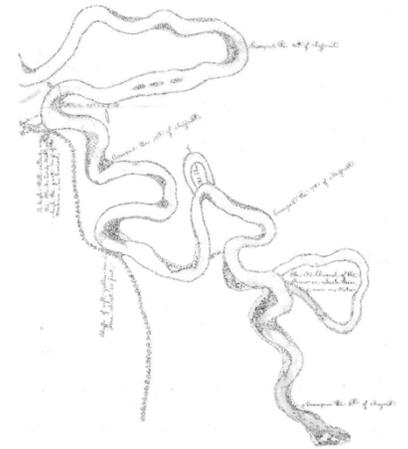


A Sustainable Middle Missouri River Concept

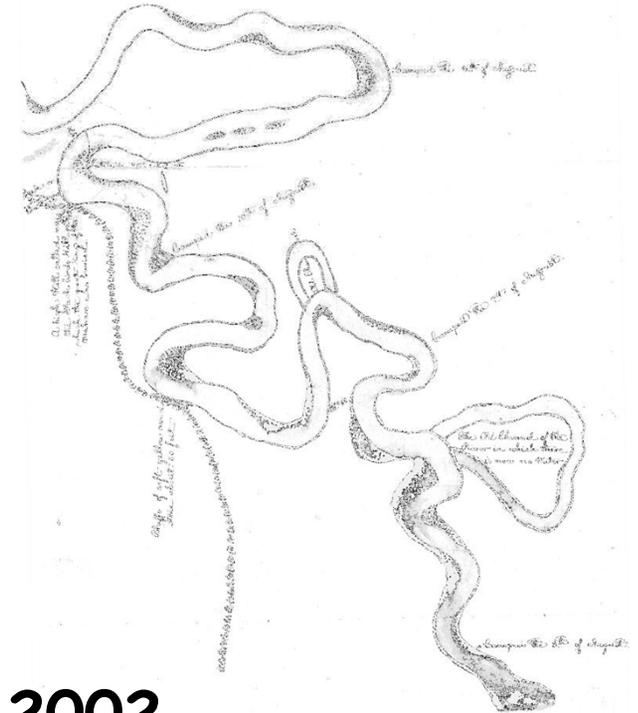
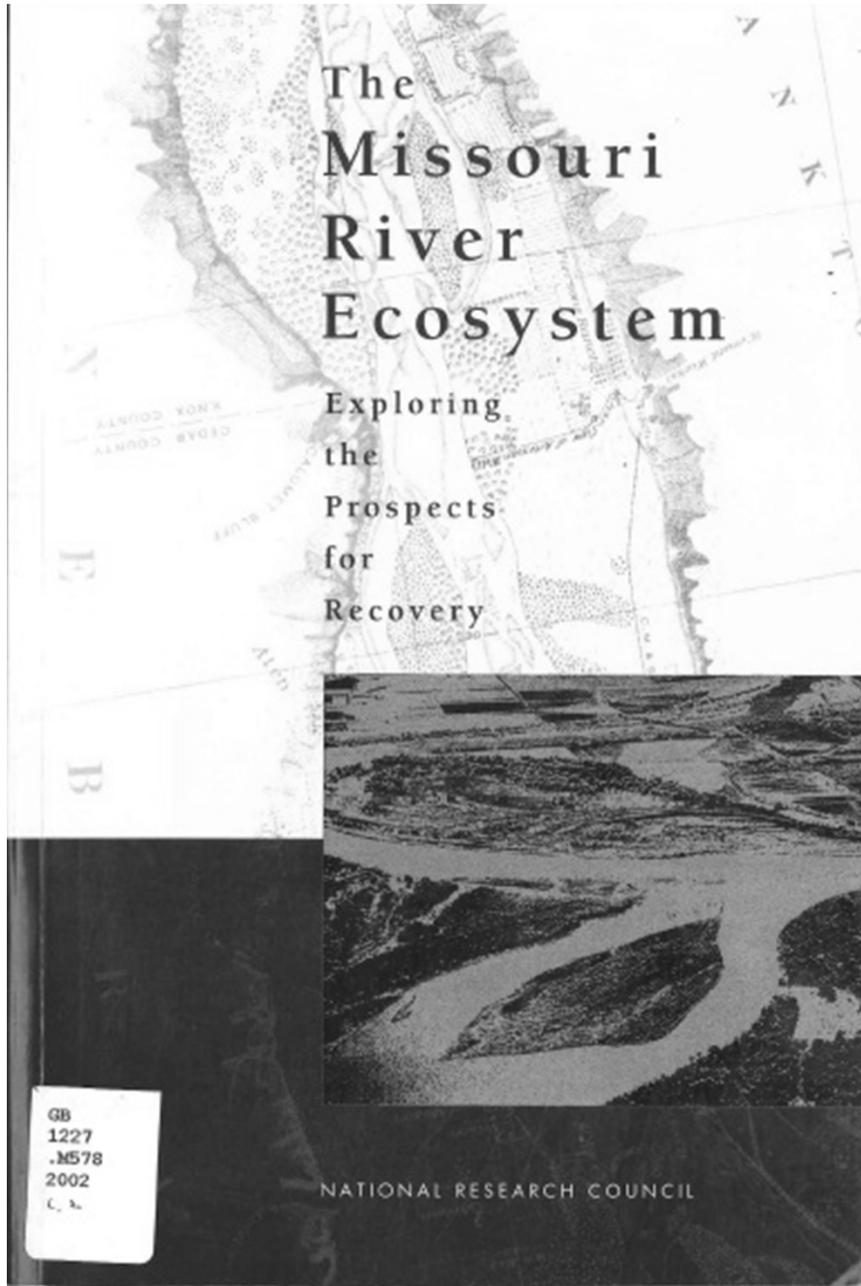
NDNR, NE Stakeholder Brief
by MORAST Representatives
July 27, 2009
Papio-Missouri NRD Office



Problem ?



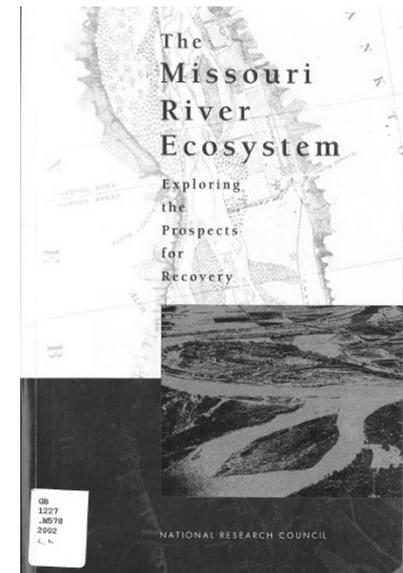
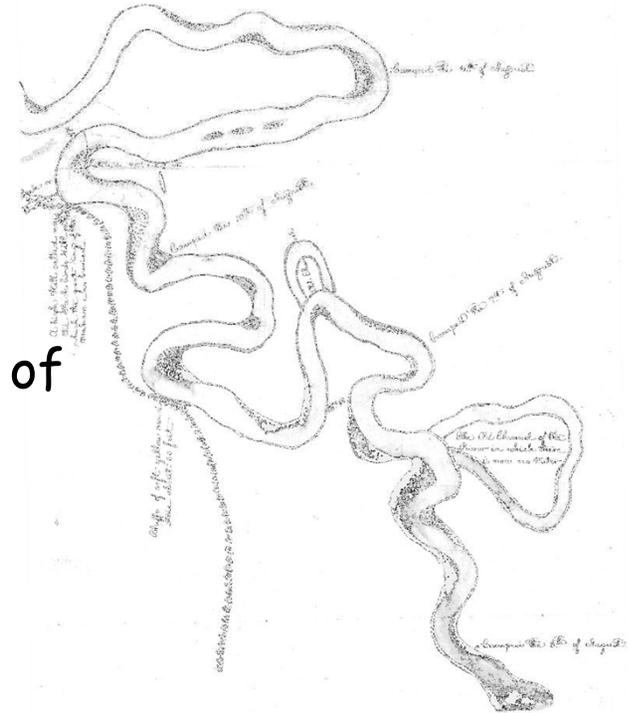
The current channel configuration of the Middle Missouri River (RM 734-490) is NOT meeting the basic ecological needs of many species.



