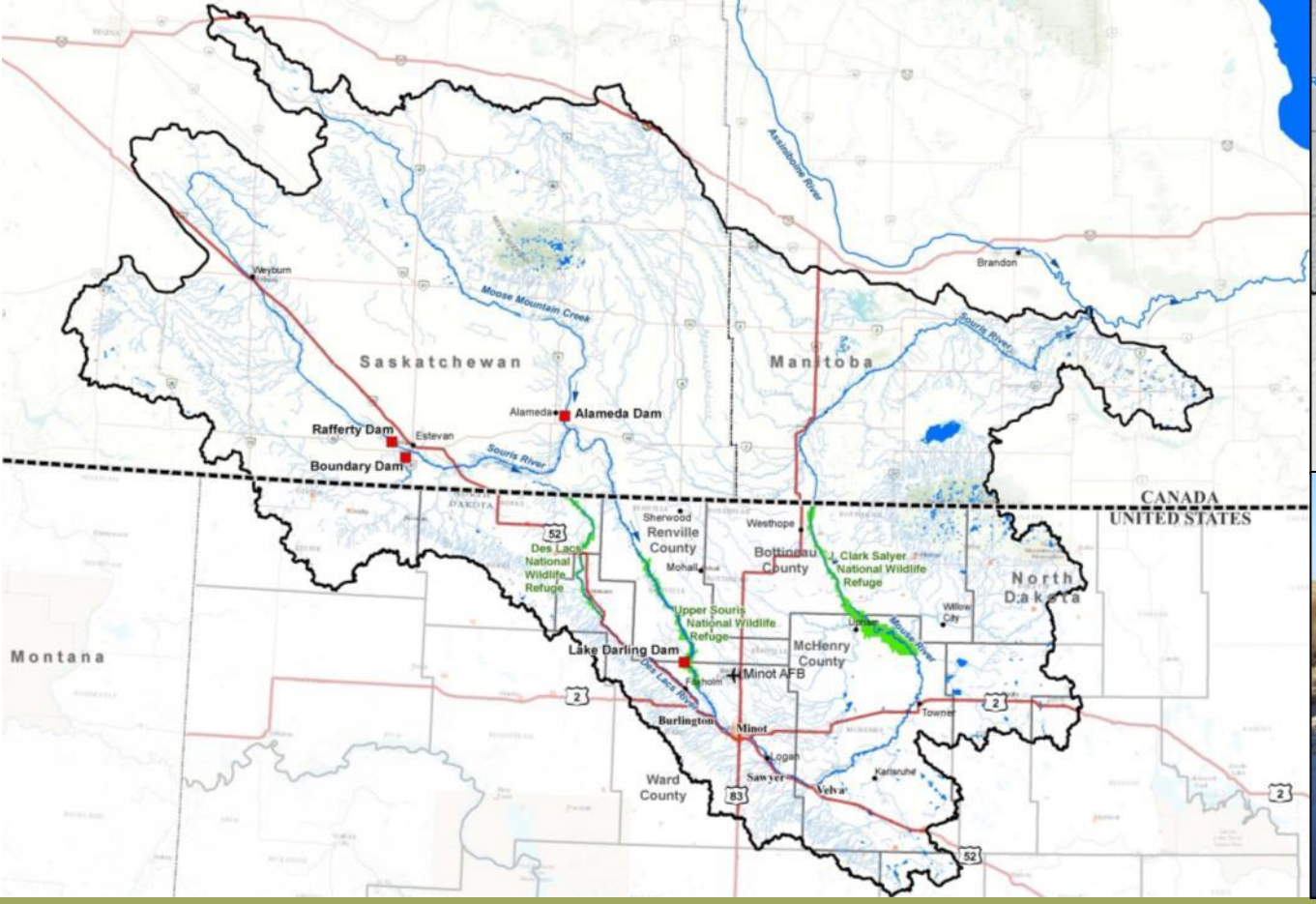
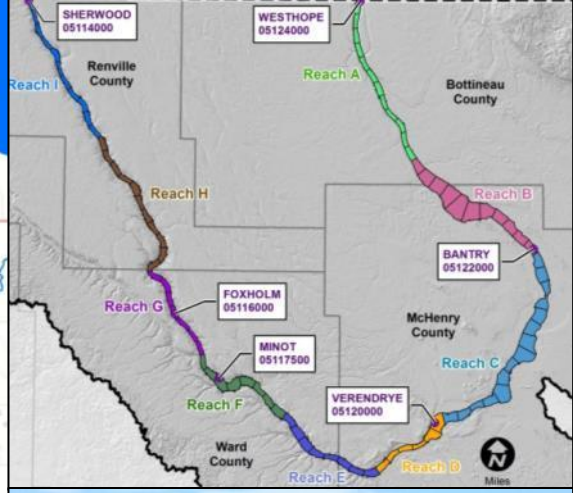




Basin-scale geomorphology using GIS for preliminary stream classification and impact analysis

