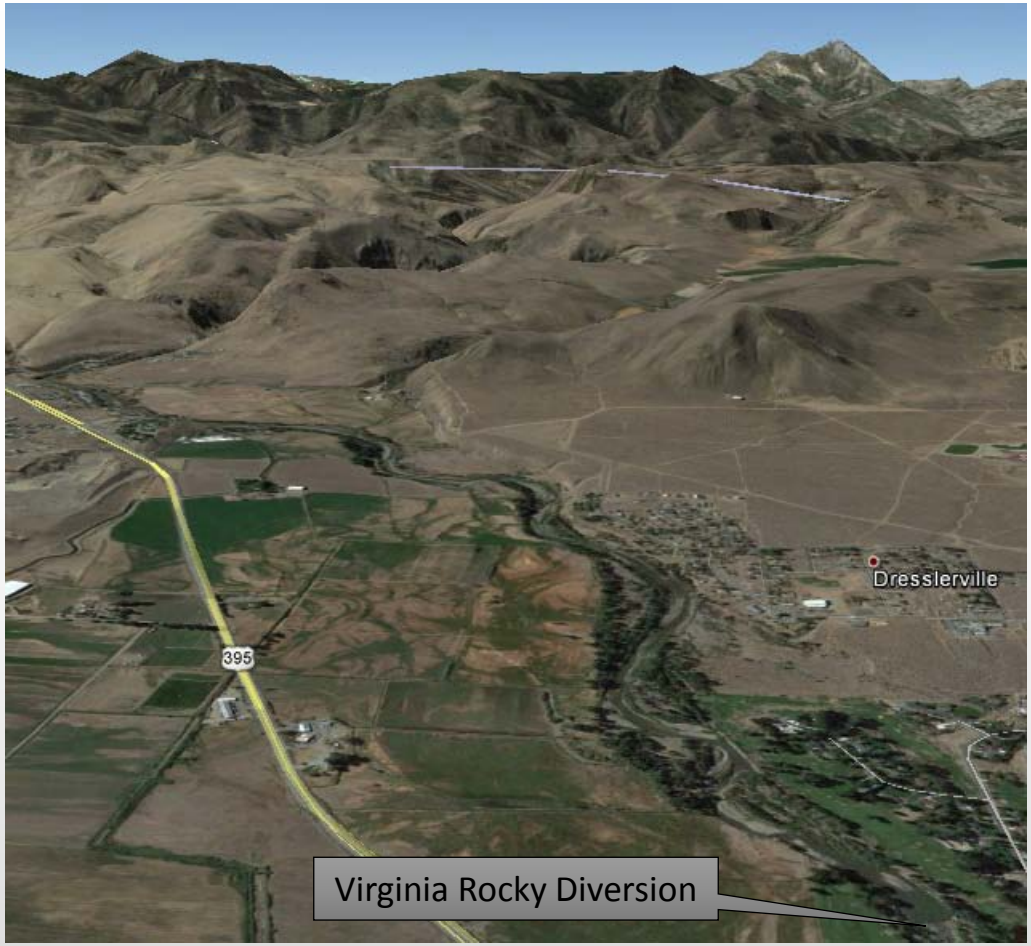

Image credit: Google Earth, USGS, NASA, and Digital Globe (2015)

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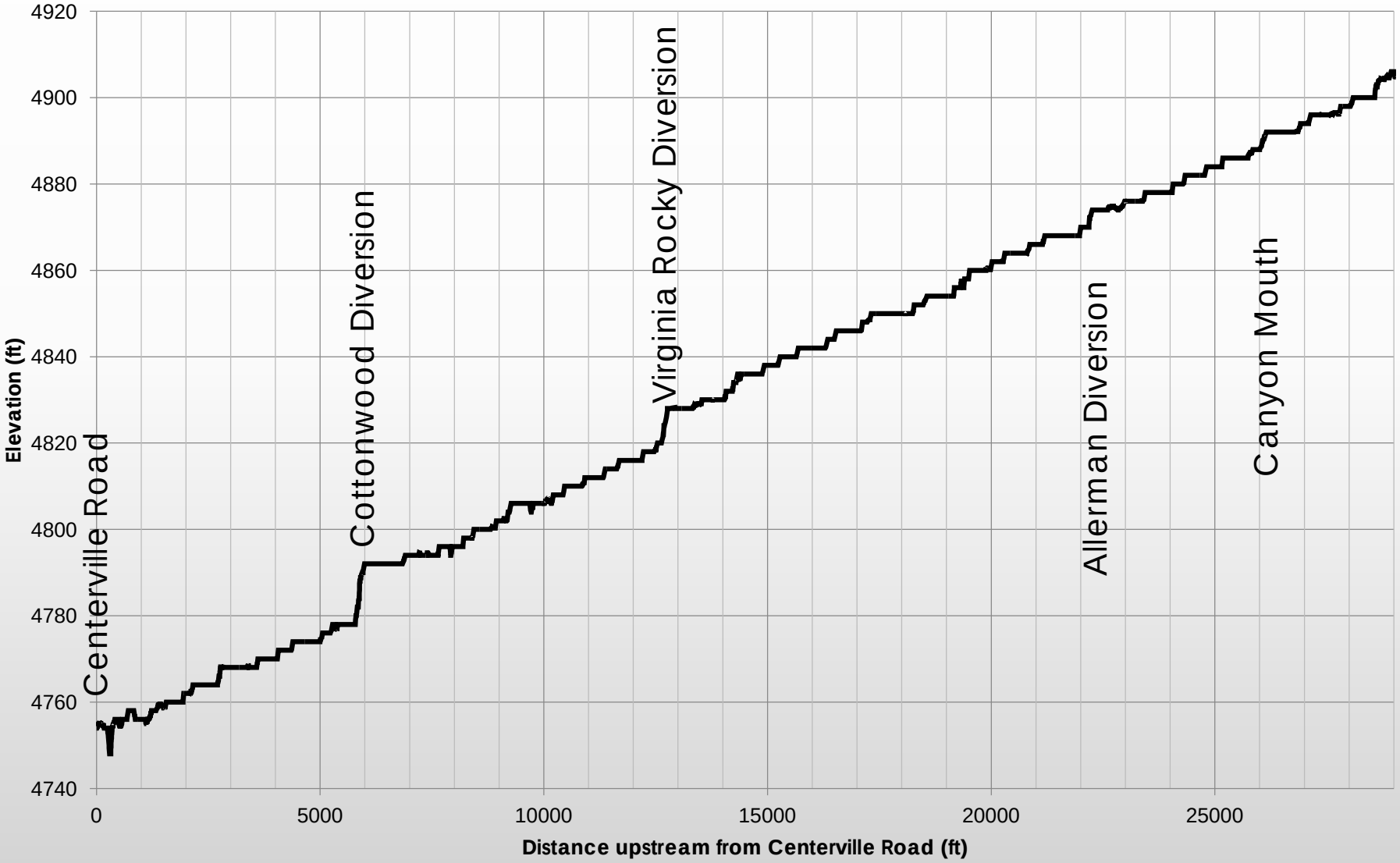
Sediment Transport



Sediment Transport

- Inter-Fluve (1997) described how aggradation in the reach is causing widening
- Katzer and Bennett (1980) demonstrated the reach to be aggradational with a computational model
  - Their study reach was much larger (10.5 miles) though the model predicted positive bed change upstream from Virginia Rocky Diversion

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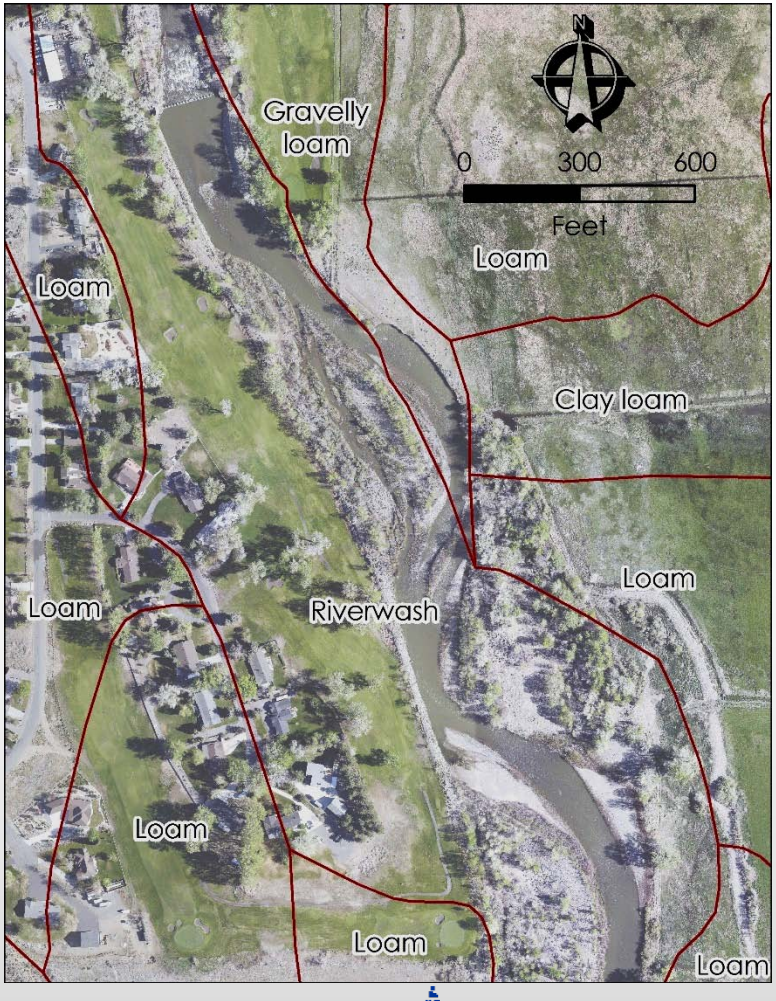
Geology and Soils