2002

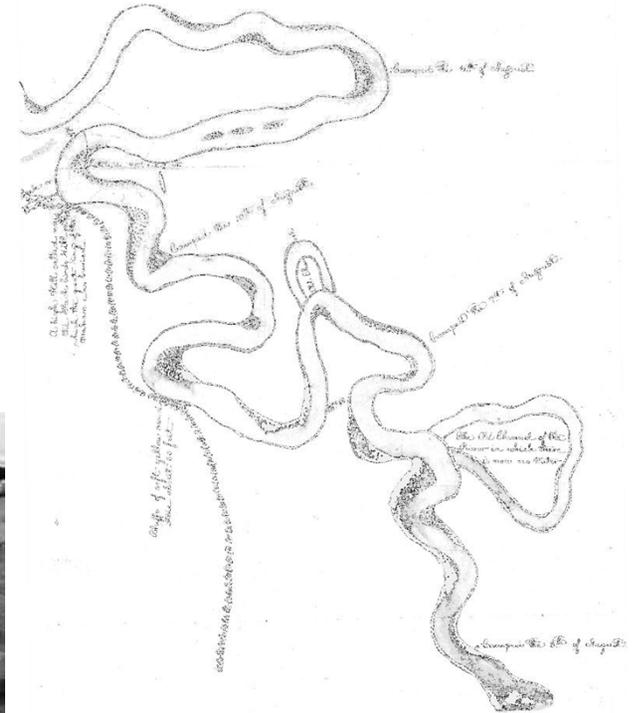
The National Research Council is committed to providing elected leaders, policy makers, and the public with expert advice based on sound scientific evidence, including:

- Degradation of the natural Missouri River ecosystem is clear and continuing
- The ecosystem has experienced a substantial reduction in biological productivity as the result of habitat transformation
- Natural riverine processes have been greatly altered
- The ecosystem has been simplified
- Degradation will continue unless some portion of the hydrologic and geomorphic processes that sustained the pre-regulation Missouri River and floodplain ecosystem are restored including flow pulses and cut and fill alluviation
- The ecosystem faces the prospect of irreversible extinction of species





Sturgeon Chub



Sicklefin Chub

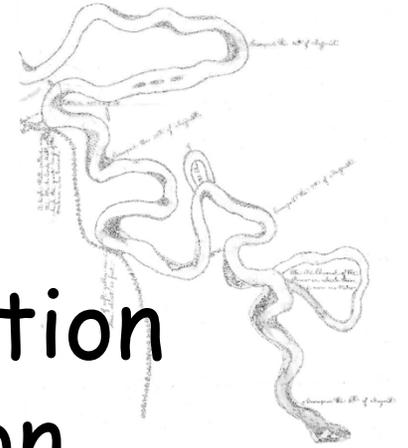
Over 50 native Missouri River fish species are described as rare, uncommon or declining



The MR has been highly modified



Bank Stabilization Navigation Project

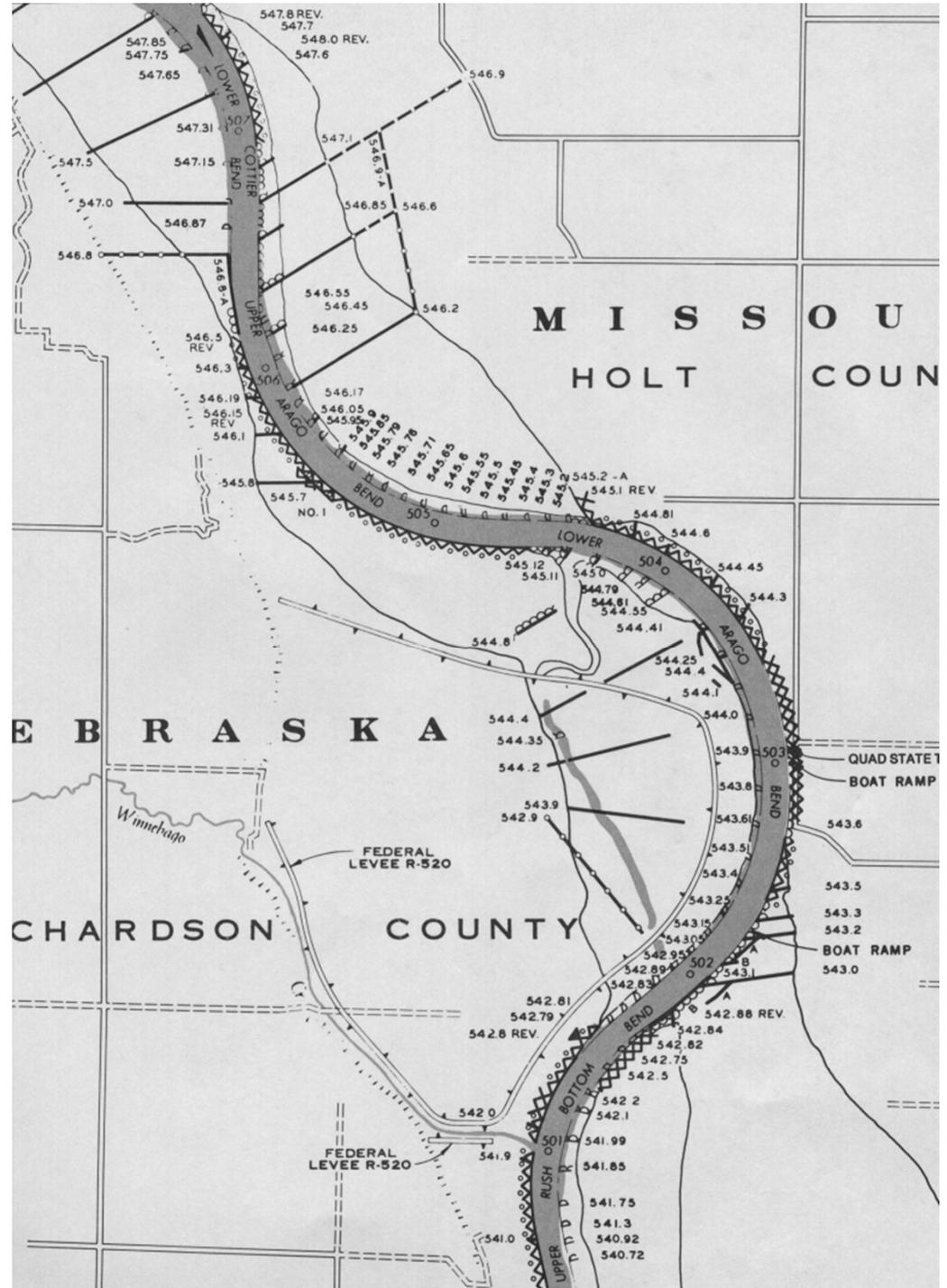


Gavins
Point Dam

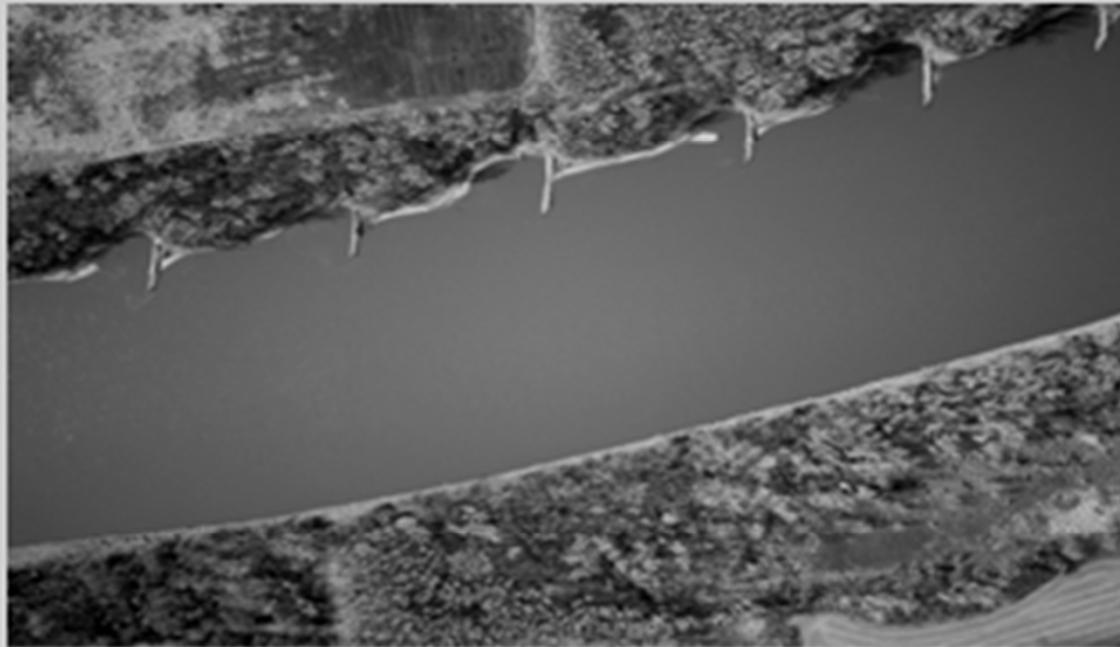


Middle Missouri River Today is

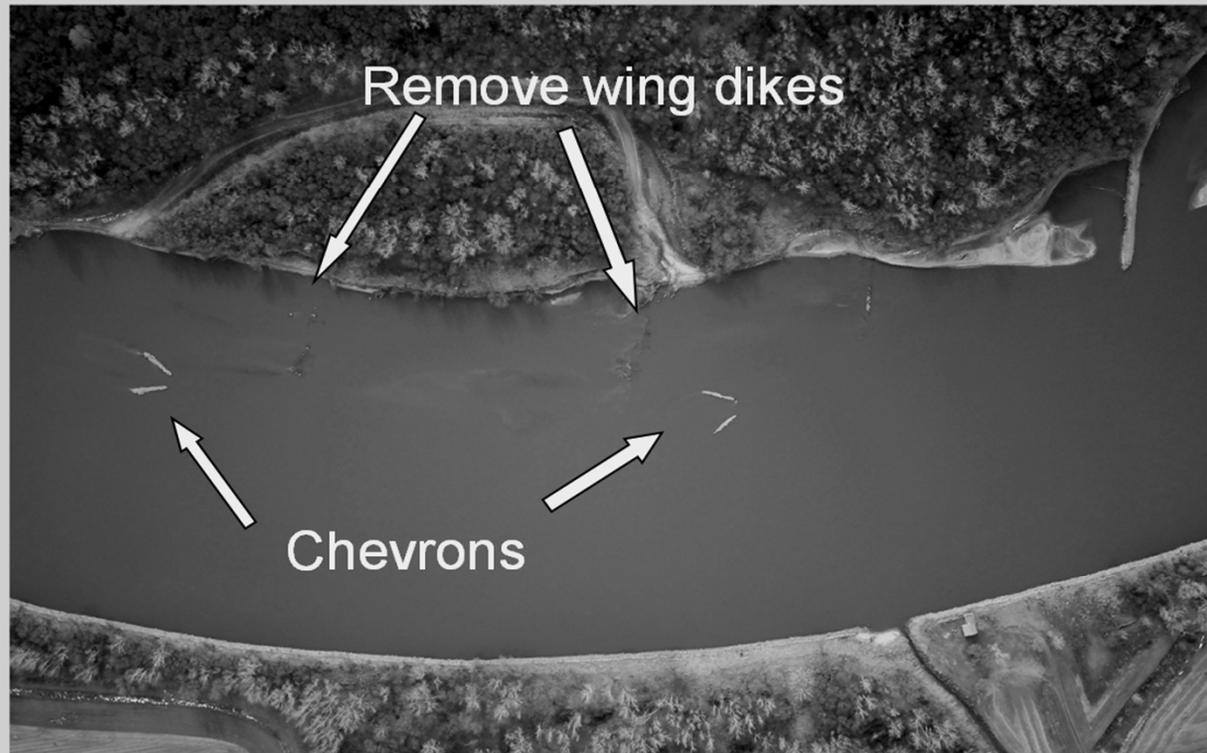
- Shorter
- Narrower
- Deeper
- Clearer
- Simpler
- Static
- Less Productive