Amy Mikus, Peter Hinck, Benjamin Sheets, and Miguel Wong

basin-scale geomorphology for the Souris/Mouse River

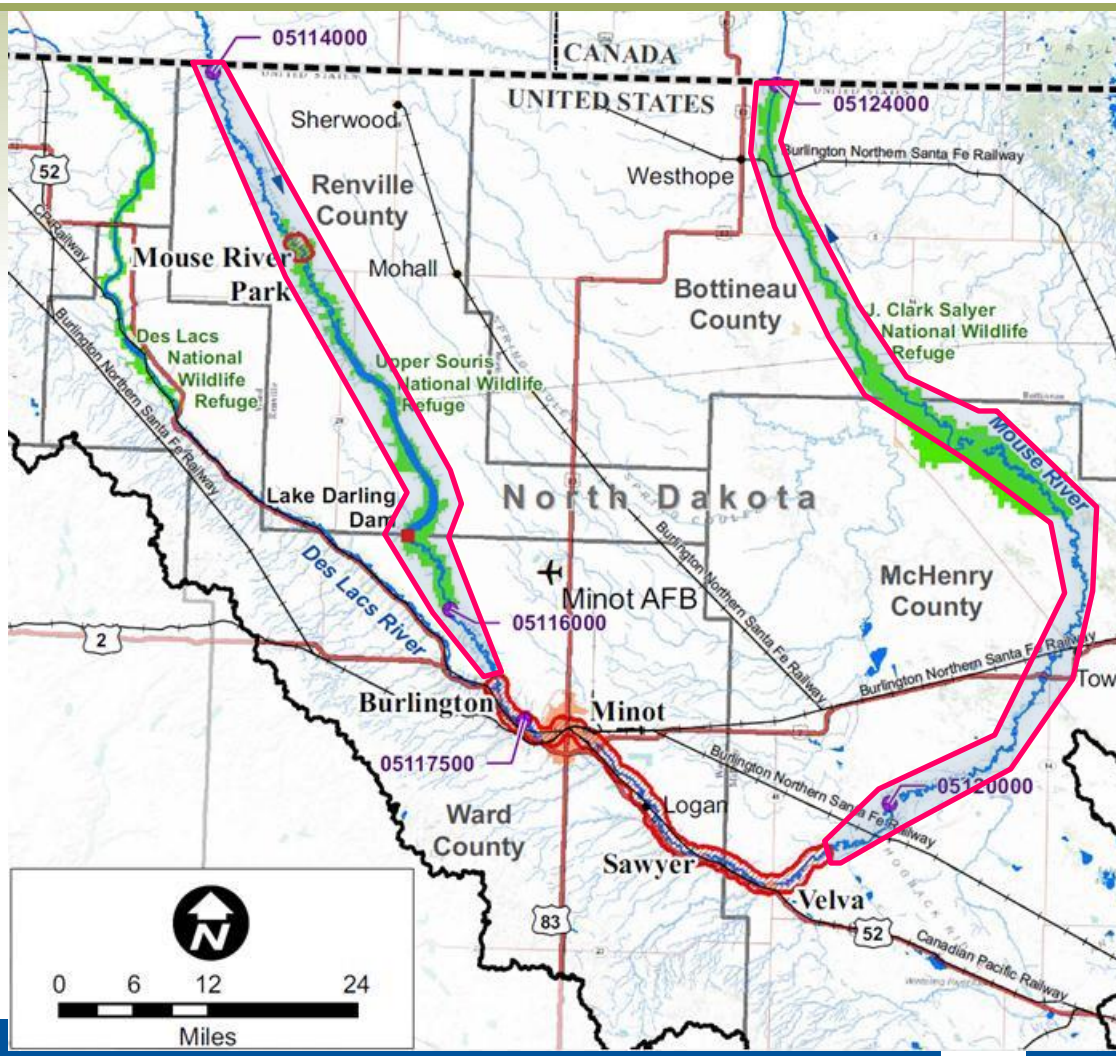
- introduction
- project background and purpose
- Mouse River geologic setting
- valley/channel classification
- implications for project impacts

Mouse River watershed 2011 flood

- peak flow at Minot 26,900 cfs
- levees designed for 5,000 cfs (100-yr)
- sig. urban & rural flooding for months
- est. $690 million structural damages

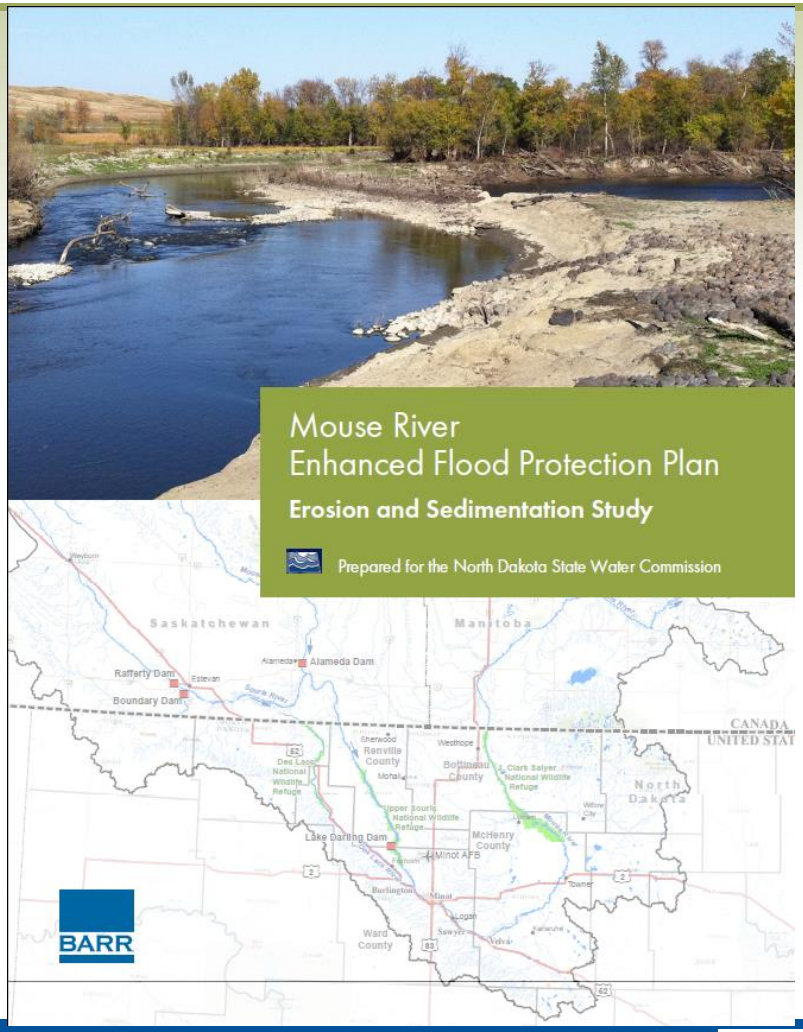
ND State Water Commission
Mouse River Enhanced Flood Control Project

- Flood protection for Burlington-Velva
- Effects rural areas along remaining length in the US