- Levee is forcing channel to the east out of its historical meander belt
- Development of bar is accelerating rate of bank retreat



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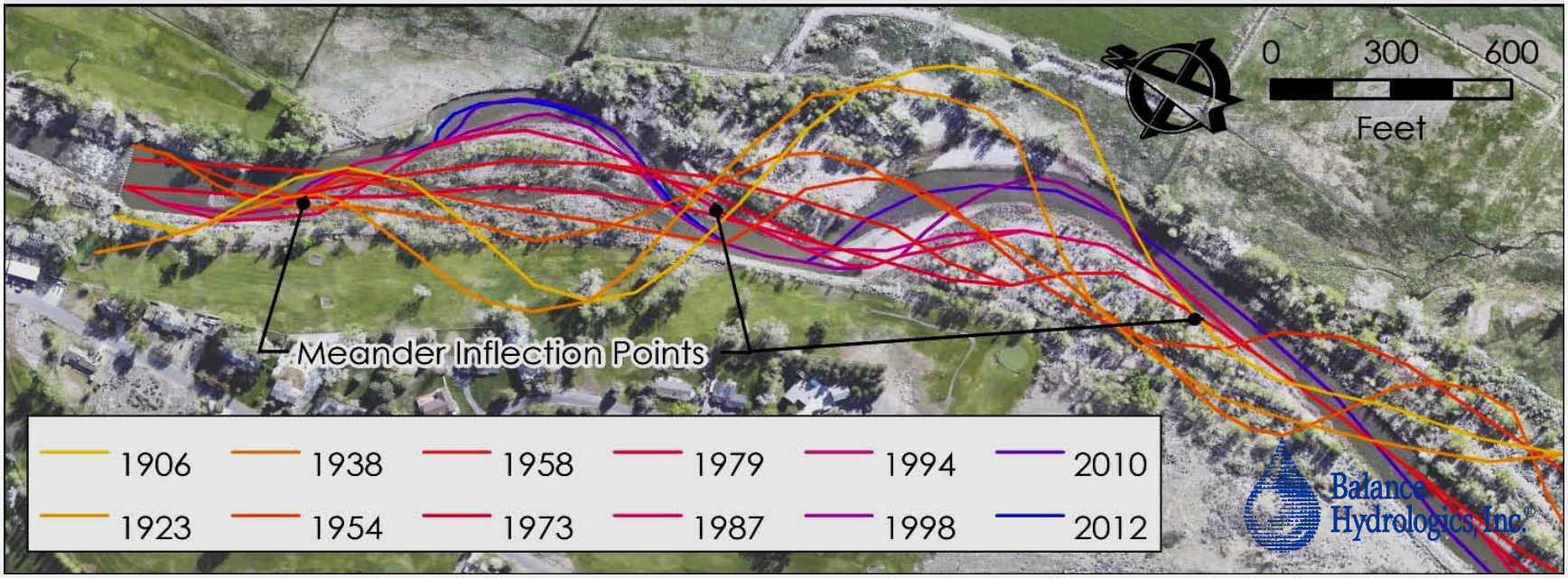
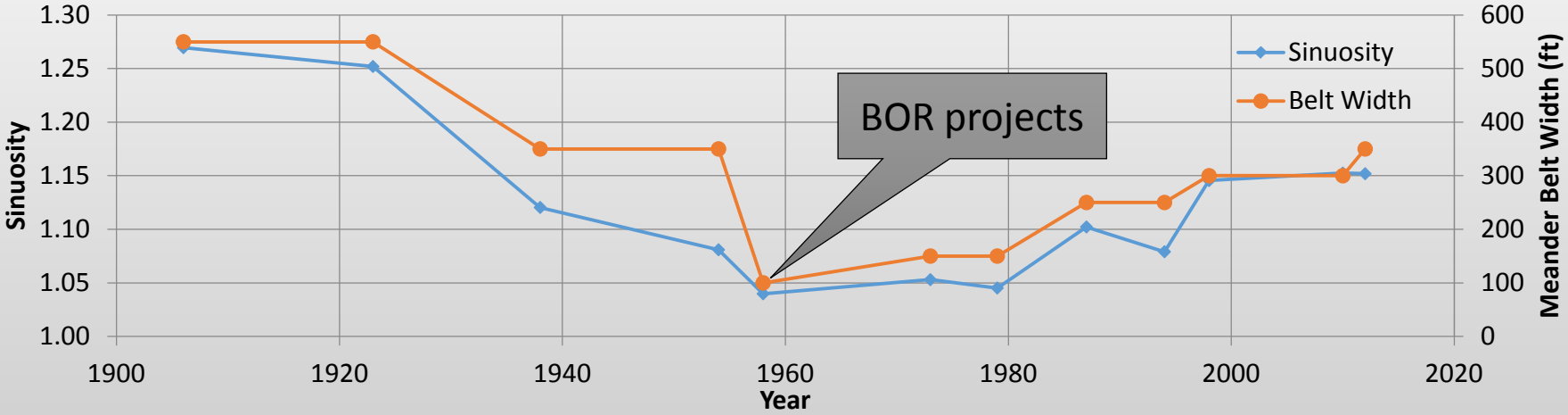
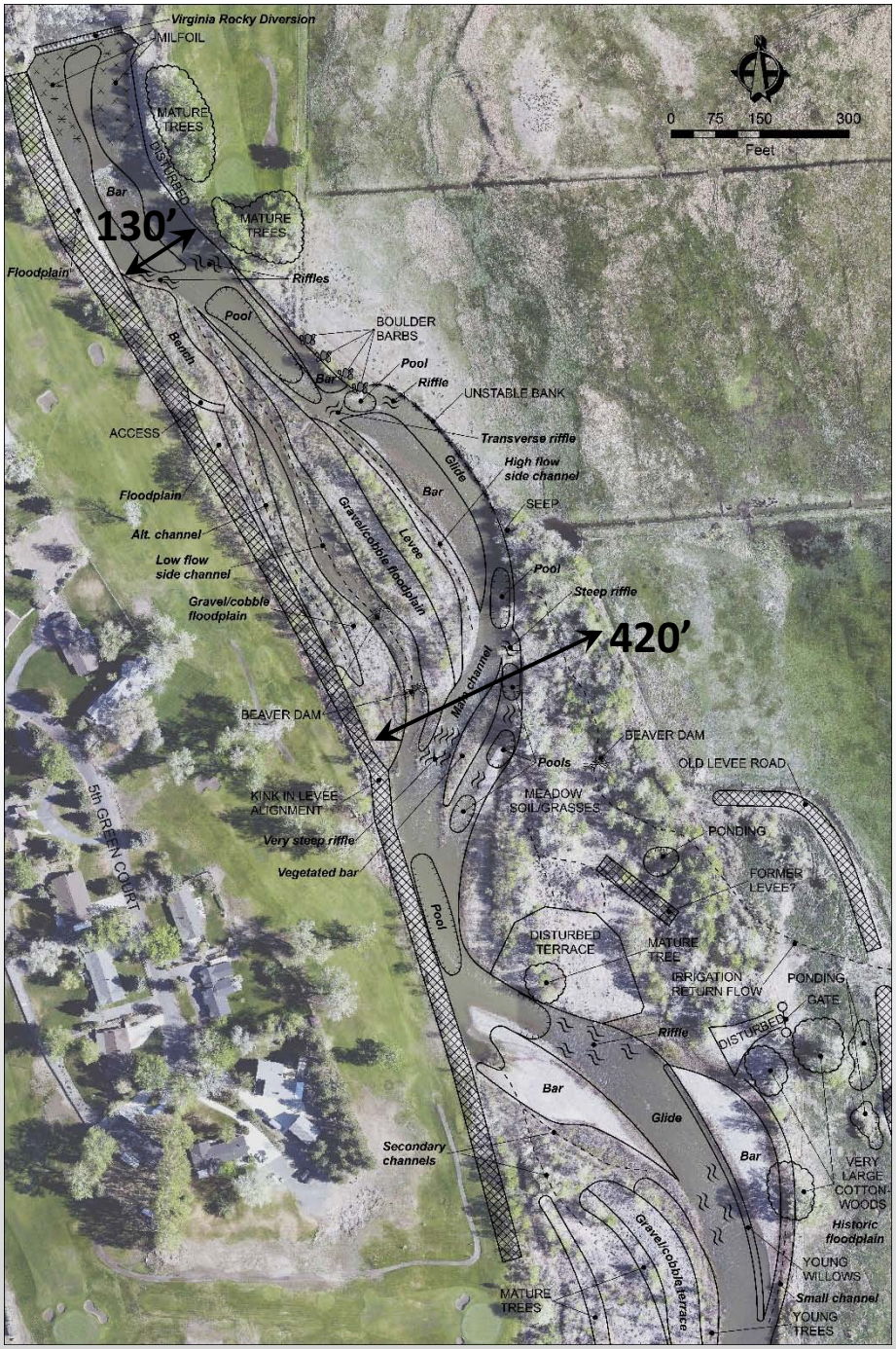
Sinuosity and Meander Belt Width