Channelized Missouri River



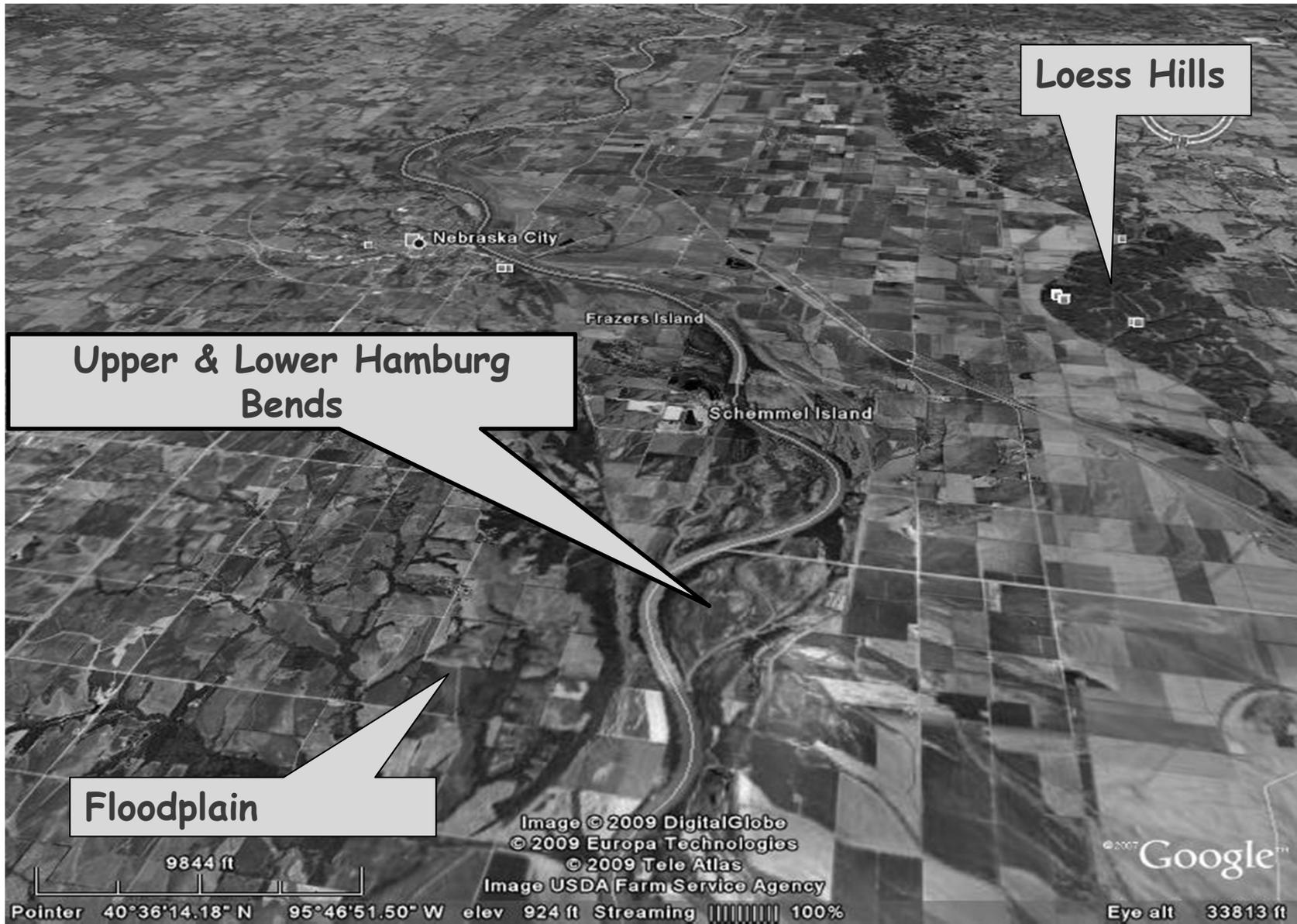
Major Modifications



Type B Notched Wing Dikes



Notch wing dikes



Loess Hills

Upper & Lower Hamburg Bends

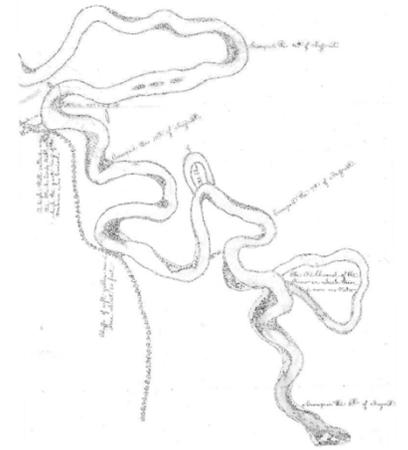
Floodplain

Image © 2009 DigitalGlobe
© 2009 Europa Technologies
© 2009 Tele Atlas
Image USDA Farm Service Agency
Pointer 40°36'14.18" N 95°46'51.50" W elev 924 ft Streaming ||||| 100%

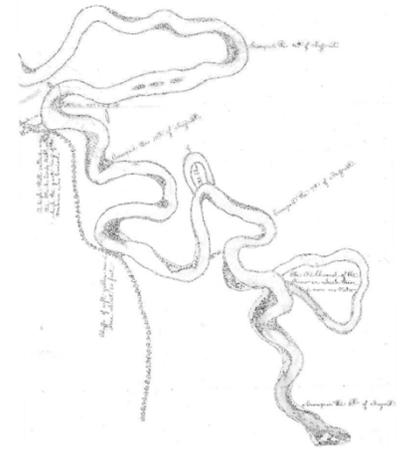
© 2007 Google™
Eye alt 33813 ft

Questions

- What would it take to restore the Middle Missouri River to a healthy, sustainable ecosystem ?
- What did the historic Middle Missouri River look like ?
- Reference Conditions ?



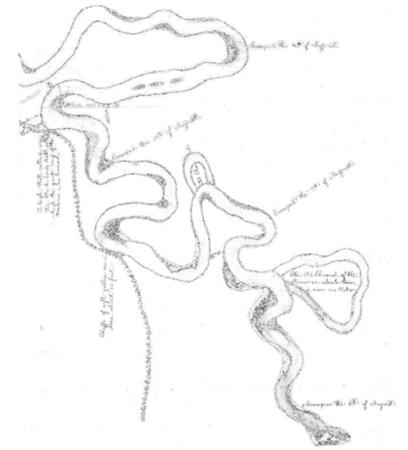
Reference Conditions for the Middle Missouri River:



