BUREAU OF RECLAMATION

Estimating Wetland Area using Hydrology and 2D Hydraulic Modeling

2024 MRGESCP Science Symposium

Outline

- What is a wetland and where are they found?
- What is wetland hydrology?
- Using gage data to characterize wetland hydrology.
- Proposed Los Lunas River Maintenance Project
- Applying 2D hydraulic modeling and GIS to estimate spatial extent of wetland hydrology.
- Conclusions

What is a wetland and where are they?

- **Federal Definition** (2008 USACE Arid West Regional Supplement)

  One key feature of the definition of wetlands is that, under normal circumstances, they support "a prevalence of vegetation typically adapted for life in saturated soil conditions." Many waters of the United States are unvegetated and thus are excluded from the Corps/EPA definition of wetlands, although they may still be subject to Clean Water Act regulation.

- **Hydrophytic Vegetation**

  The community of macrophytes that occurs in areas where inundation or soil saturation is either permanent or of sufficient frequency and duration to exert a controlling influence on the plant species present.

- **Hydric Soil Indicators**

  A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service 1994).

- **Wetland Hydrology**

  Wetland hydrology indicators provide evidence that the site has a continuing wetland hydrologic regime and that hydric soils and hydrophytic vegetation are not relicts of a past hydrologic regime.

Using Stream Gage Data for Wetland Hydrology

- The U.S. Army Corps of Engineers (2005) provides a technical standard for monitoring hydrology on such sites. This standard requires 14 or more consecutive days of flooding or ponding, or a water table 12 in. (30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability) (National Research Council 1995).

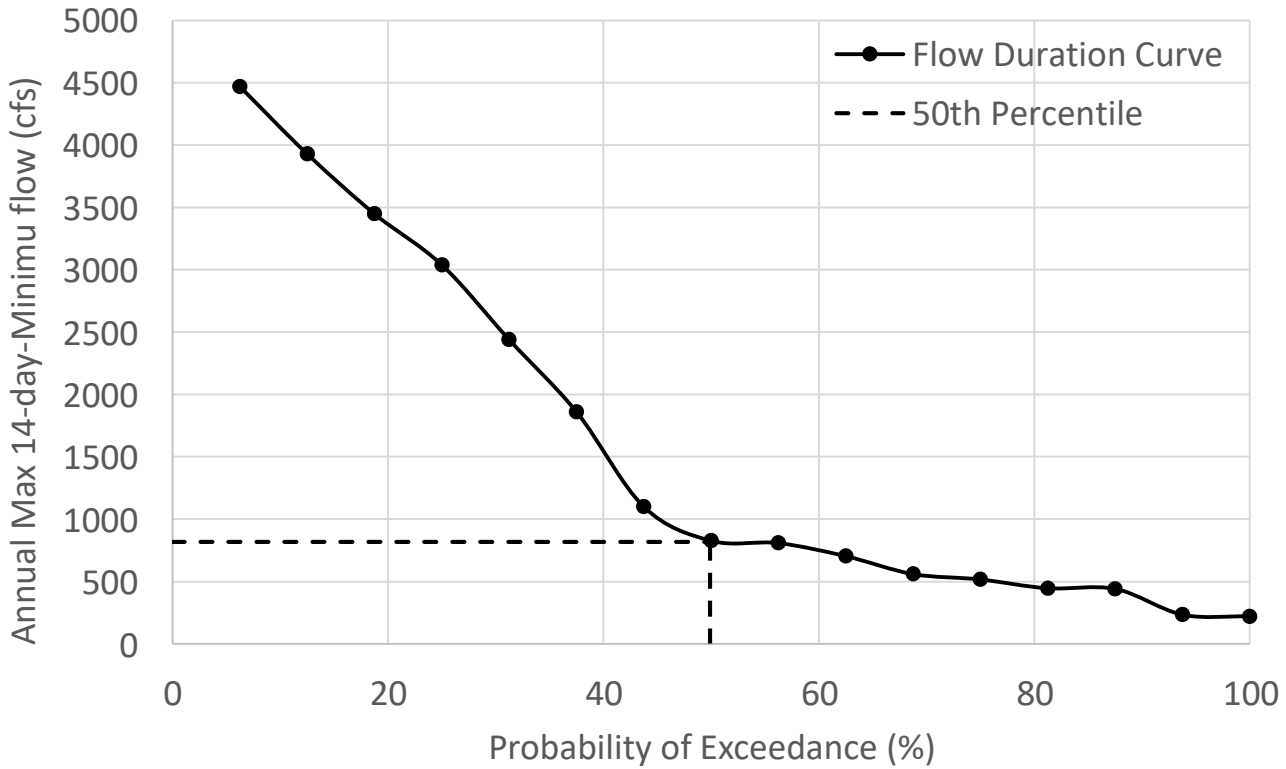
National Engineering Handbook Part 650, Chapter 19 (NRCS, 2015)