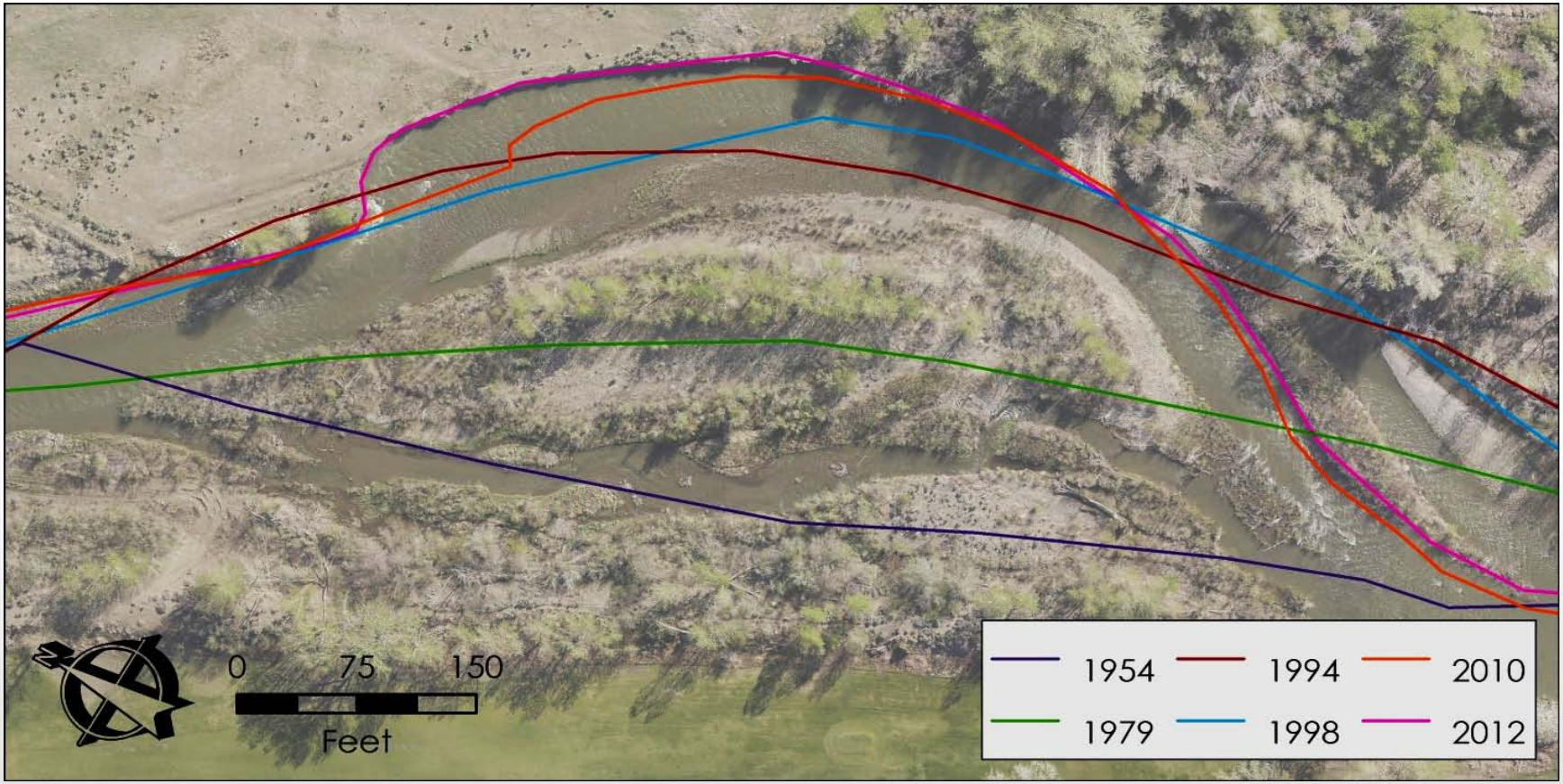


Floodplain Widening

- Within the channel there are different recent surfaces from the past 100 years
- Starting to see inset floodplain widening and establishment since BOR projects



Rates of Bank Retreat



- Note control on bank shape by boulder barbs

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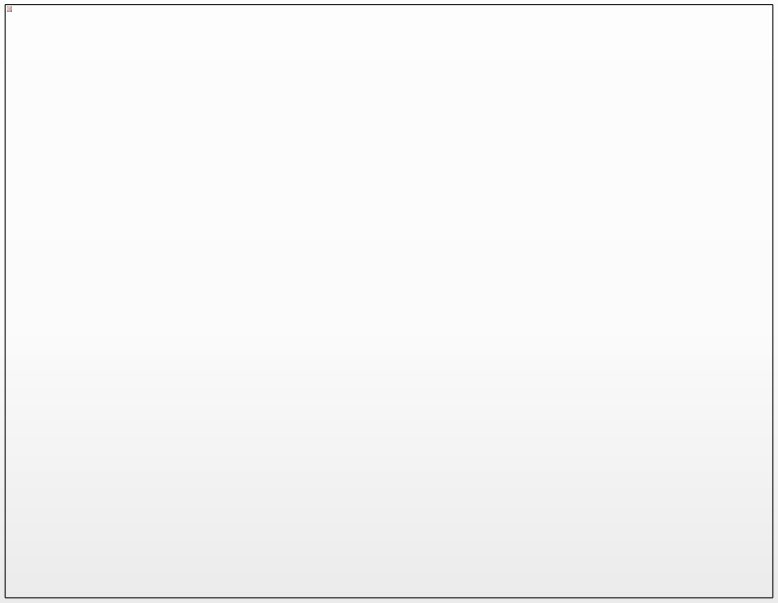
Bank Retreat is Episodic



May 13, 2011

June 16, 2011

Photos credit: Gary Aiazzi, Allerman-Upper Virginia Irrigation Company

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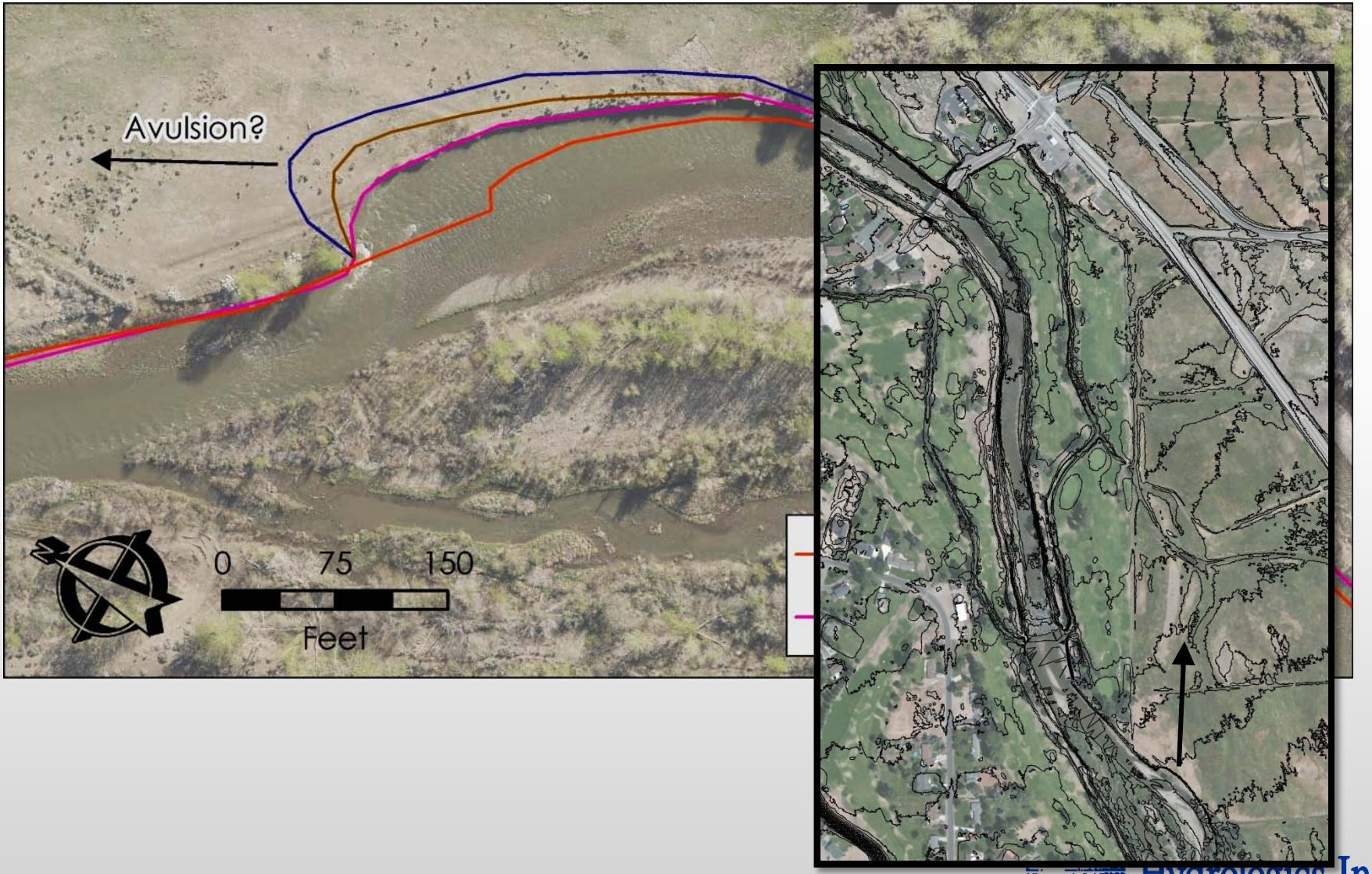
Future Bank Retreat