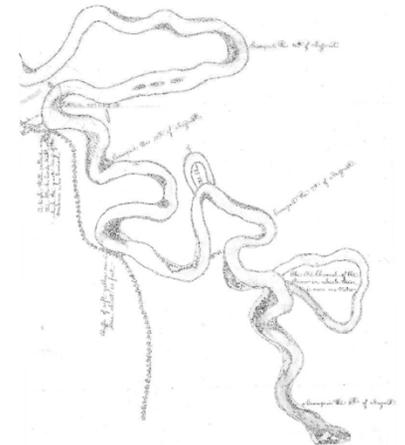
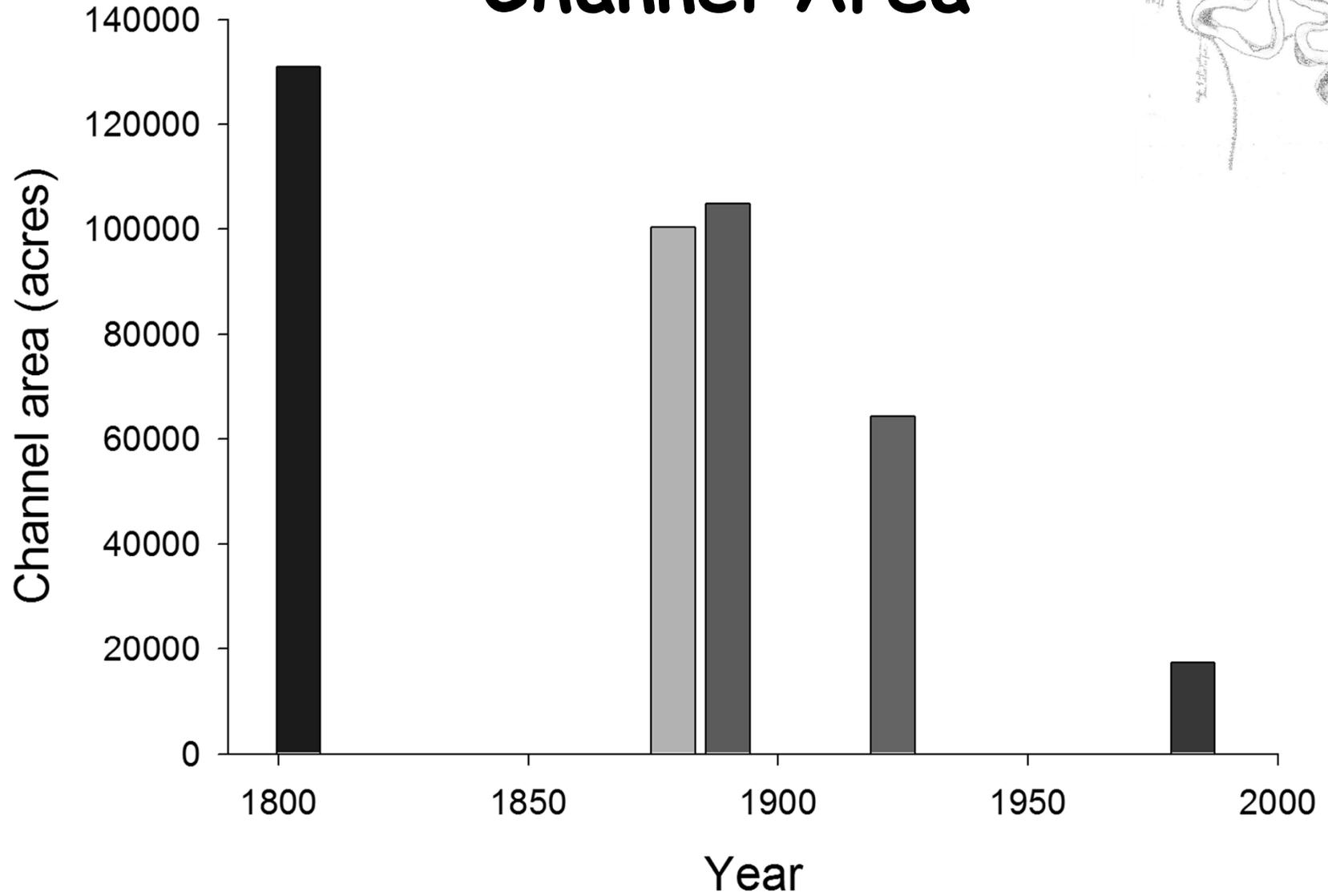
- Reference conditions are useful tools because they show what a site's potential can be under self-sustaining conditions (Egan and Howell 2001).
- Restoration is all about "learning how to discover the past and bring it forward into the future".

Reference Conditions for the Middle Missouri River:

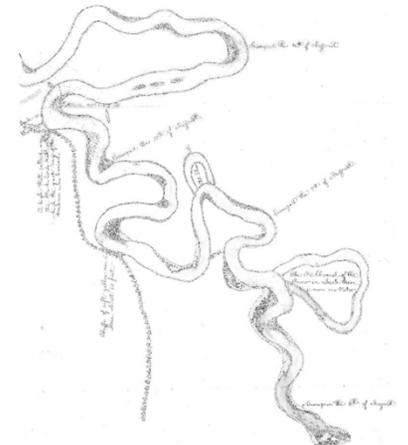
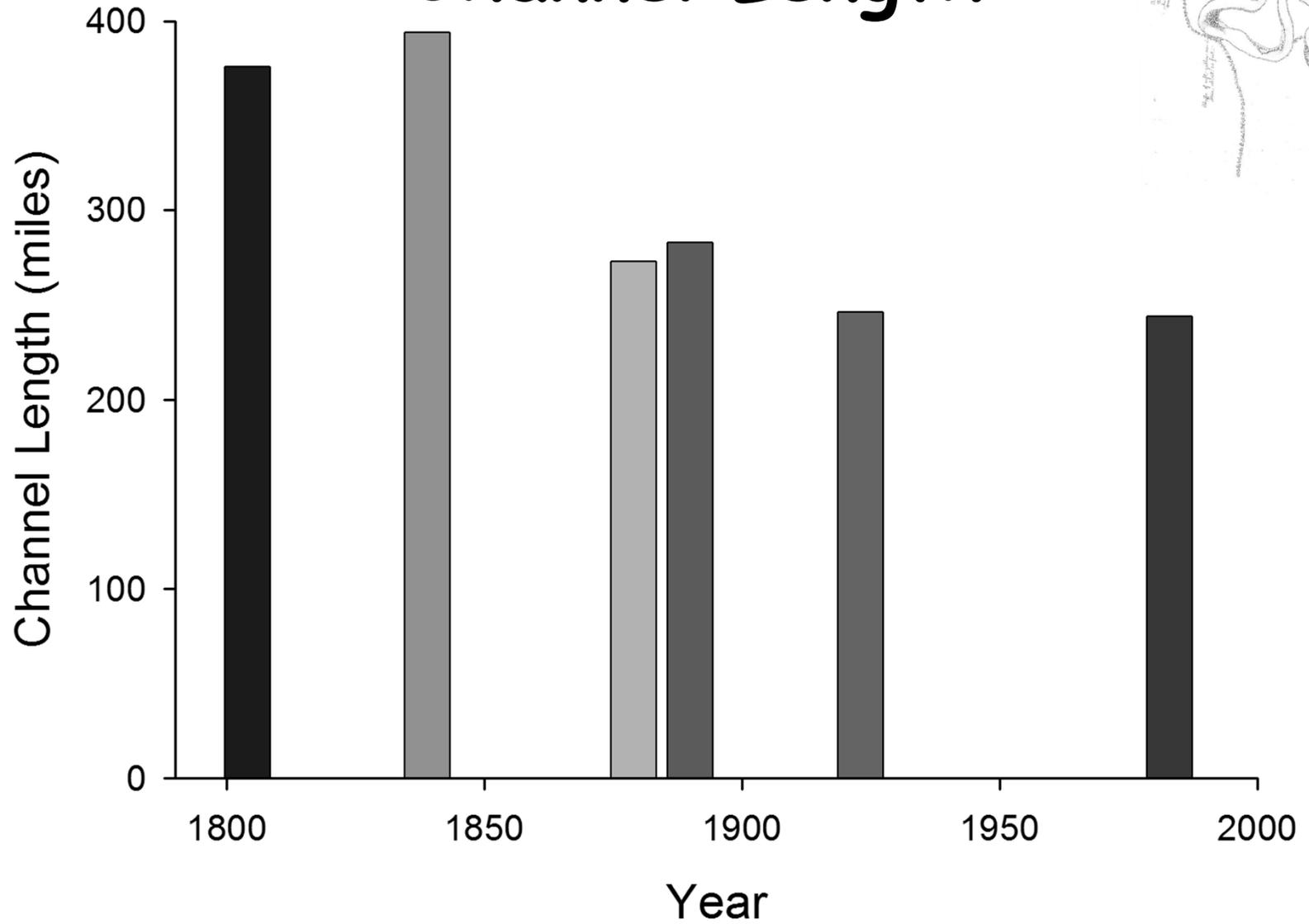
- Channel area
- Channel length
- Channel width
- Sinuosity
- Water depth
- Water velocity
- Shallow water habitat
- Channel features
- Bend & bankline movement