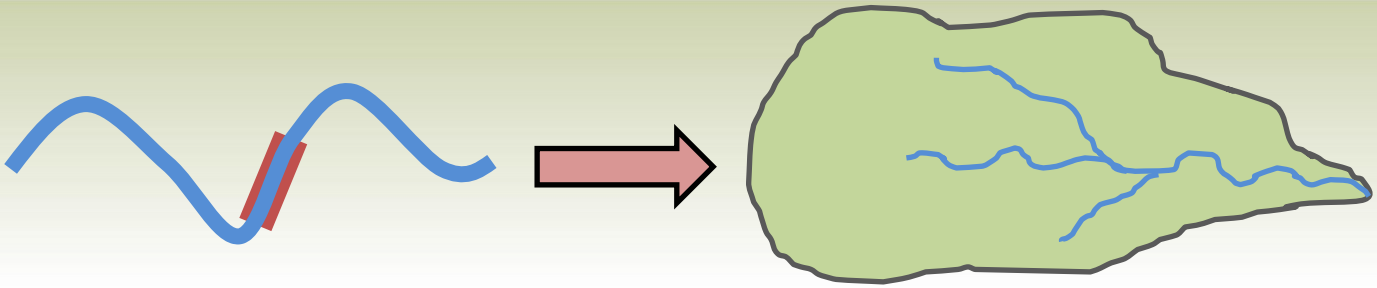


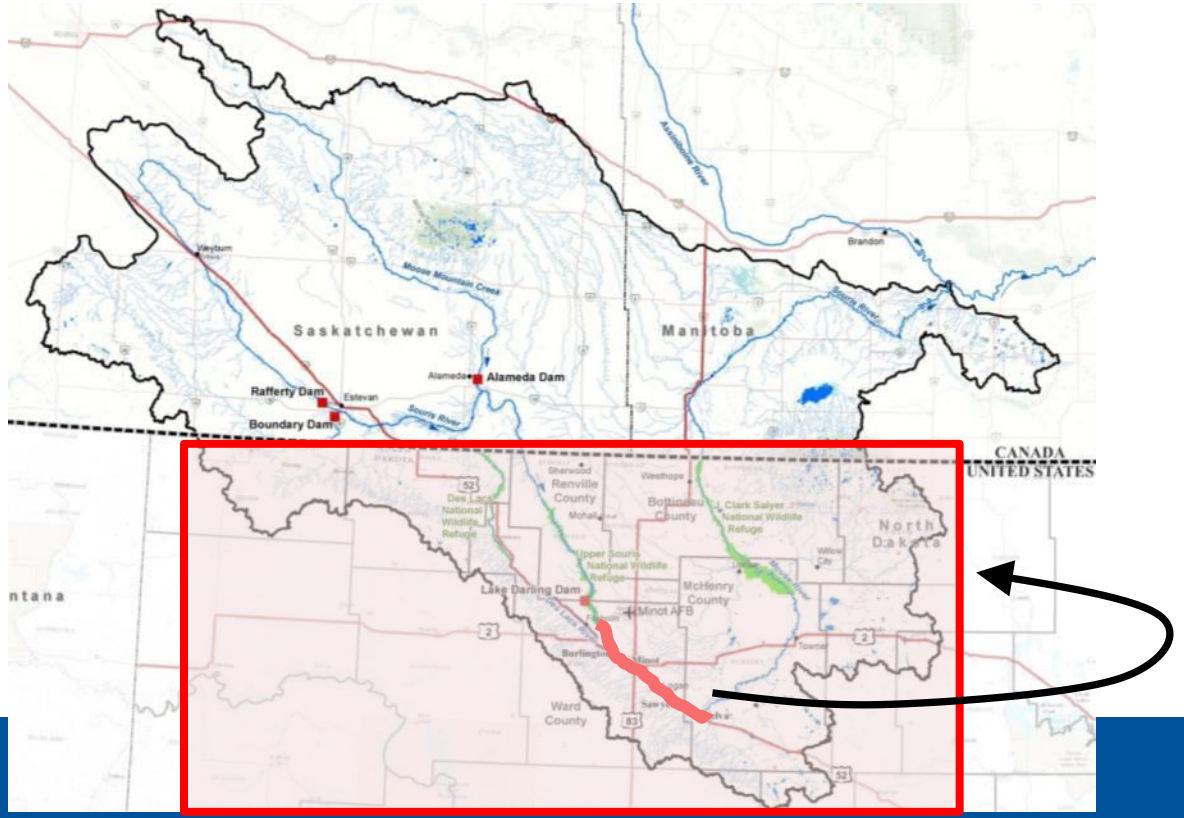
Mouse River Enhanced Flood Control Project
Erosion and Sedimentation Study (Jan 2013)

- initial characterization of geomorphology and sediment transport
- qualitative evaluation of potential project impacts to sediment transport
- scope of future data collection & modeling



match assessment scale to project scale





why investigate watershed characteristics?

Understanding large-scale processes provides a basis for detailed data collection, analysis, design, etc. . . .

. . . but we often lack time or budget to study large-scale processes in detail or small-scale processes over a basin

why investigate watershed characteristics using GIS?

GIS analysis helps generate and process large amounts of spatial data

-Broad information set which can be used to focus future sampling and data collection

-May reveal patterns or historical legacies that are difficult to see with other methods