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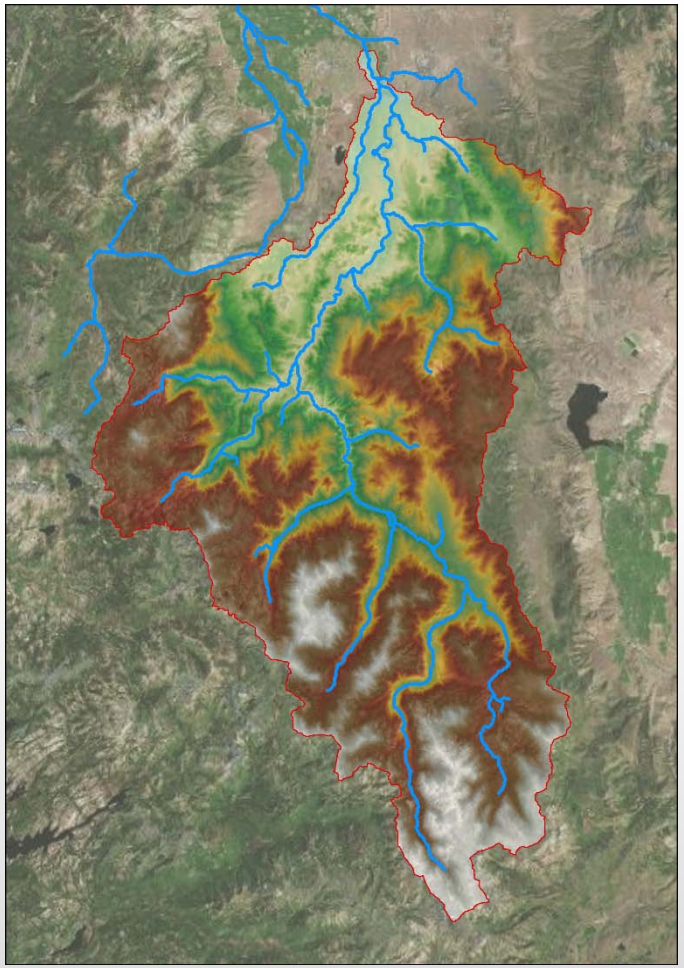
Hydrology

- 400+ square mile watershed
- Annual peaks typically from spring snowmelt runoff
- Extreme peaks have been from rain-on-snow events



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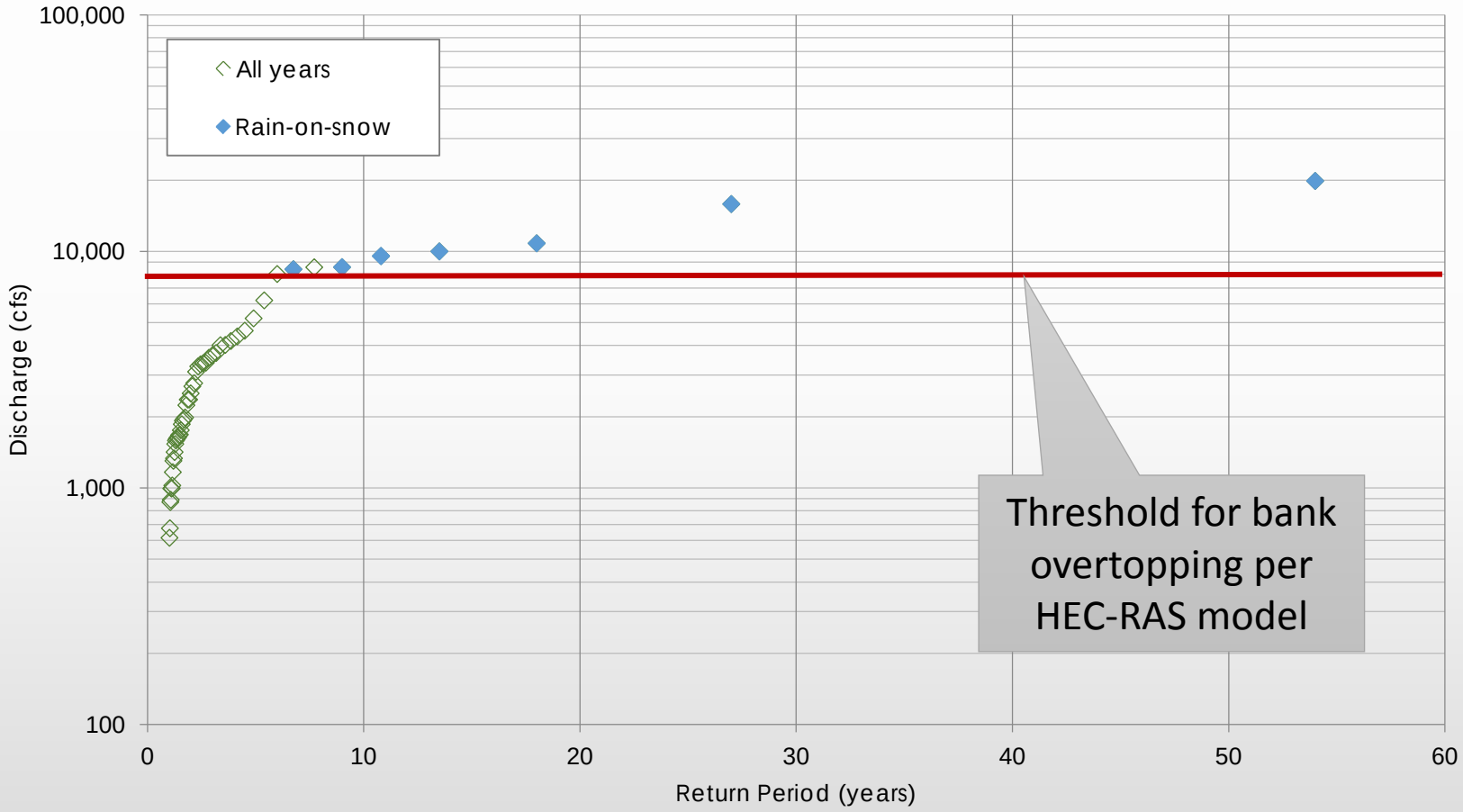
Hydrology



Data are from USGS Gage 10308200 (East Fork of the Carson River near Markleville, CA)

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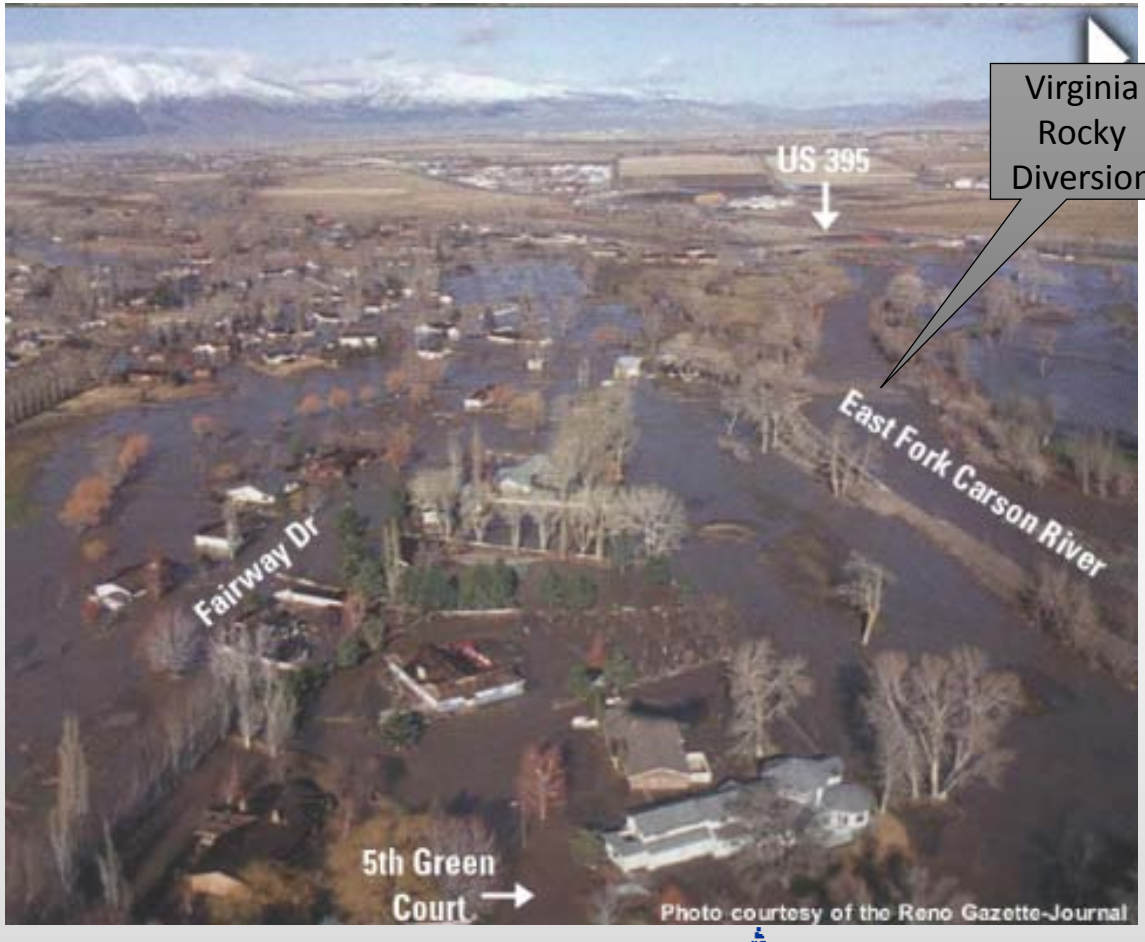
Hydraulics