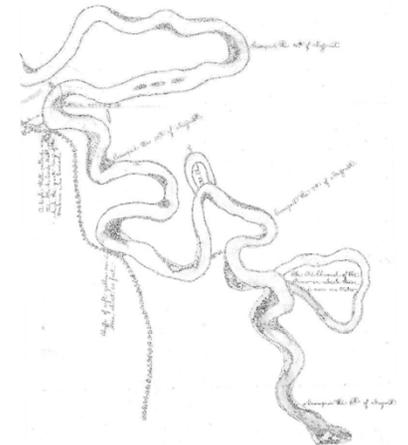
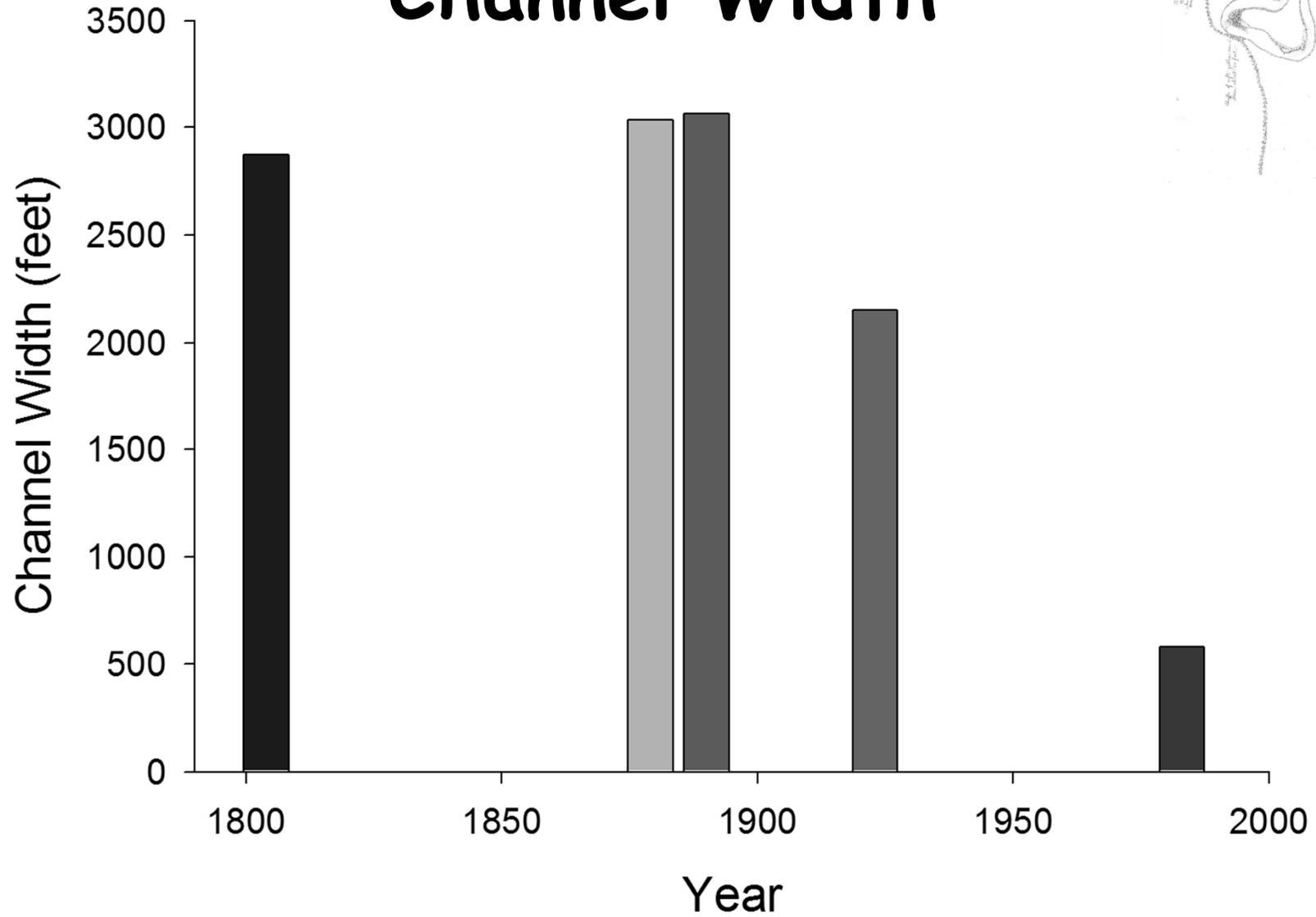
Channel Area



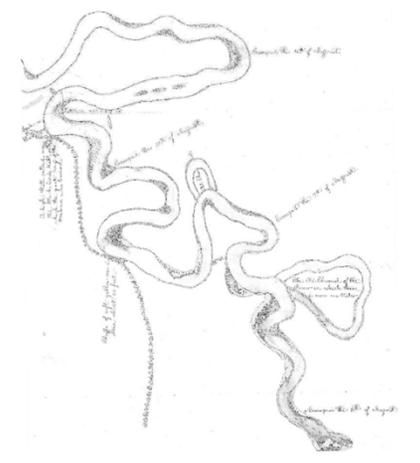
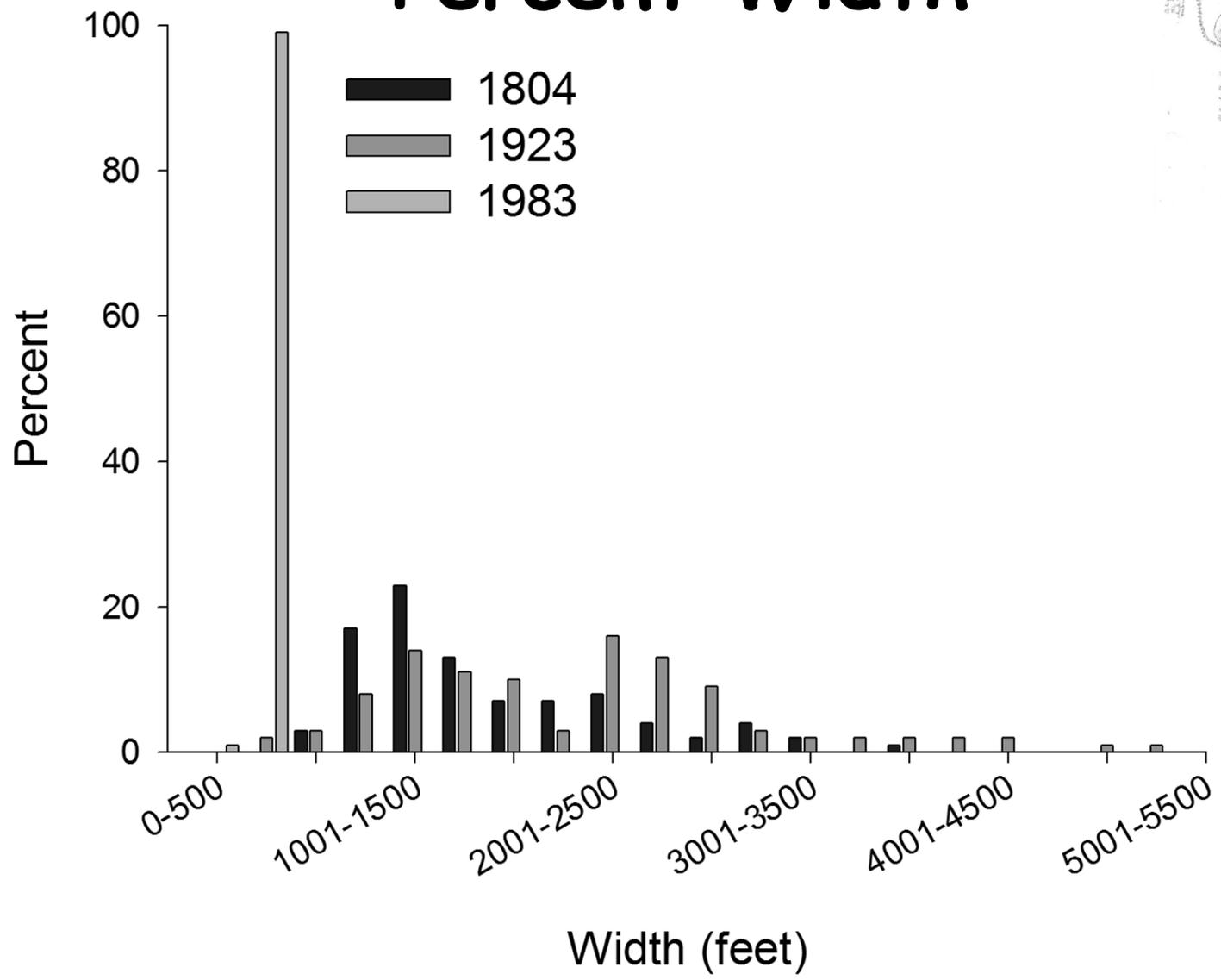
Channel Length



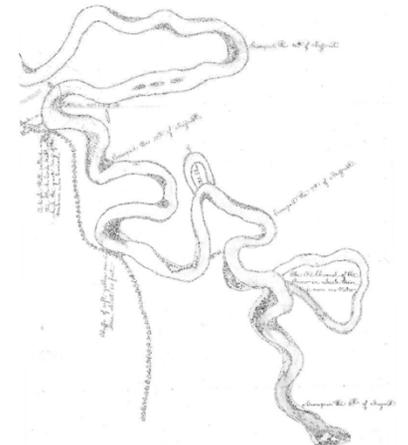
Channel Width



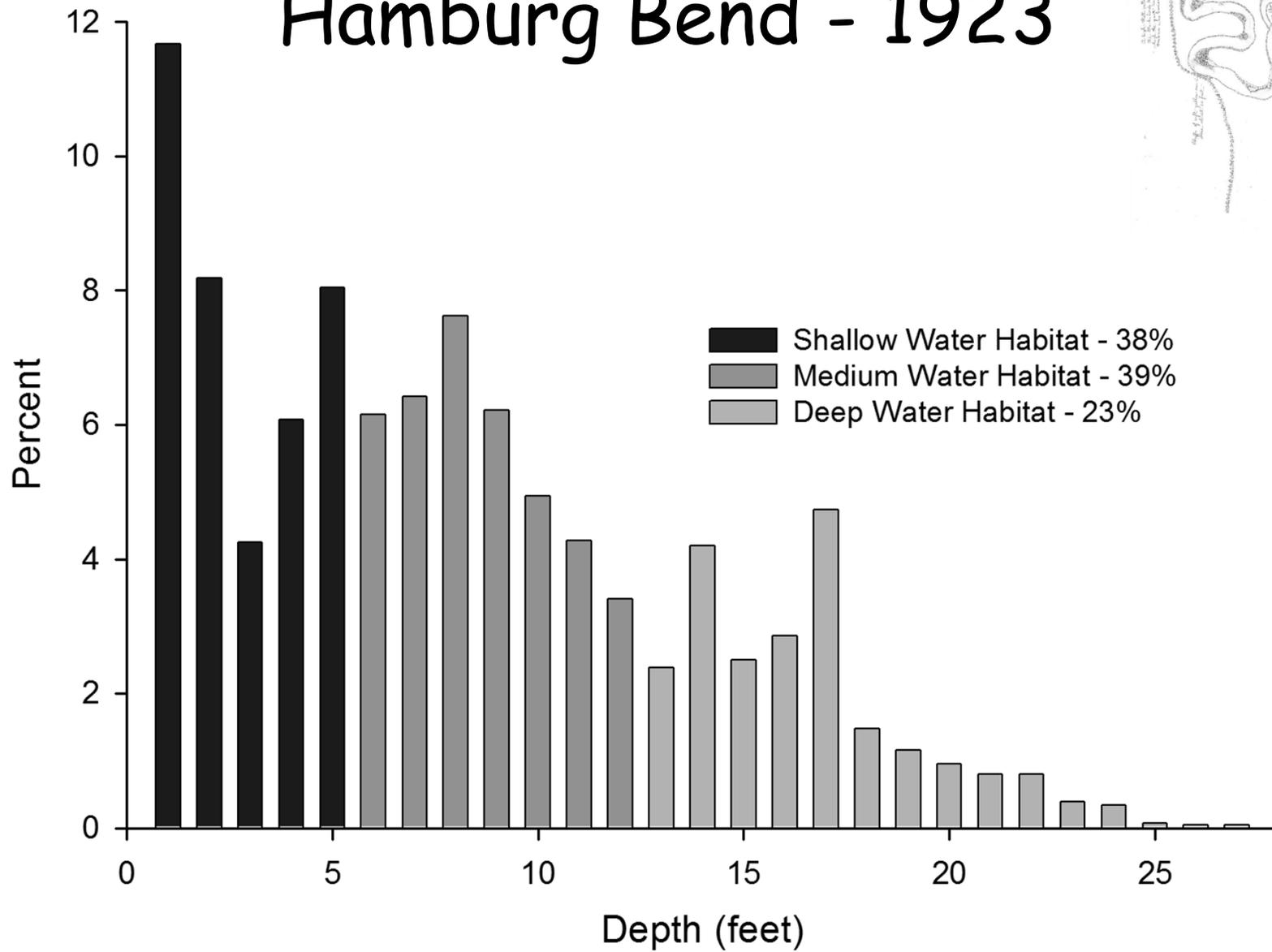
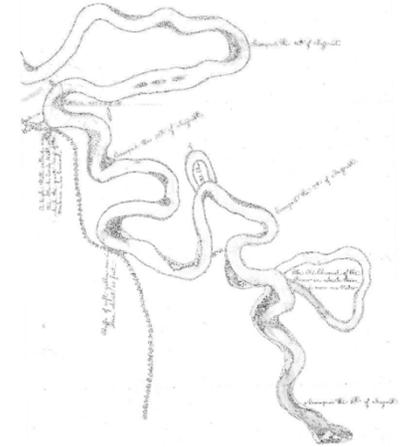
Percent Width