watershed characteristics inform stream classification

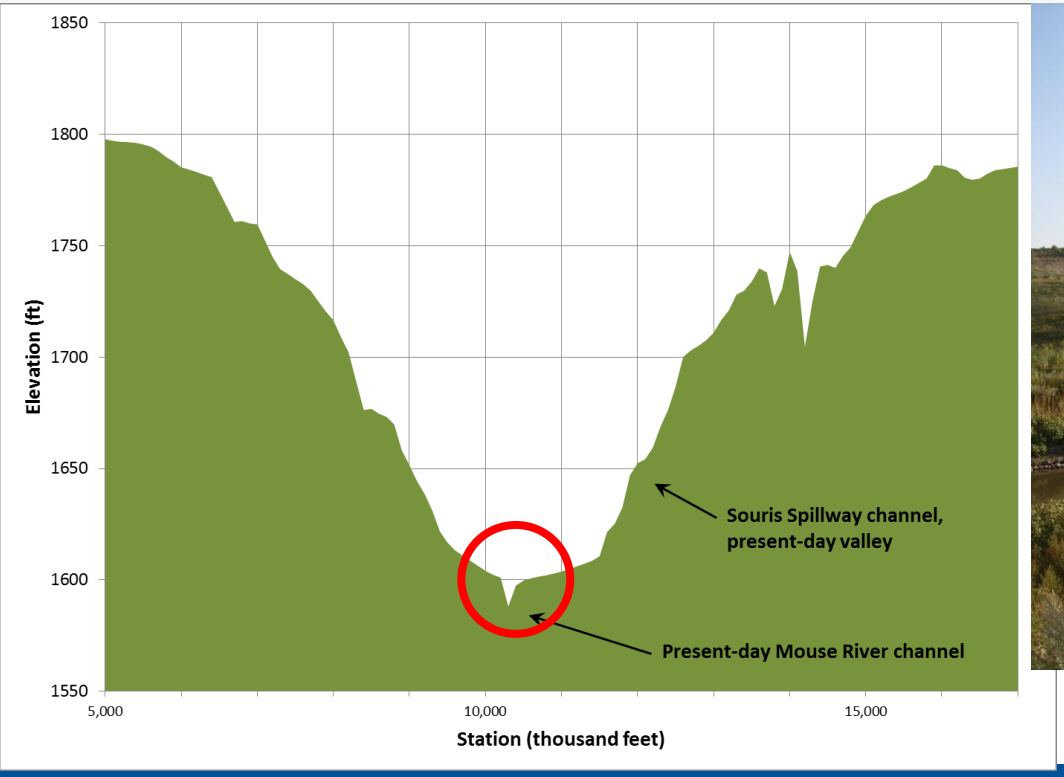
stream classification:

describing and organizing stream reaches based on shared attributes and behavior

Produced a qualitative Mouse River classification along entire US length using available data on valley and channel characteristics