- Flooding in Carson Valley has always been broad and shallow



Flooding from the New Years 1997 event
Image credit: USGS and Reno Gazette-Journal

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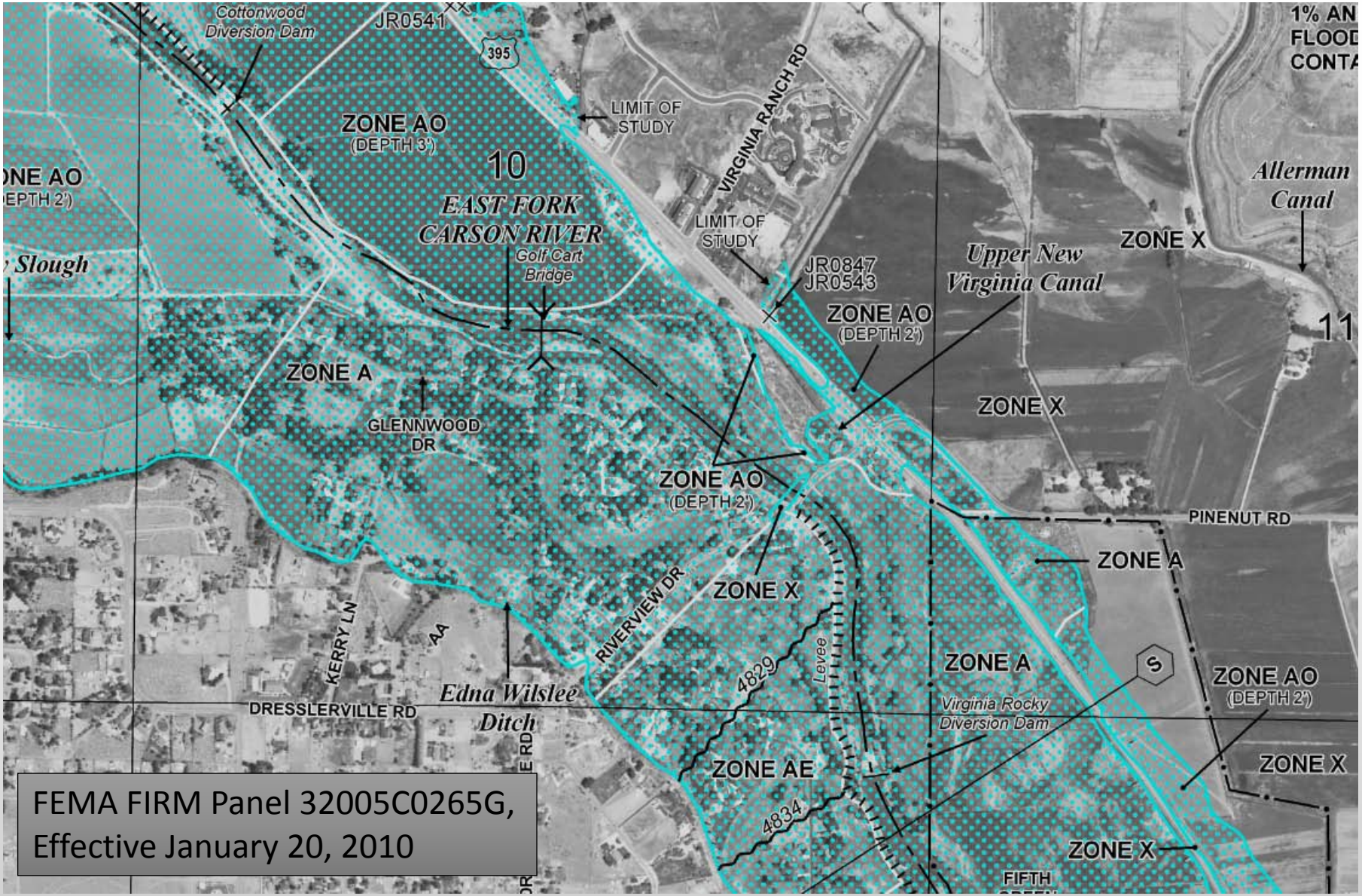
Existing Flood Pattern



FEMA FIRM Panel 32005C0265G,
Effective January 20, 2010

Future Potential Flood Pattern

- If channel avulses, levees and boulder barbs will keep channel to east
- Flow capture by irrigation channels and natural depressions
- Ongoing bank retreat lowers bank height, increases flood frequency

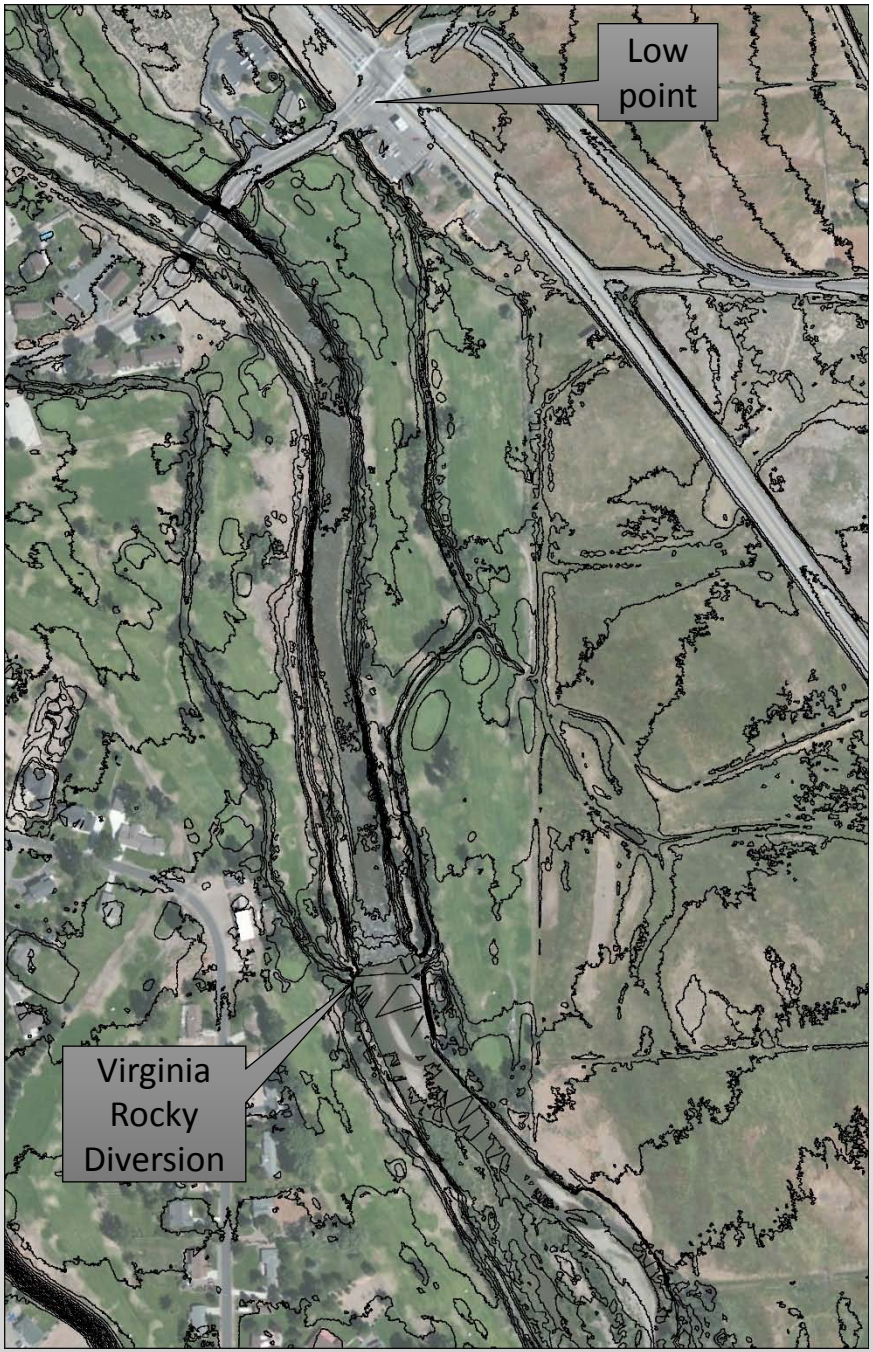


Image credit: ESRI ArcGIS Online and data partners

Risk of Avulsion is Significant

- Meander development affected by hard structures
- Ongoing adjustments expected
- Rain-on-snow events may become more frequent with climate change
- Lack of scouring flows allowing vegetation to encroach