1. For each year of record, extract the mean daily flows for the **growing season** (March 1st–November 15th).
2. A 14-day moving window is used to find the **minimum 14-day value**. Average 14-day values are not used, as they would over-estimate the level of consecutive inundation.
3. From the set of minimum 14-day values for each year, the **annual maximum value** is extracted.
4. Then the annual maximum of these 14-day minimum values for each year is used to develop a **probability of exceedance curve**, from which the **50th percentile** is determined.

Using Stream Gage Data for Wetland Hydrology

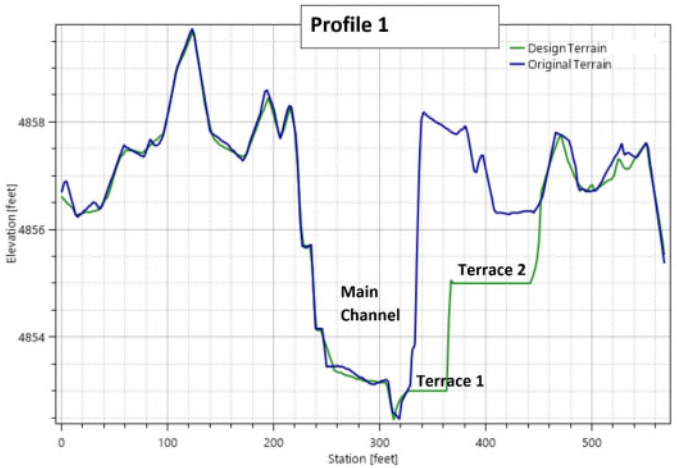
- Period of record 2006-2021 were analyzed from the USGS 08331160 Rio Grande Near Bosque Farms, NM
- The 50 percent chance, 14-day min average daily flow was determined to be 817 cfs.

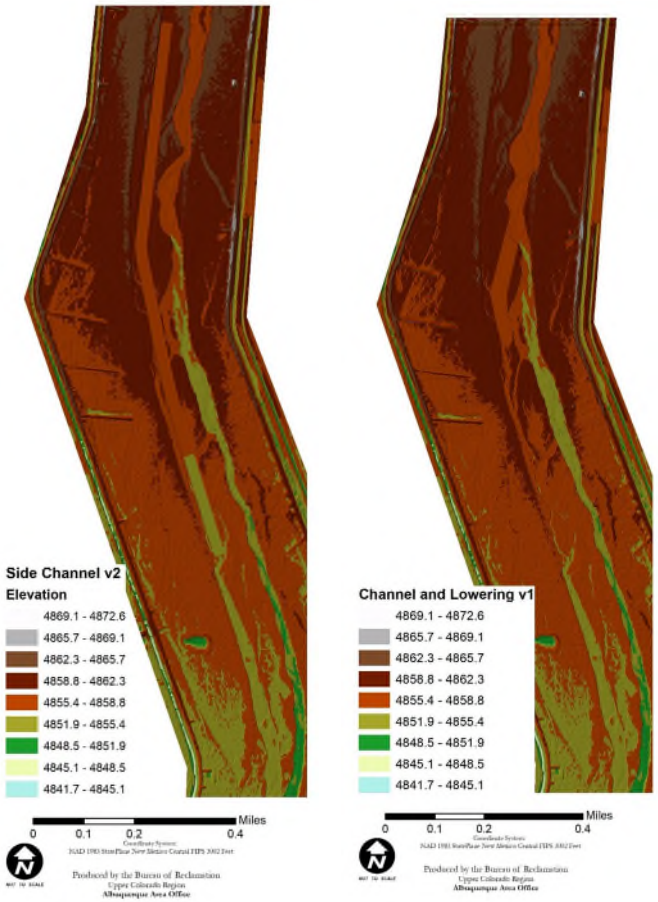
The water surface elevation associated with a discharge of 817 cfs represents the inundation level that is likely to occur at least half the time during the growing season and persist for 14 consecutive days