valley shape dramatically different upstream & downstream of Verendrye

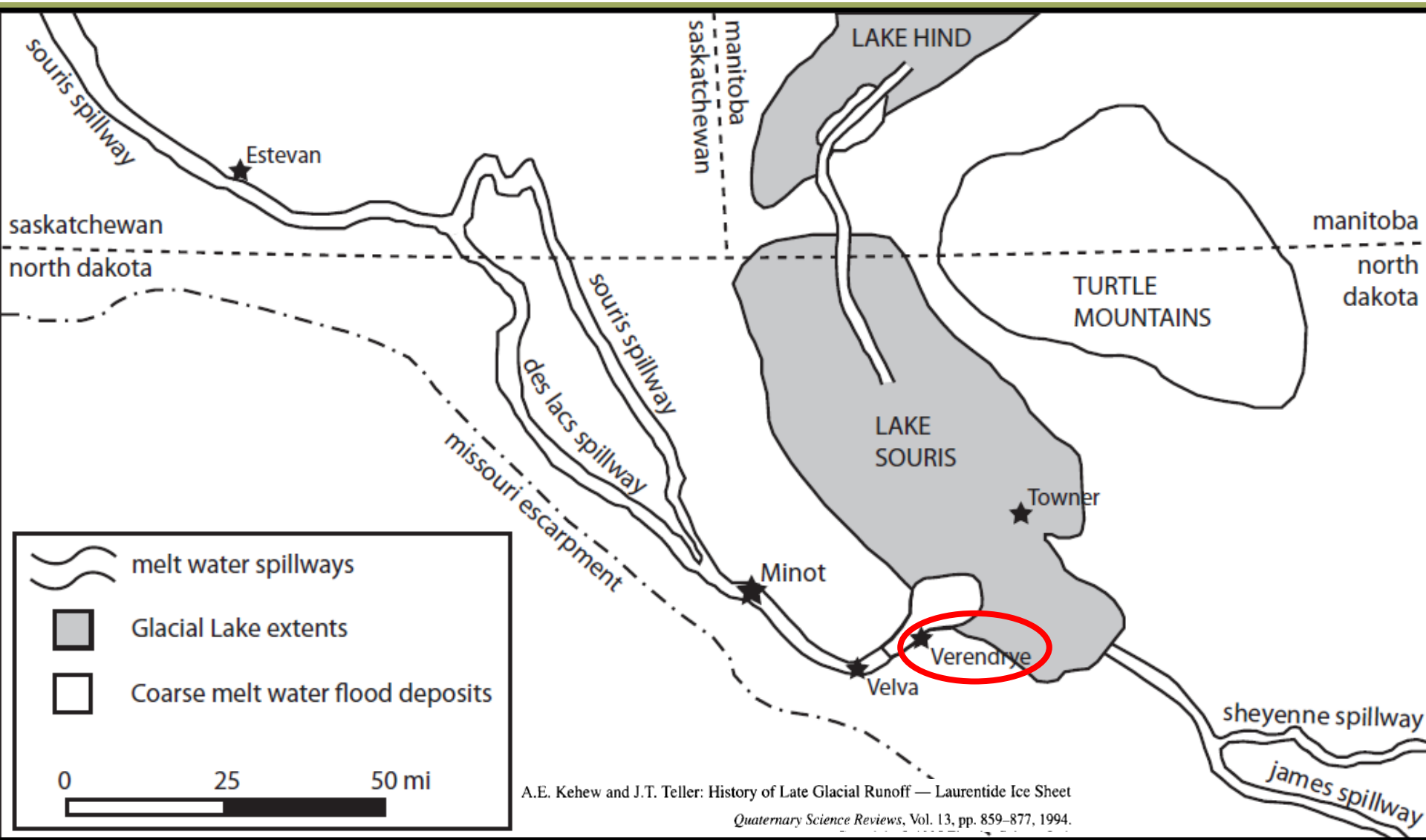
deep, well-defined valley upstream



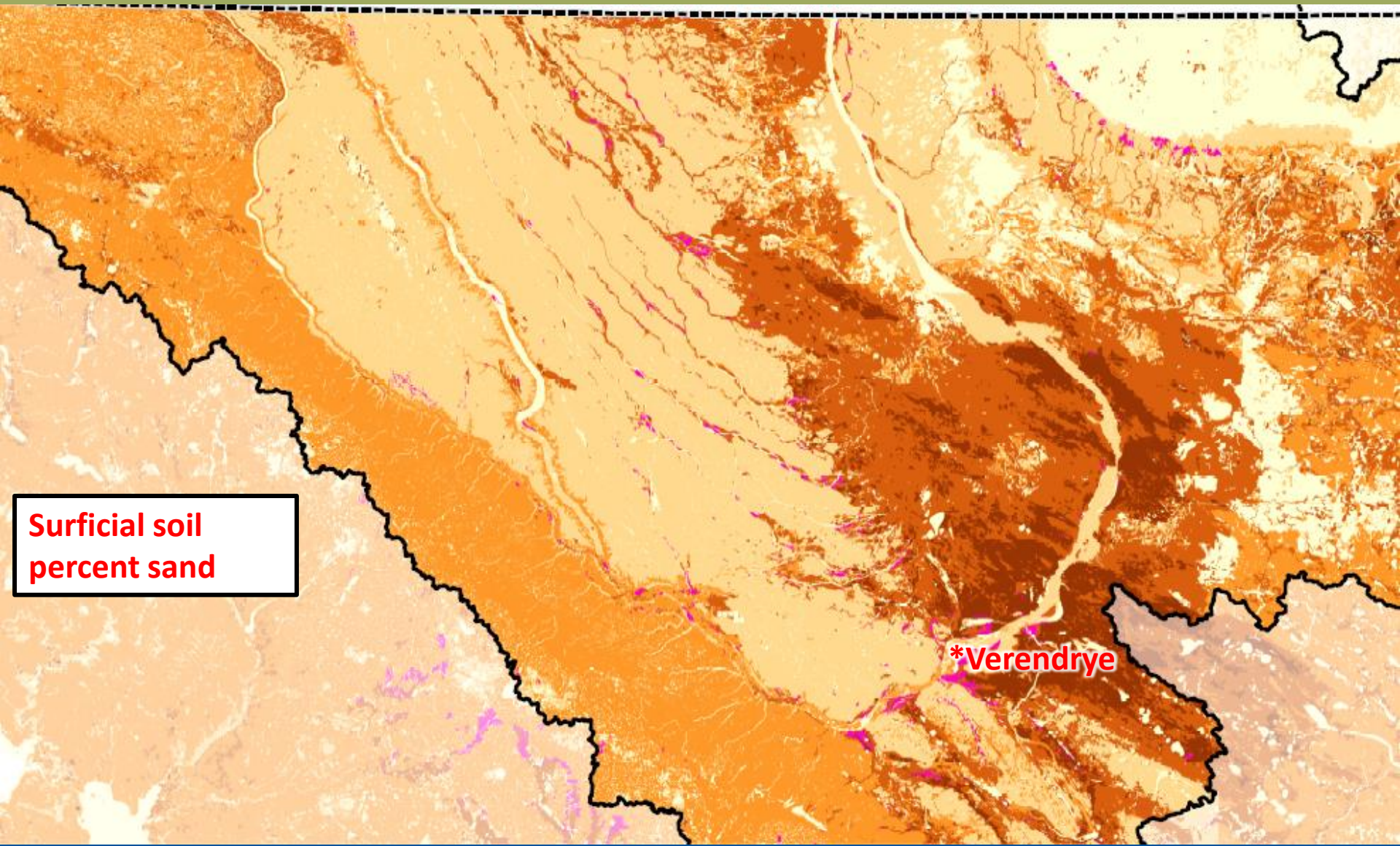
valley shape dramatically different upstream & downstream of Verendrye

wide, shallow valley downstream

north-central ND glacial landforms



watershed characteristics reflect glacial history



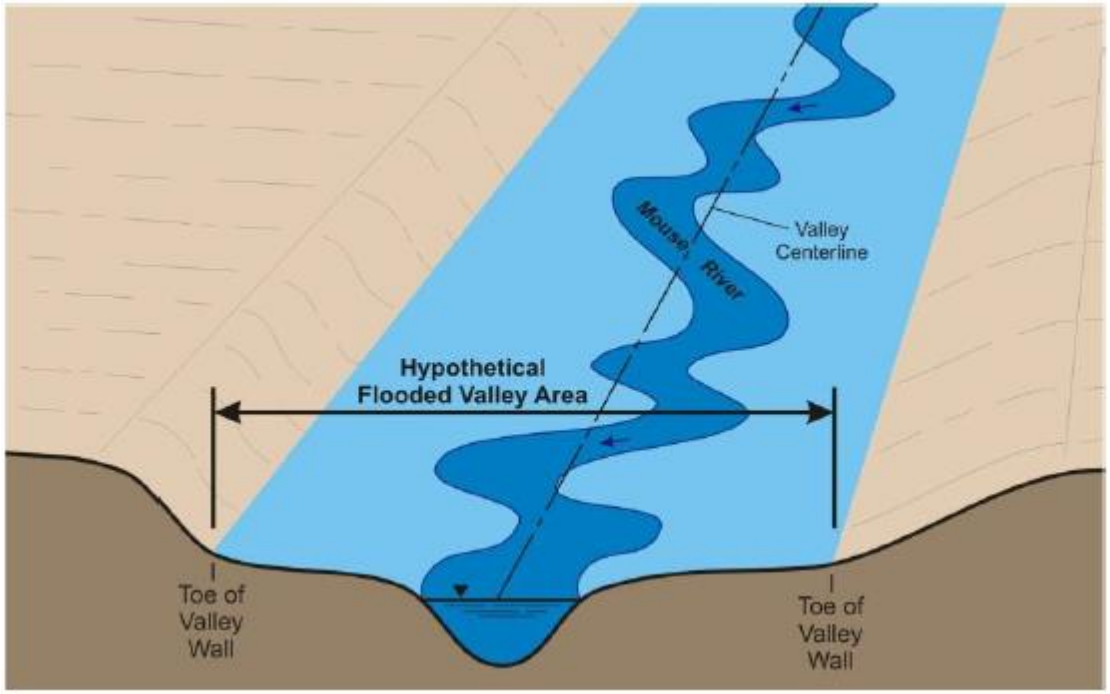
valley characteristics used for stream classification