Sinuosity



Hamburg Bend - 1923



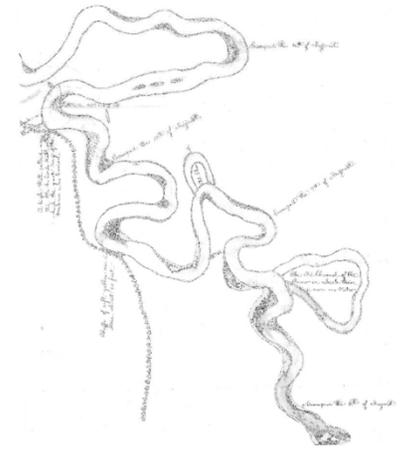
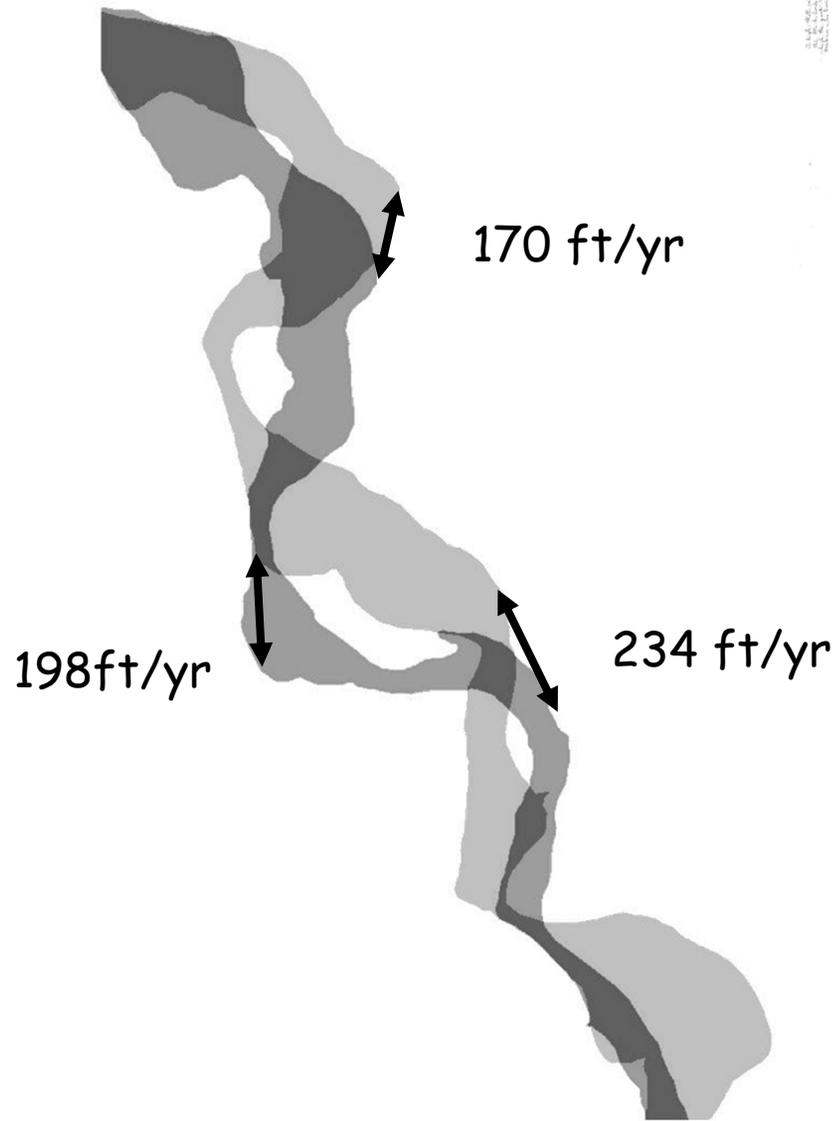
Historical channel features included:

- Sandbars - many
- Vegetated bars - fewer
- Pools - many
- Islands - few
- Tributary deltas - unconstrained
- LWD - Large Woody Debris - lots
- Rock exposures - very limited



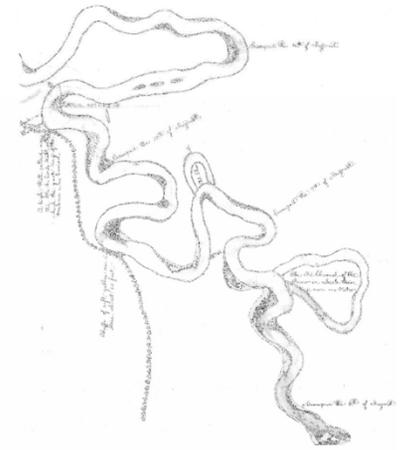
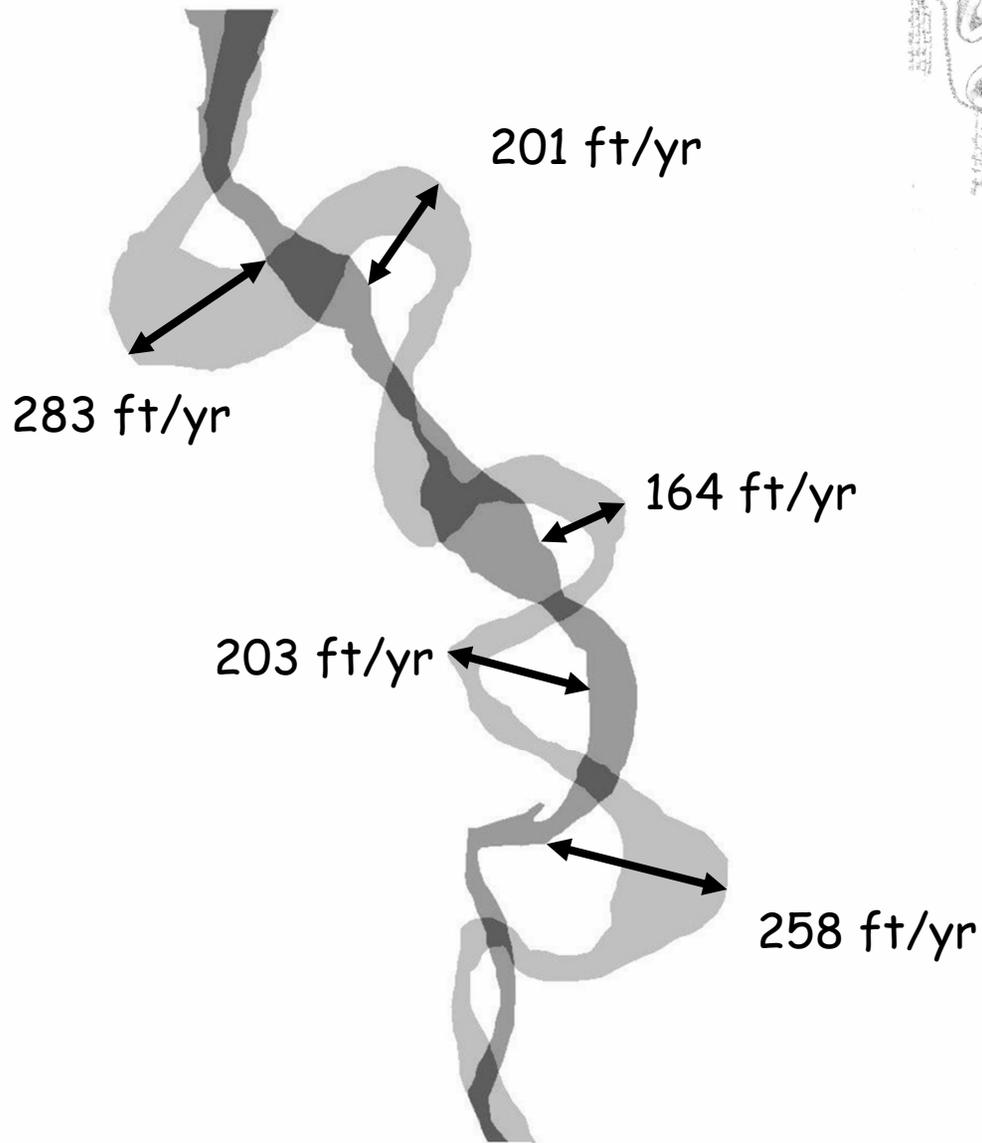
Bend migration