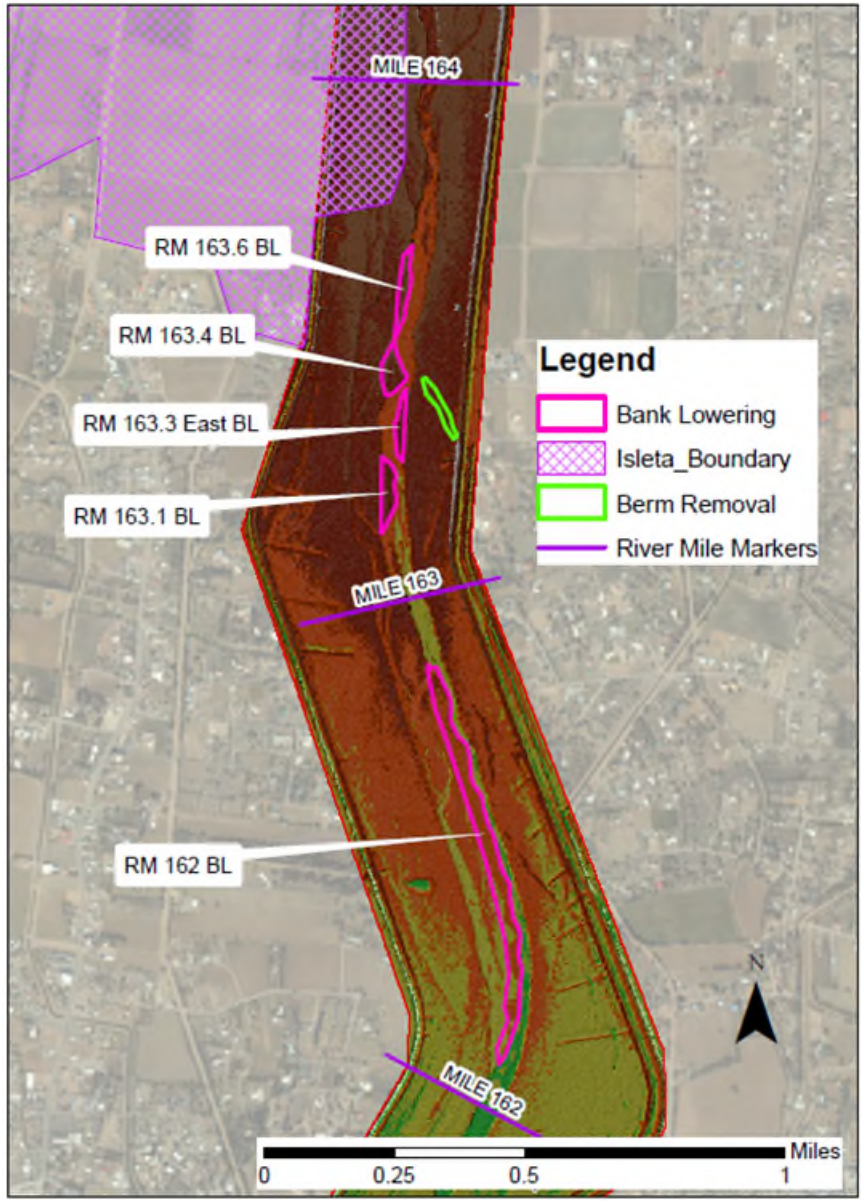


Proposed Los Lunas River Maintenance Project

- Proposed project to improve conveyance capacity & improve habitat upstream of Rt. 6 bridge in Los Lunas.
- LiDAR and field cross-sections used to create geometry
- 2D hydraulic modeling with 10 test terrains including side channels and bank terracing used to optimize design.
  - Final design focuses on bank terracing only.