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Next Step: Design Solutions

- How to maintain the diversion point AND enhance function of the river system?
- Extend reference meander belt width downstream and reduce severity of transition
- Provide flood relief to reduce right bank stress
- Biostabilization where possible
- Irrigation canals for flood relief

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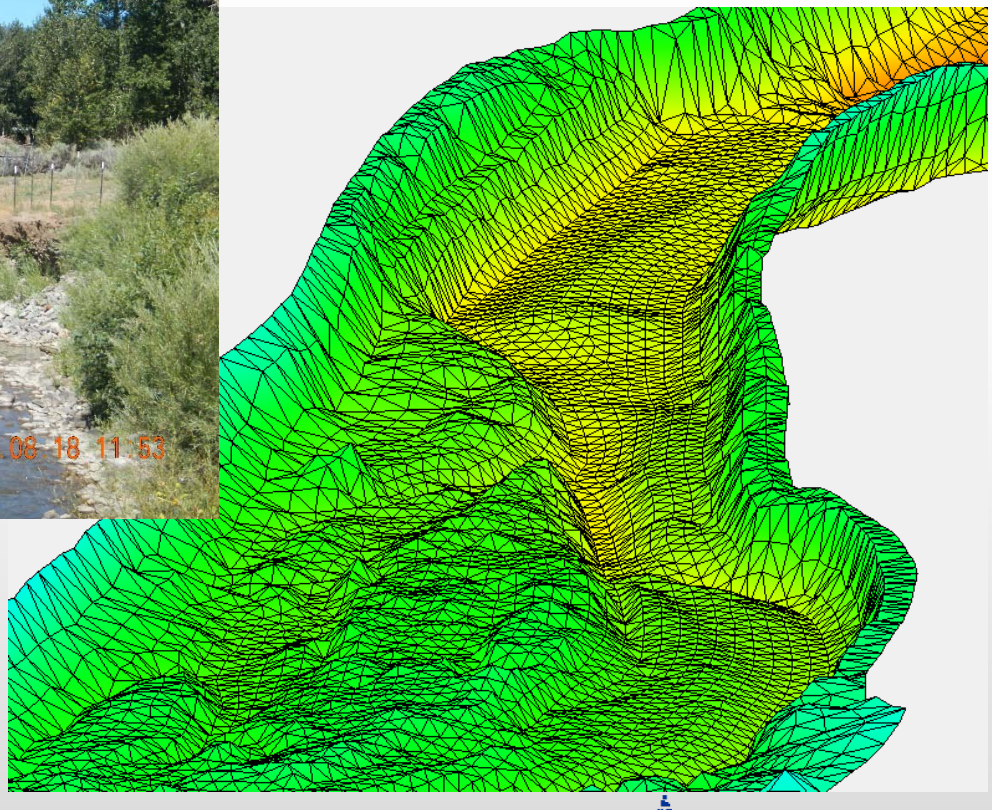
Design Solutions Tools



- 2D modeling to quantify bank stress reductions

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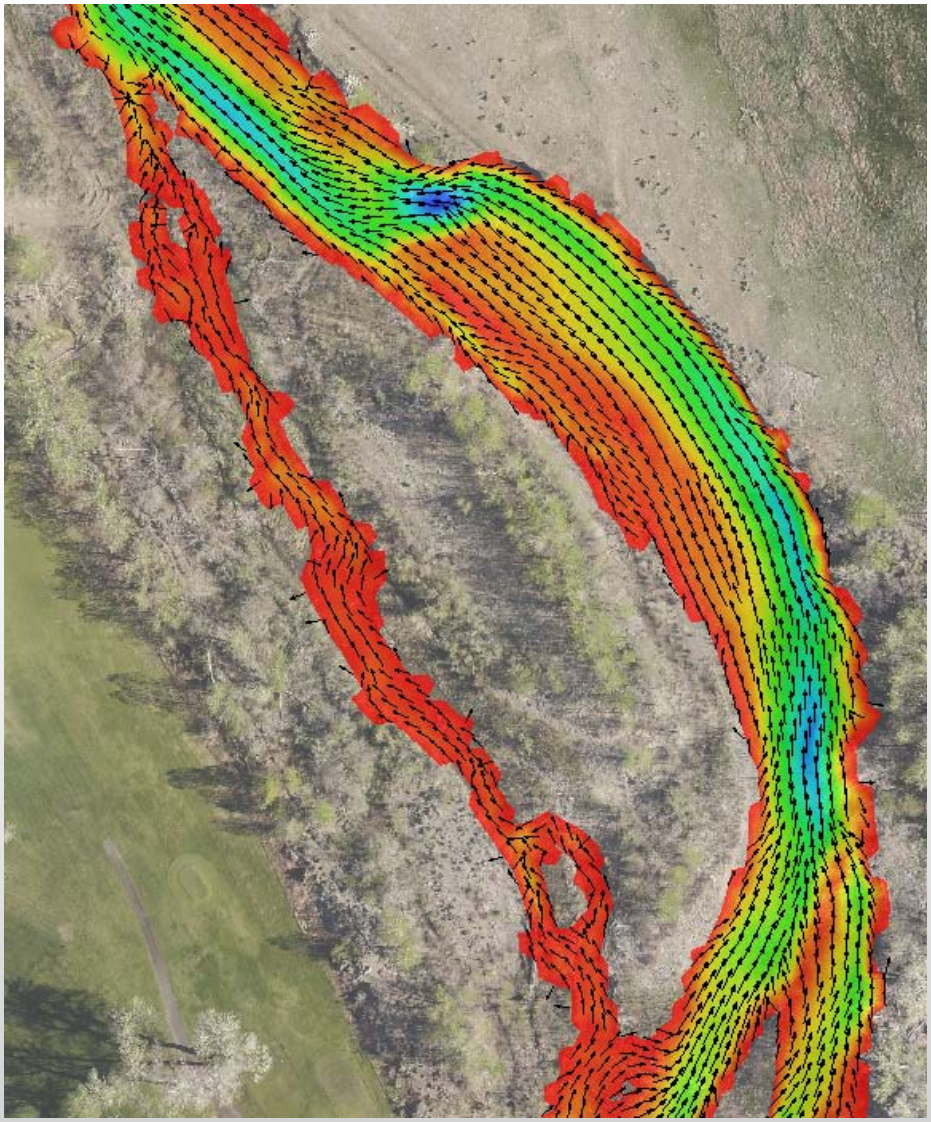
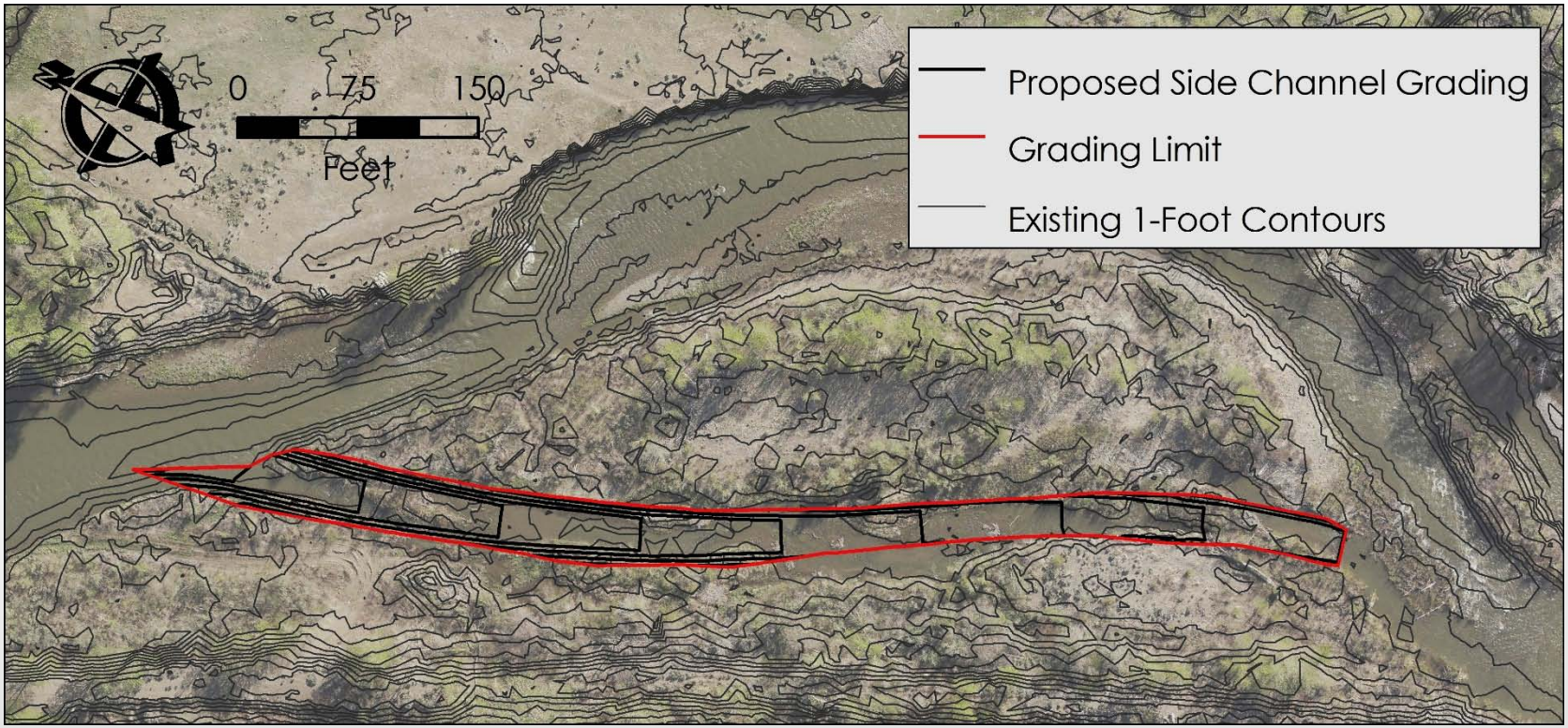
Design Solution Tools