Valley characteristics

- valley width
- valley slope
- valley soils (percent sand)
- valley land use (percent agricultural)

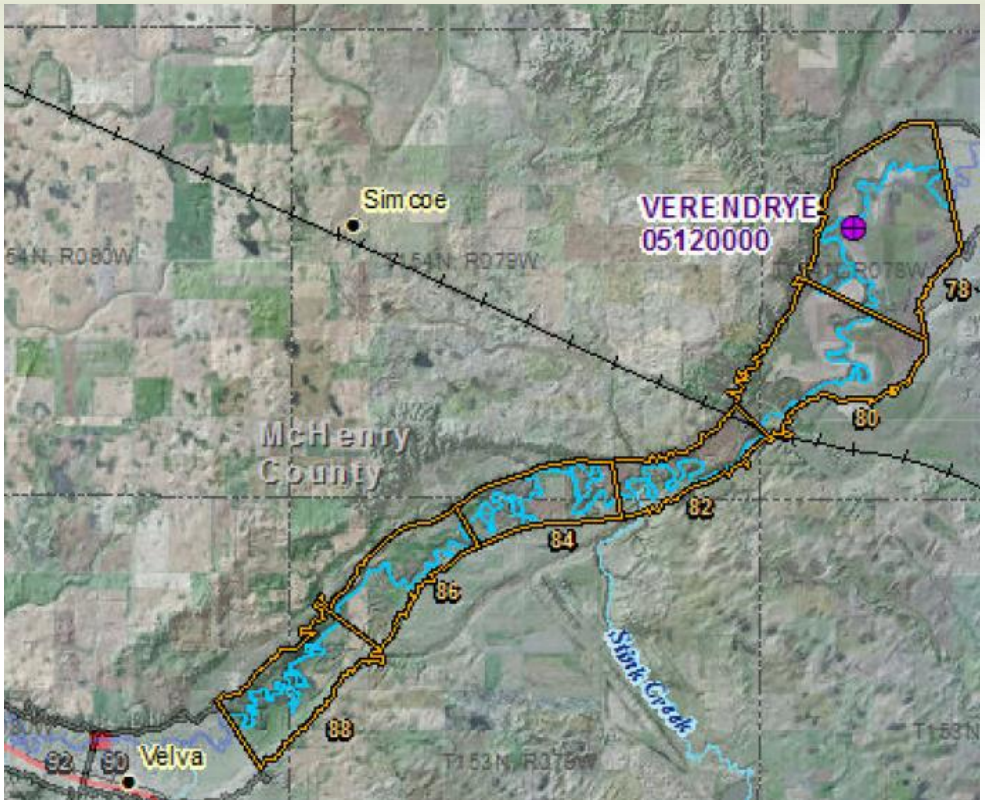
valley definition in GIS

- "Flooded" to remove small surface features
- Smoothed to eliminate influence of tributaries
- Also looked at slopes/topography to define floodplain
- End result was the outline of the valley

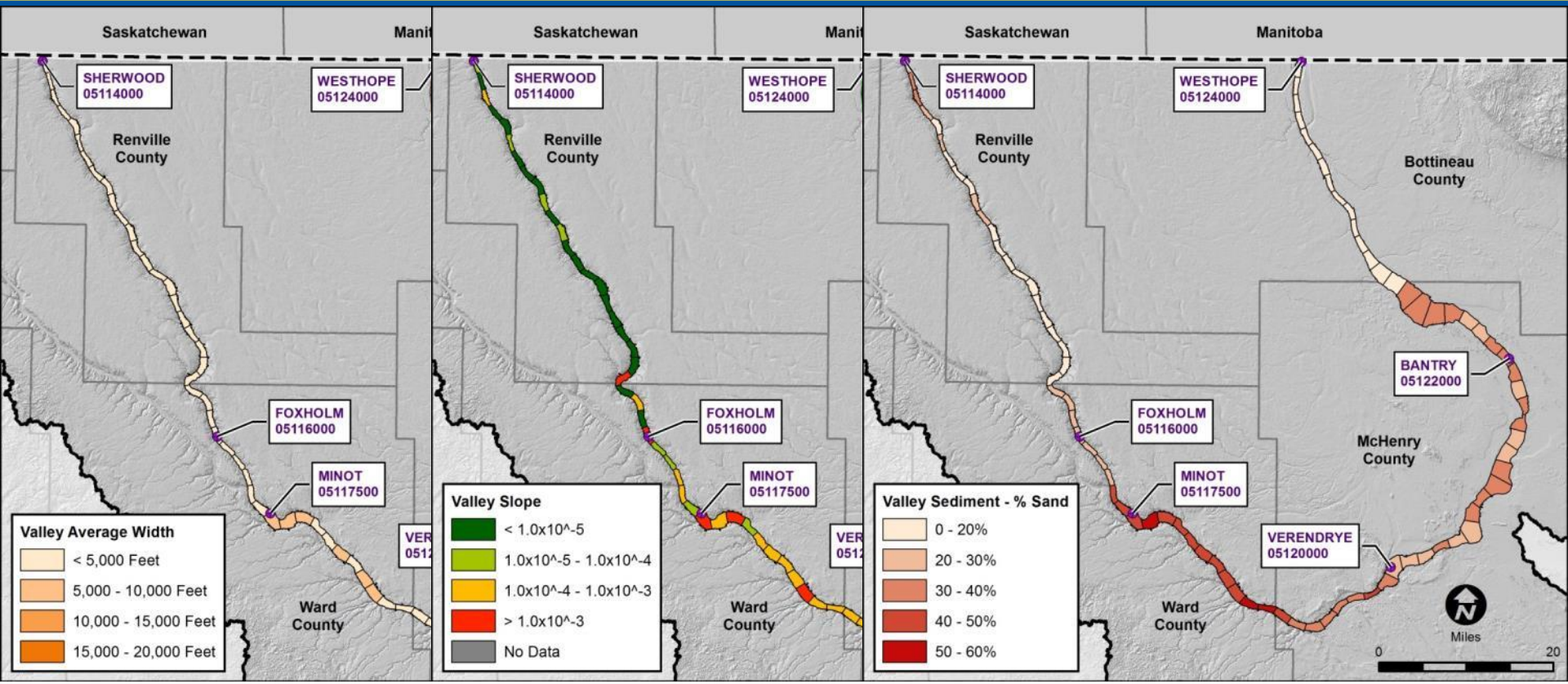


valley segmentation in GIS

- Each segment was two miles of valley length
- Boundary lines drawn perpendicular to valley walls, not stream channel
- Base unit for statistics and analysis, eventual classification