Los Lunas Upstream of Rt. 6

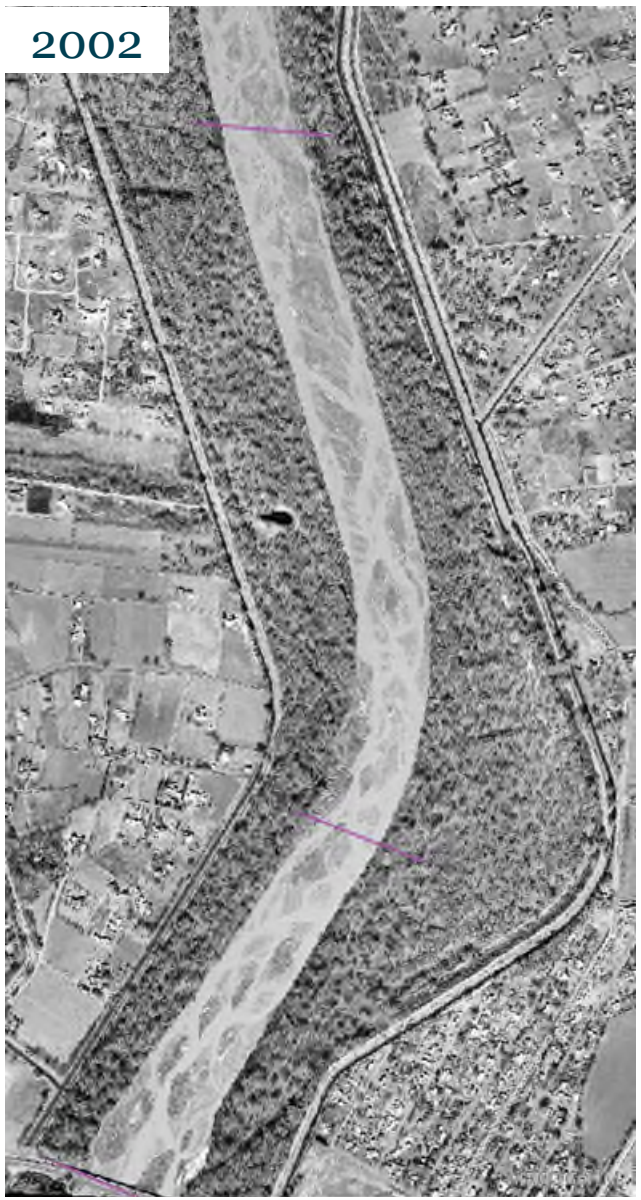
1935

1949

1962

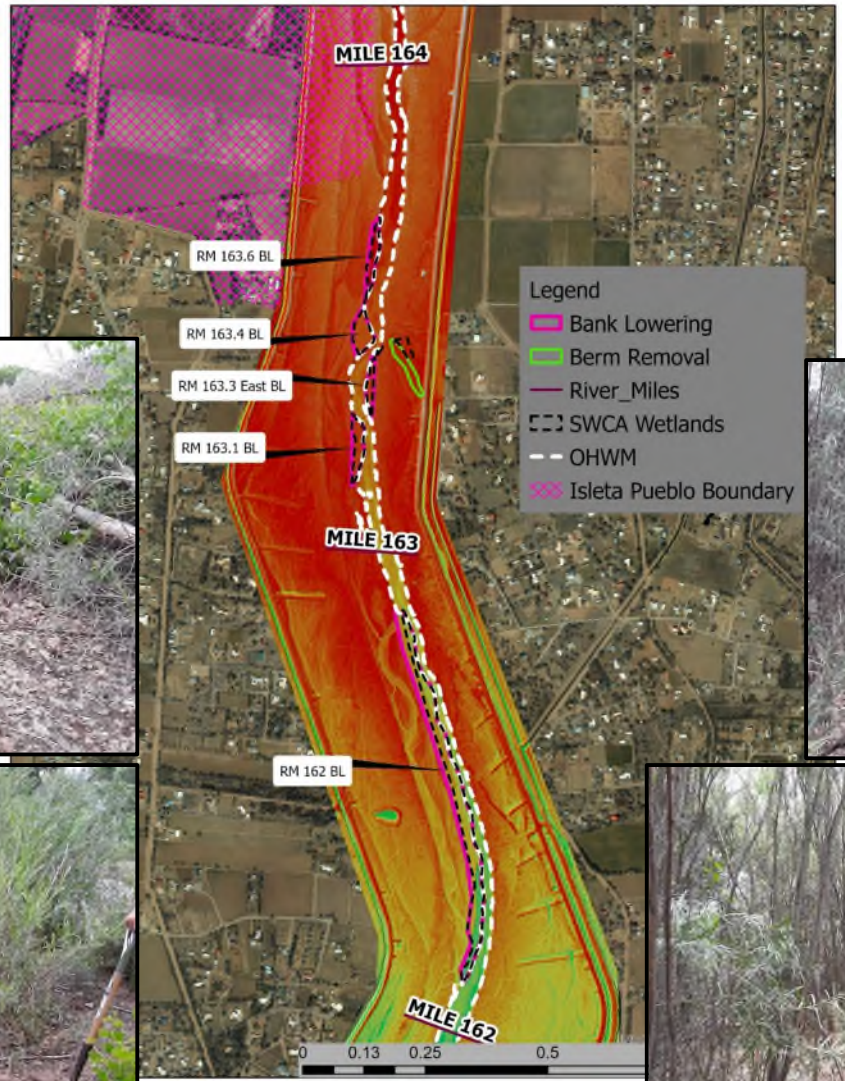
Los Lunas Upstream of Rt. 6

- Causes of Narrowing:
  - Absence of large flow events
  - Prolonged low flows
- Consequences of Narrowing:
  - Loss of channel capacity
  - Channel homogeneity
  - Little shallow water habitat
  - Often associated with deepening; however, the bed is stable through this subreach