- SRH-2D 2.2 (U.S. Bureau of Reclamation, 2012)
- Surface Modeling System 11.2 GUI (Aquaveo LLC, 2015)



Design Solutions



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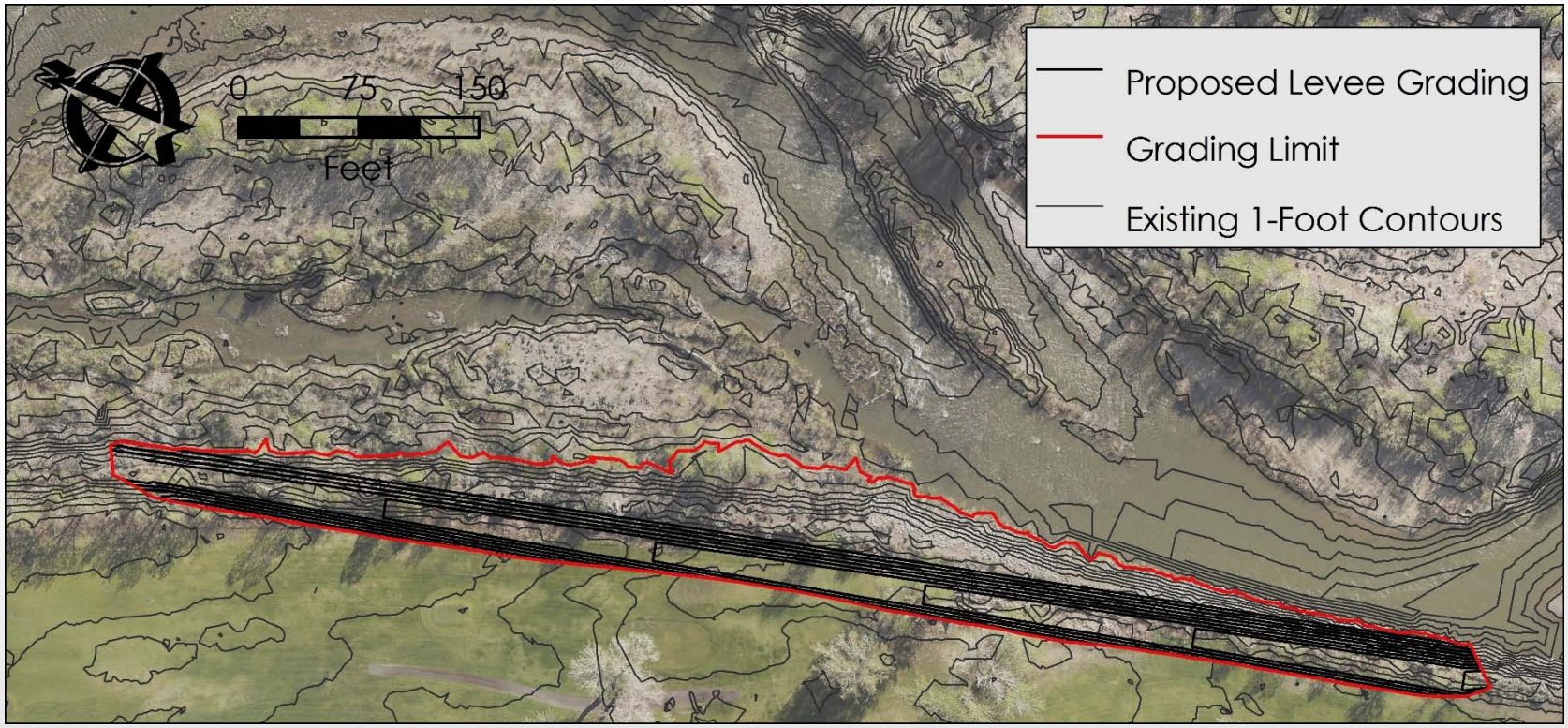
Design Solutions



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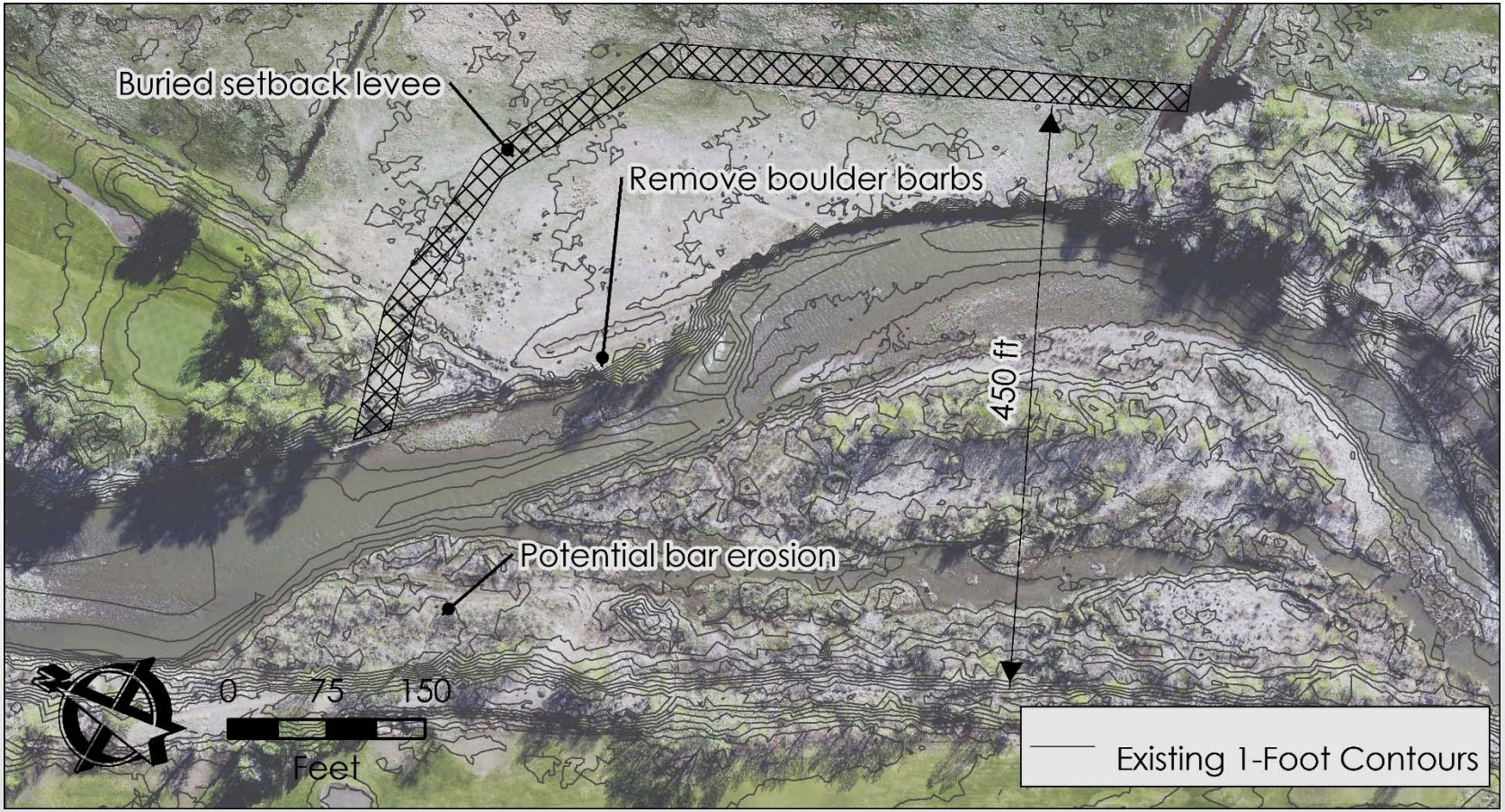
Design Solutions