valley characteristics clearly show changes due to geologic constraints



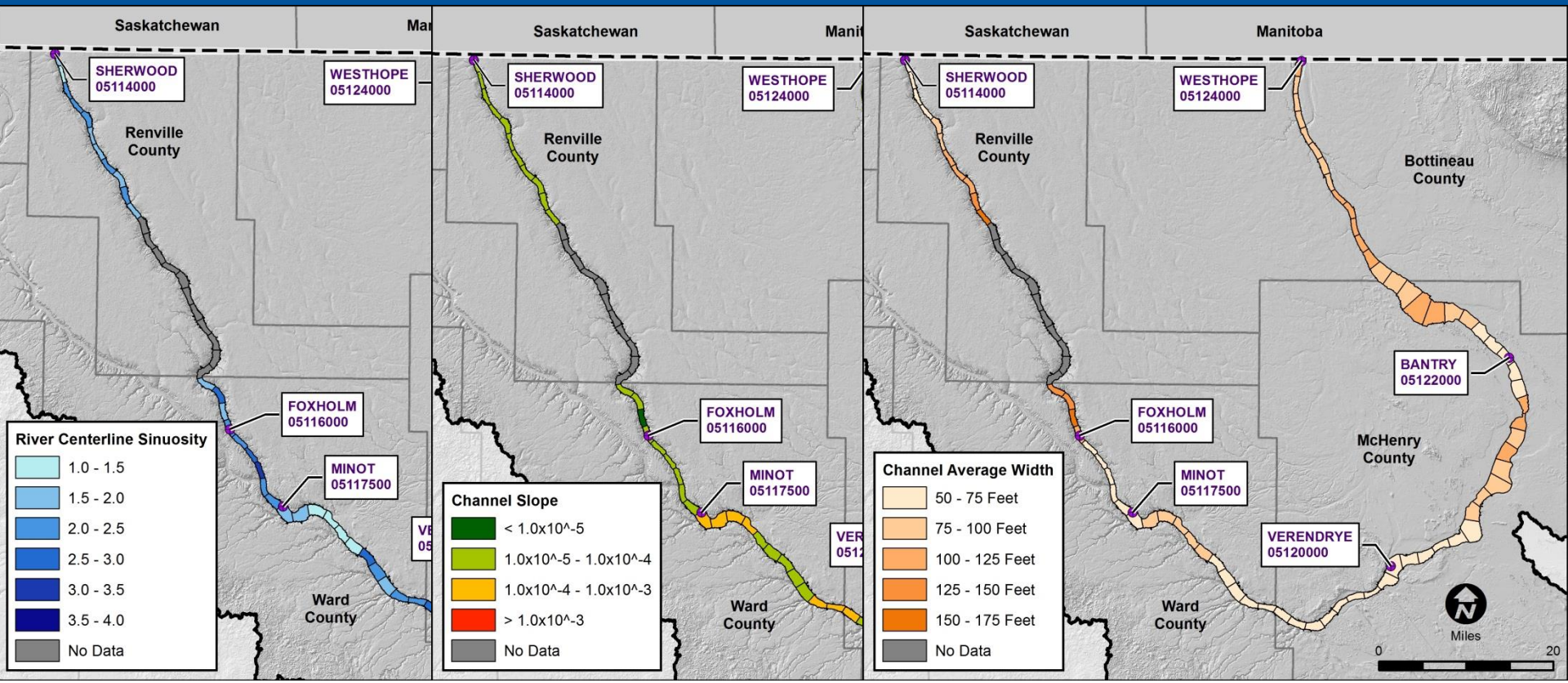
valley width **valley slope** **valley % sand**

channel characteristics used for stream classification

Channel characteristics

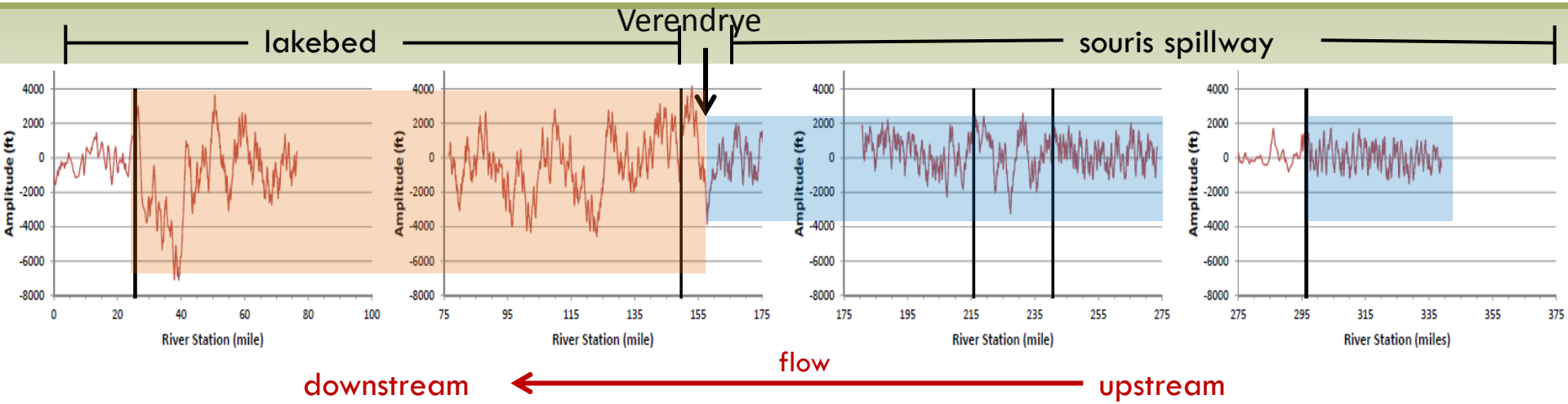
- sinuosity
- channel slope
- channel width
- channel cross-sectional area
- channel planform (wavelength/amplitude)