**From 1890
To 1923**

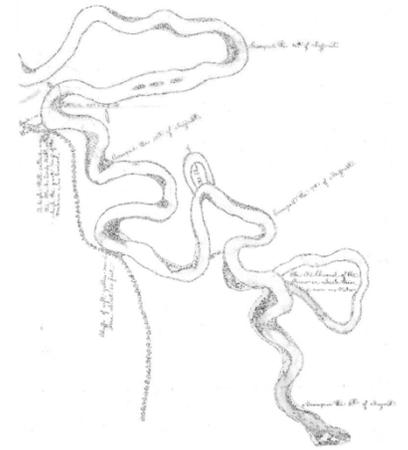


Bend cut-offs

From 1890
To 1923

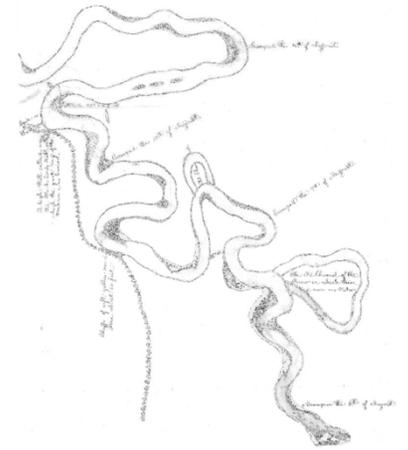


What would it take to restore the Middle Missouri River to a healthy, sustainable ecosystem?



- It will take an approach that supports the hydrologic, geomorphic and biotic processes that form and maintain a healthy alluvial river ecosystem.

Trush, McBain & Leopold 2000



Full Restoration

Complete return to pre-disturbance state

Rehabilitation

Partial return to pre-disturbance structure or function

Enhancement

Any improvement in environmental quality

Creation

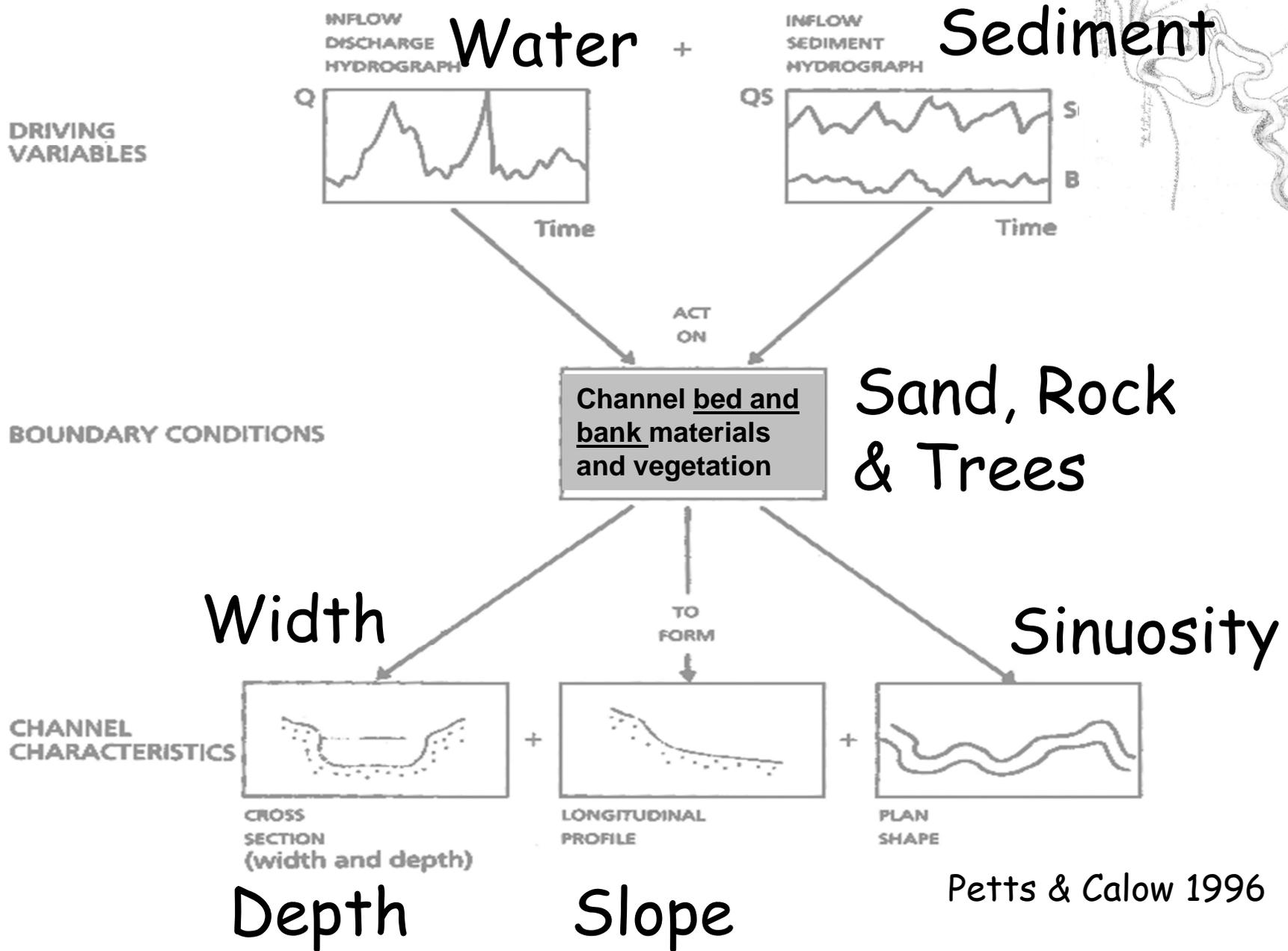
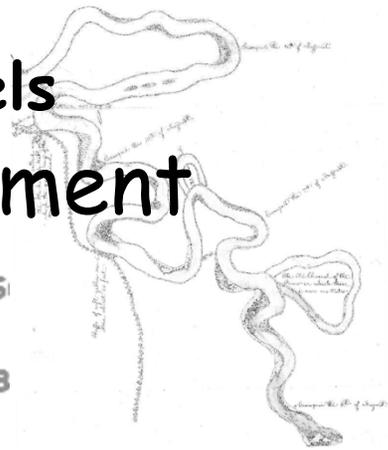
Morphological and ecological configuration with contemporary magnitudes and rates of FLUVIAL PROCESSES

What are Fluvial Processes ?



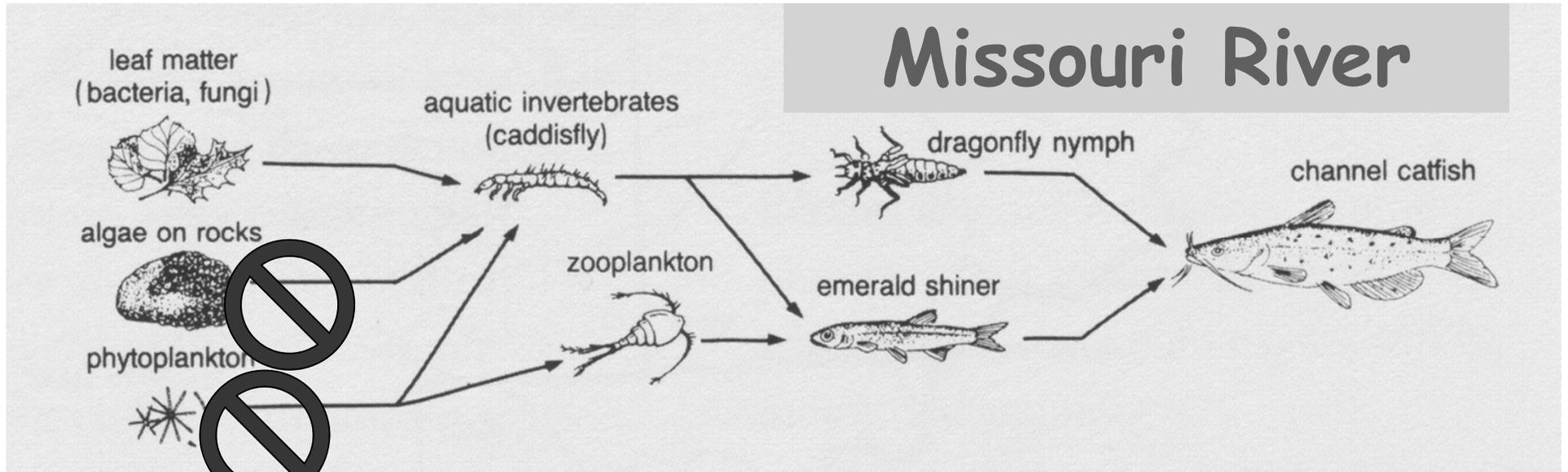
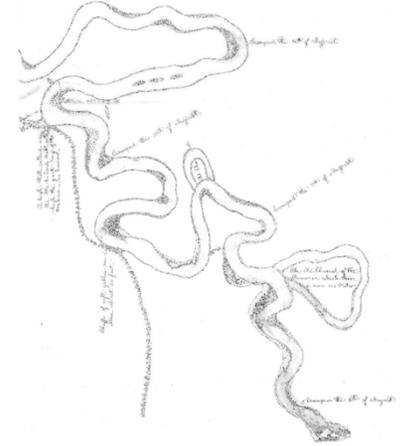
- Erosion by moving water across the bed. The sediment being transported in the river wears away the bed and the fragments themselves are ground down becoming smaller and more rounded. The sediment is transported as either bedload and/or suspended load. There is also a component carried as dissolved material.
- Physical interaction of flowing water and the natural channels of rivers and streams
- The processes associated with rivers and streams and the deposits and landforms created by them