- Other concepts expressed at conceptual level

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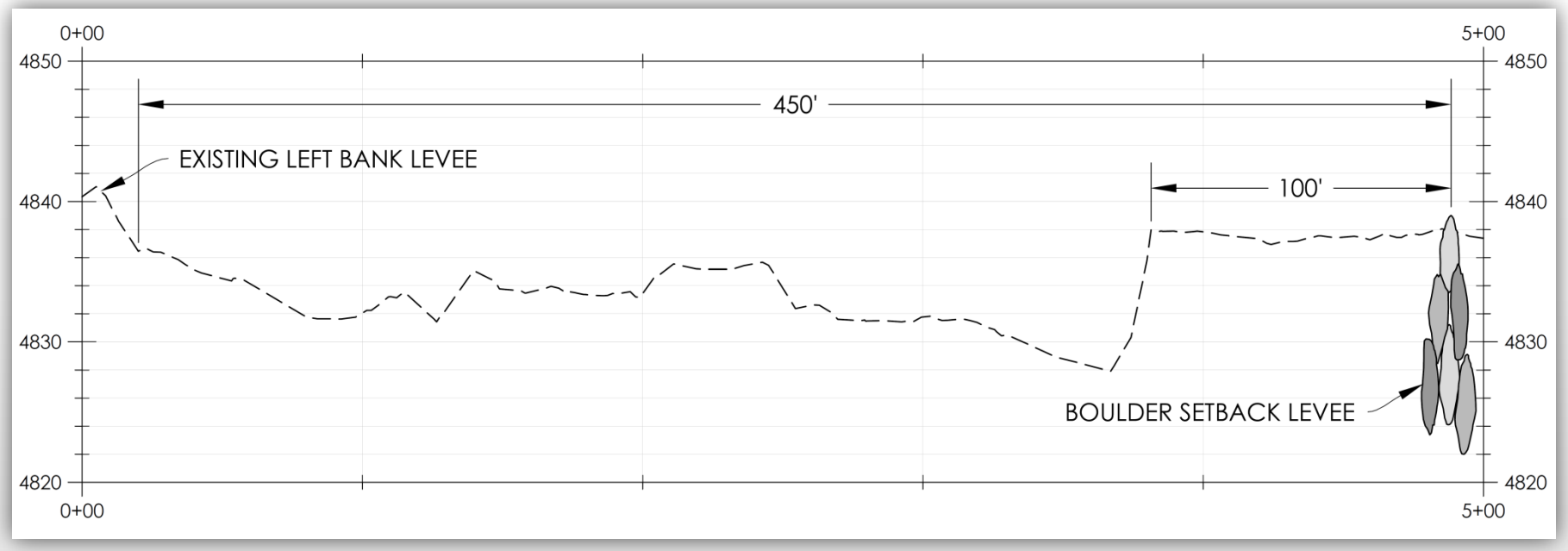

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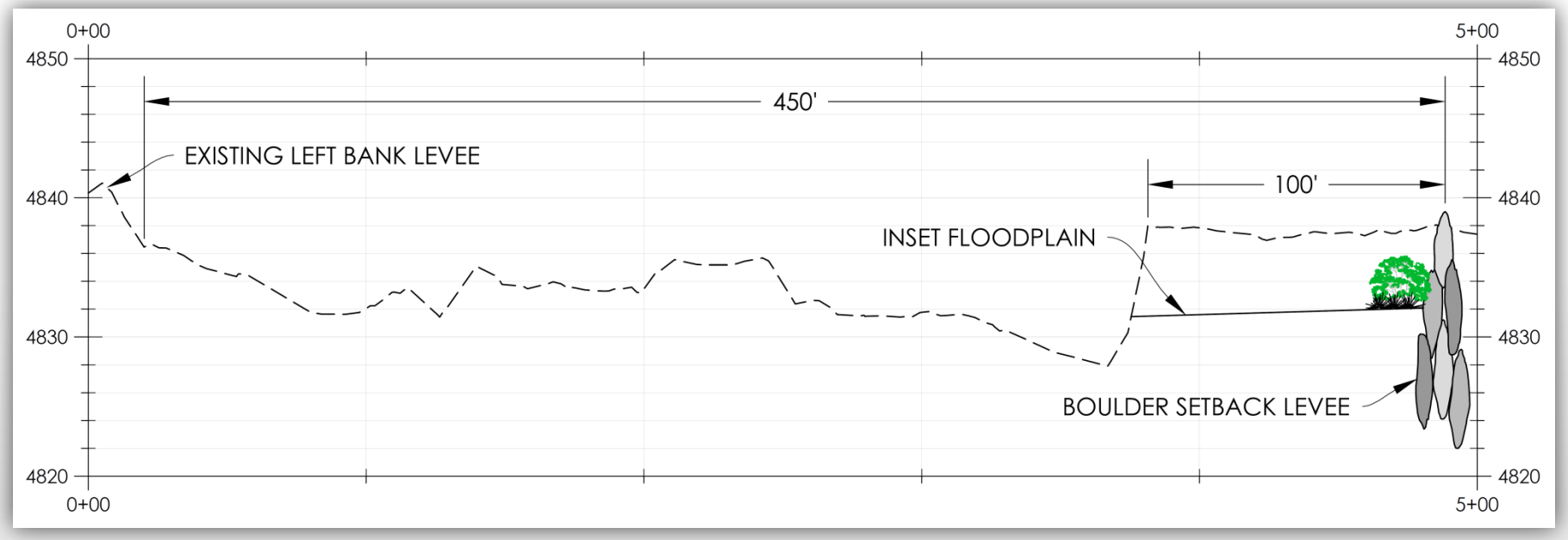

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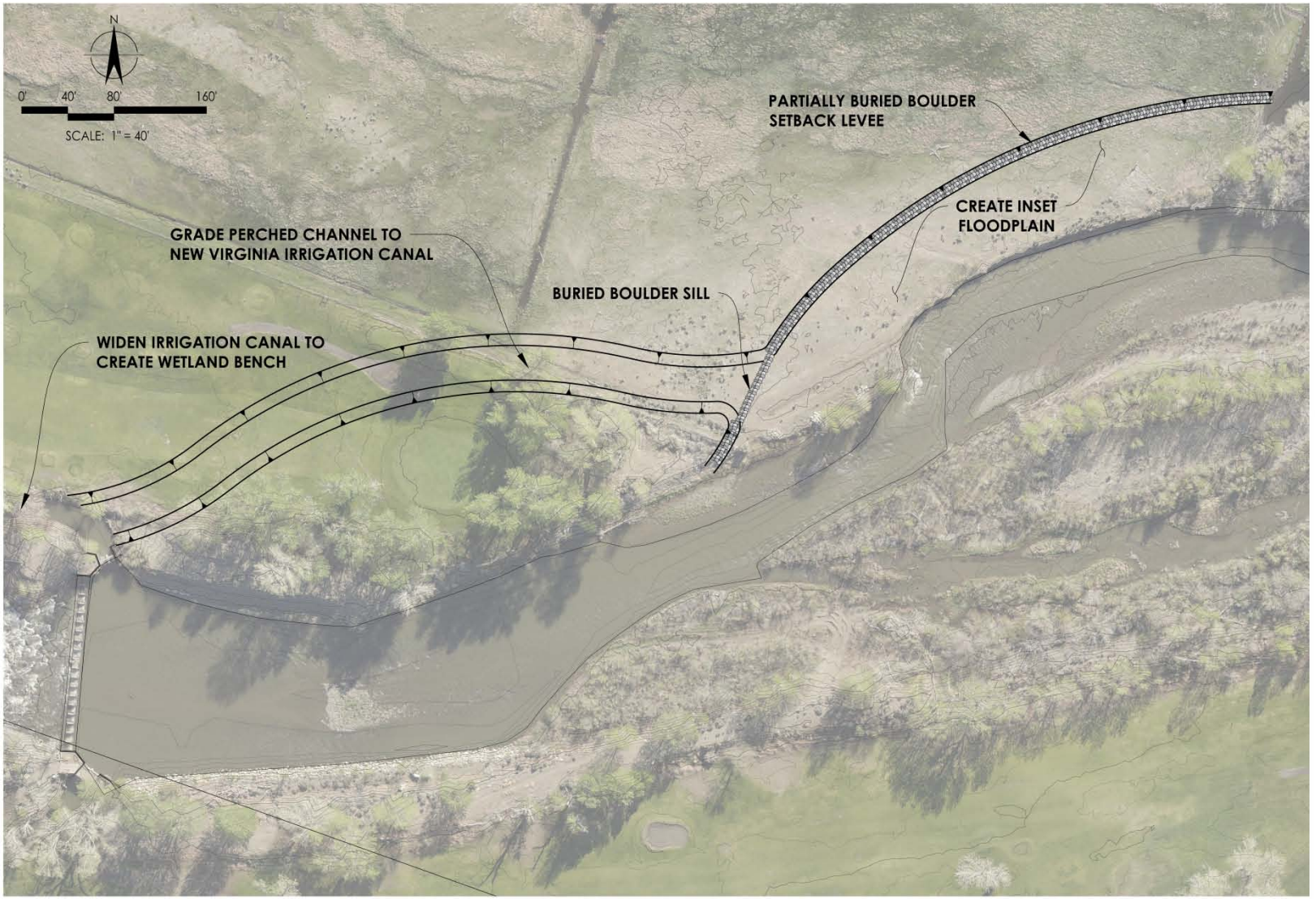

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DESIGNED BY P KU.CHAWK
DRAWN BY P KU.CHAWK
CHECKED BY
IN CHARGE
DATE

BY	DATE	SUBMITTALS / REVISIONS

INSET FLOODPLAIN WITH FLOOD RELIEF CHANNEL

EAST FORK OF THE CARSON RIVER

DOUGLAS COUNTY, NEVADA

PROJECT NUMBER 214085

SCALE 1" = 40'

SHEET

CONCEPTUAL PLANS - NOT FOR CONSTRUCTION

Questions

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