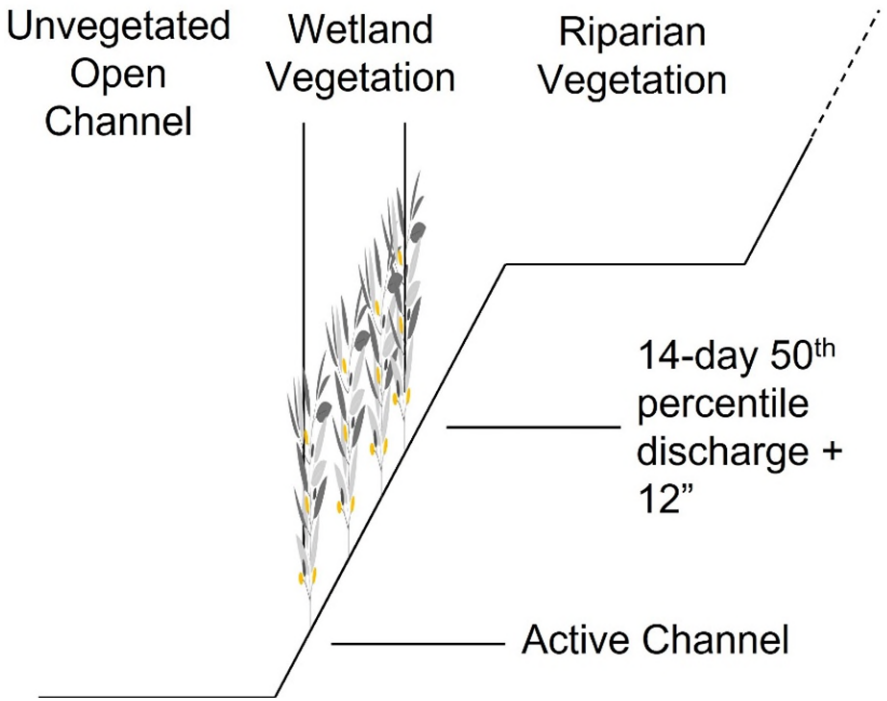
Bankline wetlands co-located with Project

- Willow scrub – shrub vegetation and hydric soil found on bankline terraces.



Vertical and Spatial Distribution of Wetlands

- Active Channel: Mobile bed prevents establishment of vegetation and soils.
- Water Surface Elevation of 14-day 50th percentile flow + 12”
  1. Use hydraulic model to find spatial distribution of WSE.
  2. Use GIS to add 12” to WSE and extend across area of interest.