channel characteristics follow valley influences



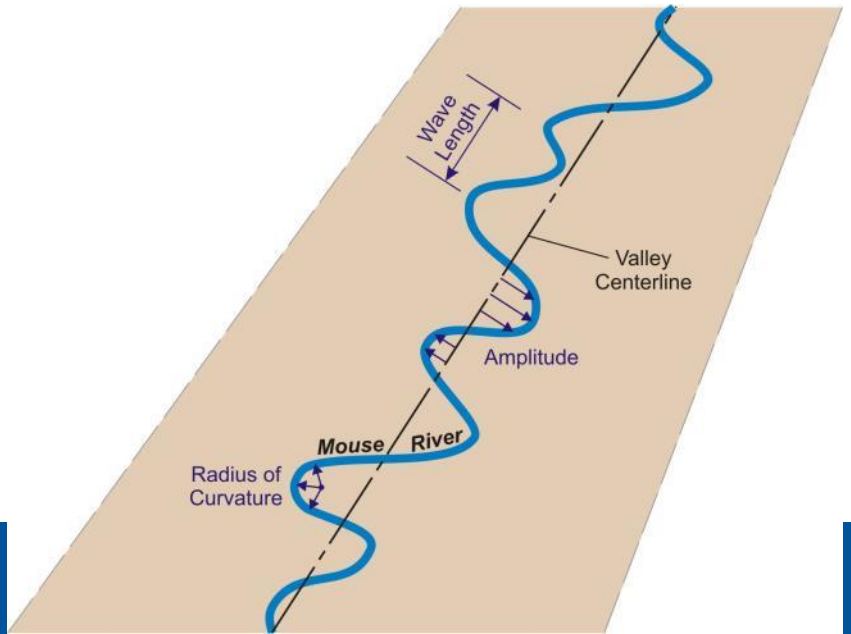
sinuosity **channel slope** **channel width**

channel characteristics follow valley influences



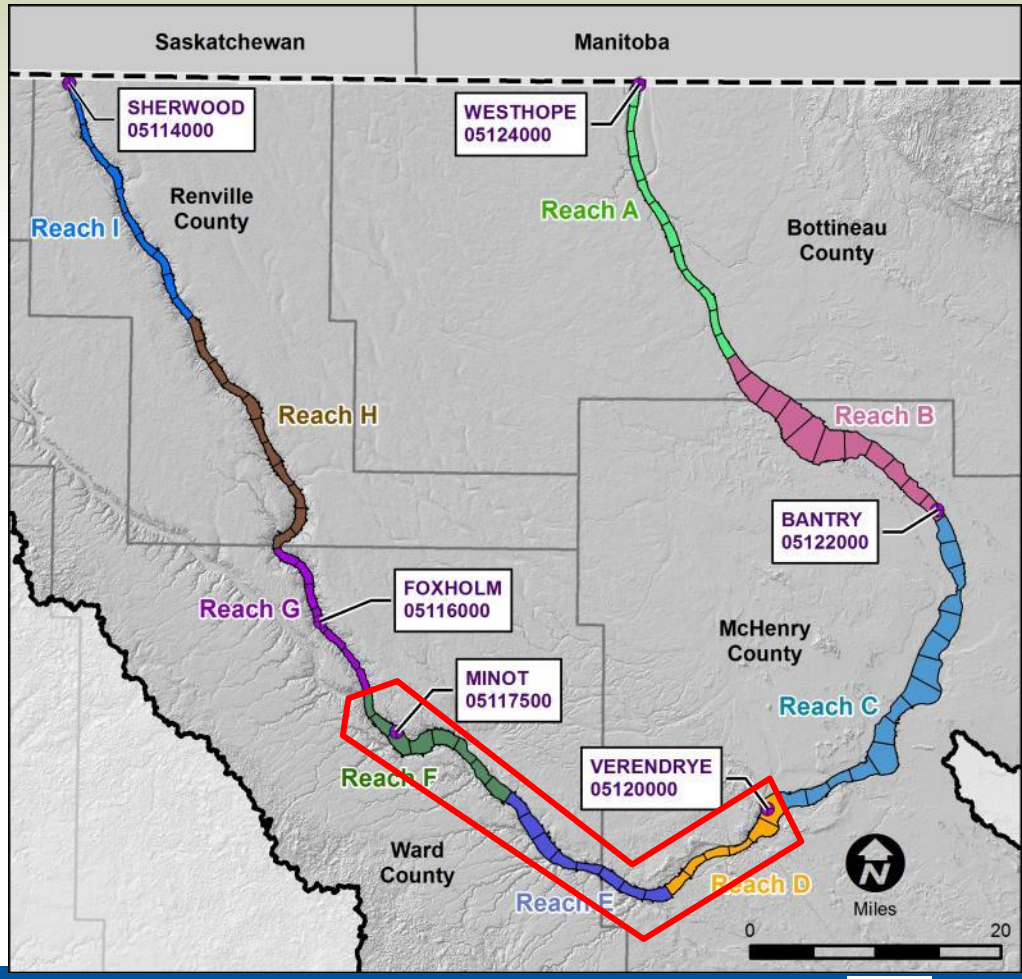
flow

downstream ← upstream



resulting classification into 9 distinct reaches

- urbanized reaches are steepest, sandiest soils, most straightened
- downstream reaches are natural depositional areas



implications of geomorphic classification

- identify areas most sensitive to flood-control project impacts
  - natural erosional and/or highly mobile reaches
  - highly straightened/confined reaches
  - natural depositional reaches
- target these areas in future field data collection & modeling

why perform basin-scale geomorphology assessment?

- understand background geologic influences
- target field data collection & modeling
- focus project design refinements
- reduce potential project impacts

Acknowledgments

- Majority of GIS work and figures done by Mike Strong and Kelly Wild, Barr Engineering
- Site visit and some data analysis done in cooperation with Ackerman-Estvold, Minot, ND
- Figures by Rick Gustner, Barr Engineering

questions?