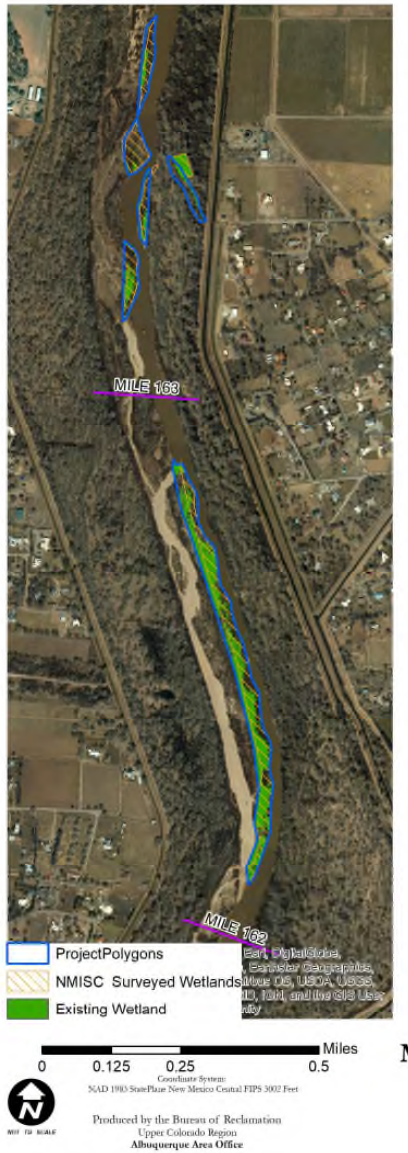


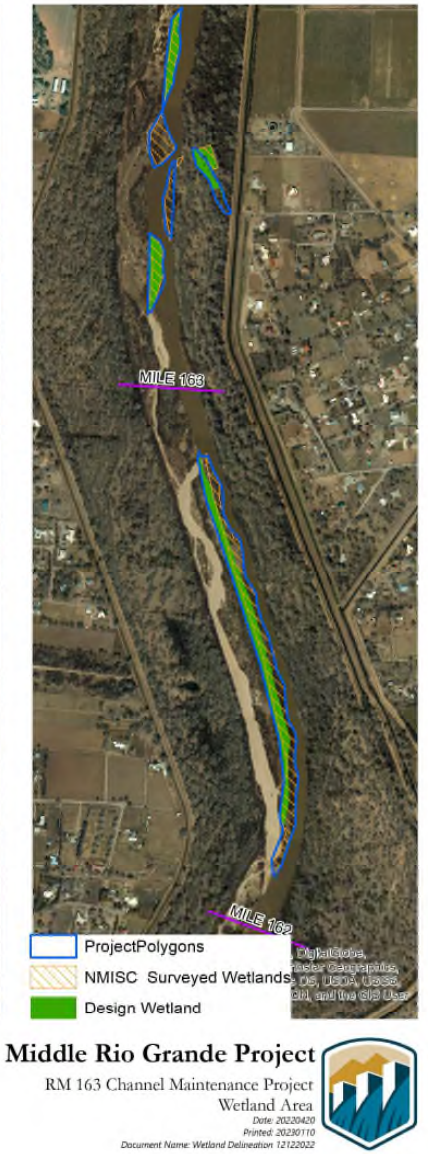
$$Wetland\ Area = Terrain\ Area\ Below\ Min\ 14\text{–}day + 12" - Terrain\ Area\ Below\ Active\ Channel\ Water\ Surface$$

Results of Spatial Distribution Active Channel and Wetland Locations

- Using aerial imagery 500 cfs WSE best represents unvegetated active channel.
- Design terrain illustrates elevation of different terraces.
- Surveys located 14 acres of wetlands.

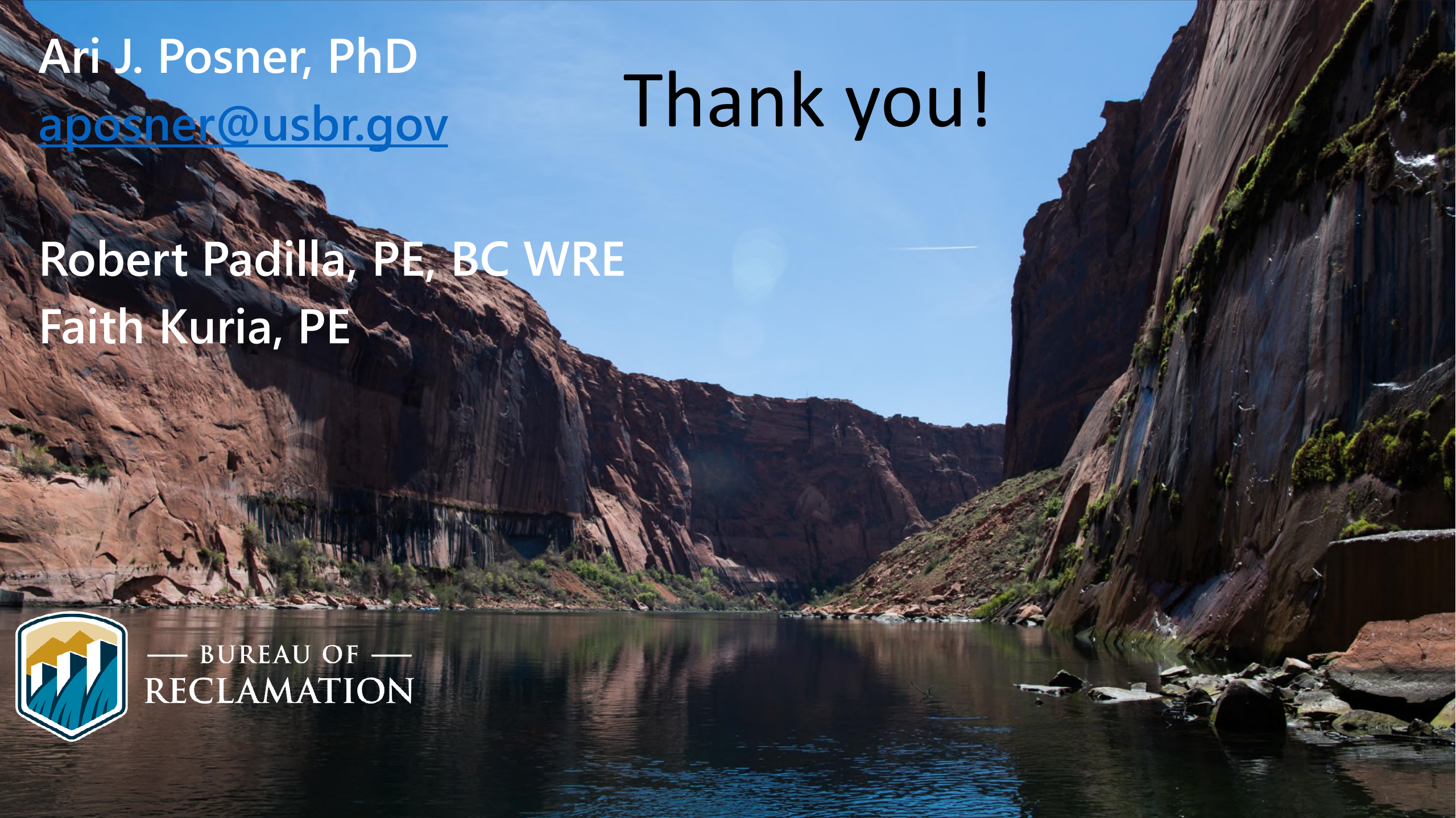
Model	Active Channel Area (ac)	Wetland Area (ac)
Existing Terrain	52.9	10
Design Terrain	73.8	11
Difference	+20.9	+1





Conclusions

- Hydrologic analysis and hydraulic modeling complements, does not replace, vegetation and soil surveys.
- Quantitative strategy can reasonably reproduce wetland spatial extent, when compared to physical surveys.
- Prediction of wetland spatial extent consistent with professional judgement.
- Large uncertainties around shallow groundwater vertical and horizontal distribution.
- Channel perching may over-predict extent of wetlands.



Thank you!

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