Equilibrium concepts for erodible channels



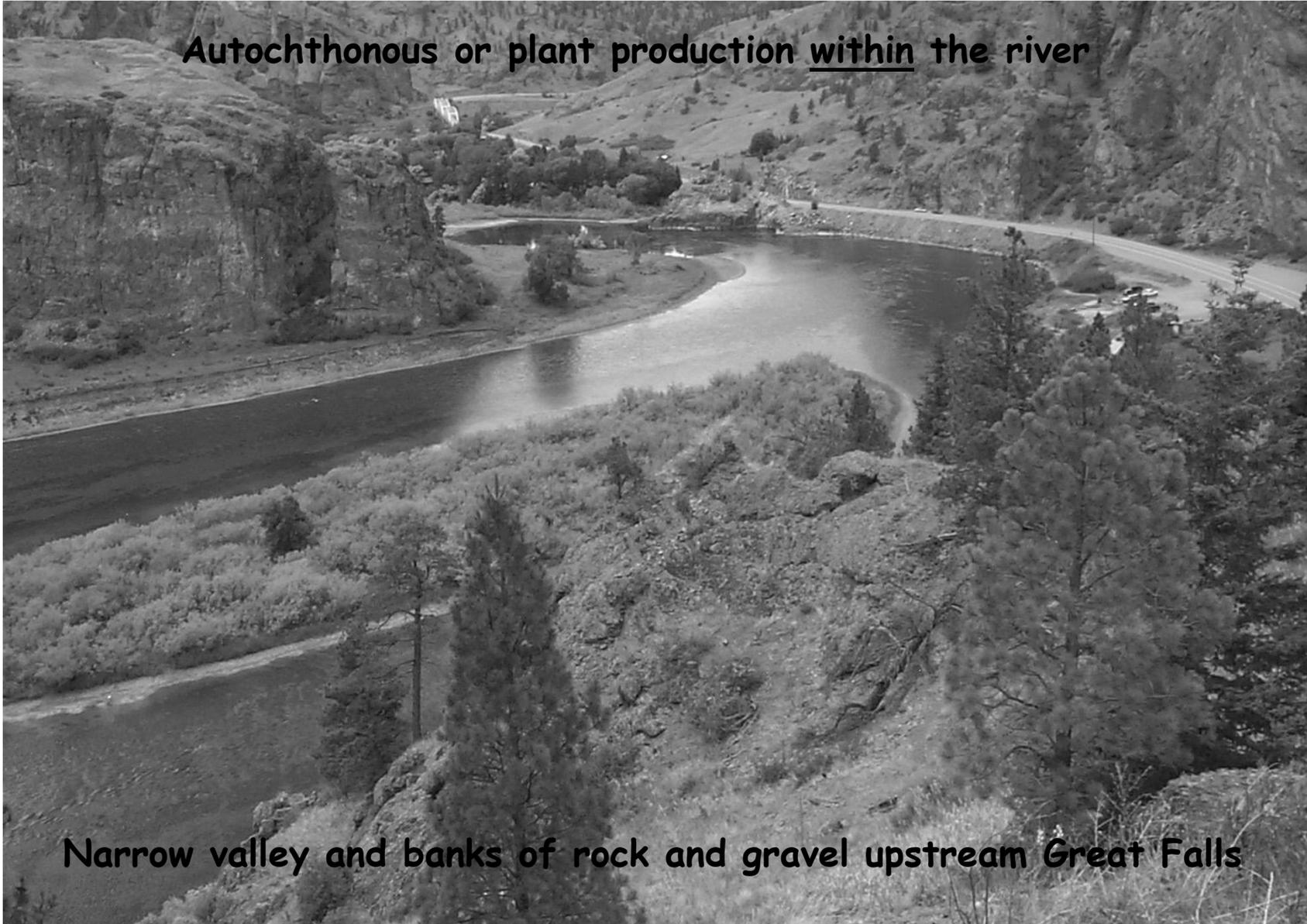
Petts & Calow 1996

Why are fluvial processes important ?



Fact: The Missouri River is an allochthonous system

Autochthonous or plant production within the river



Narrow valley and banks of rock and gravel upstream Great Falls

Allochthonous or plant production outside the river



Elk Point Bend RM 754

Image © 2009 DigitalGlobe

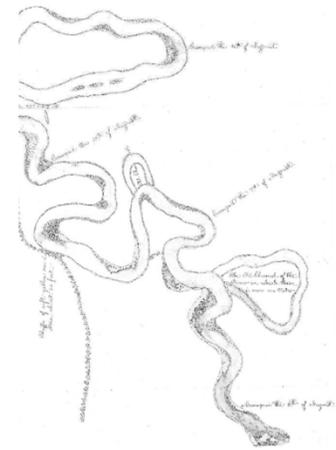
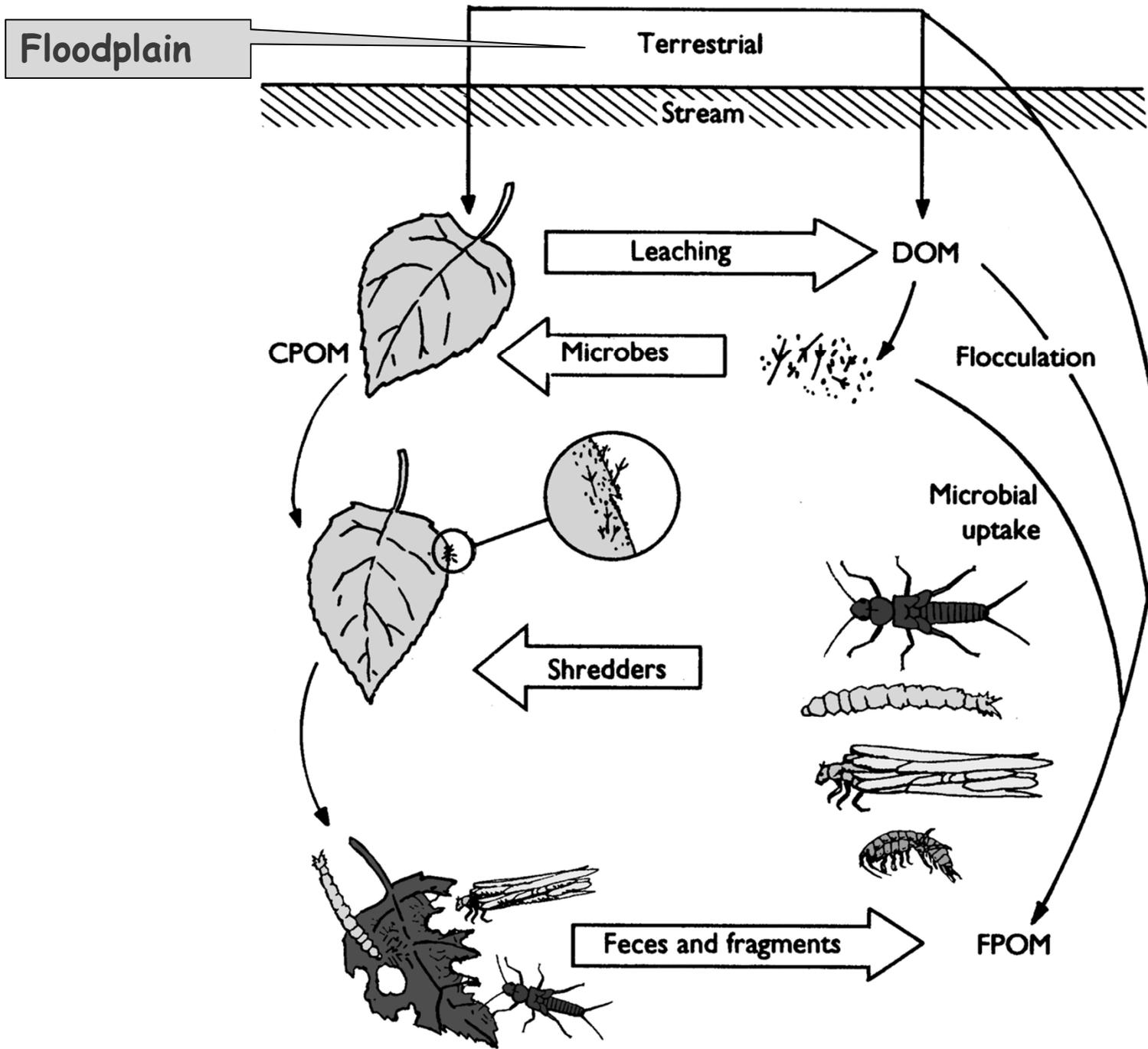
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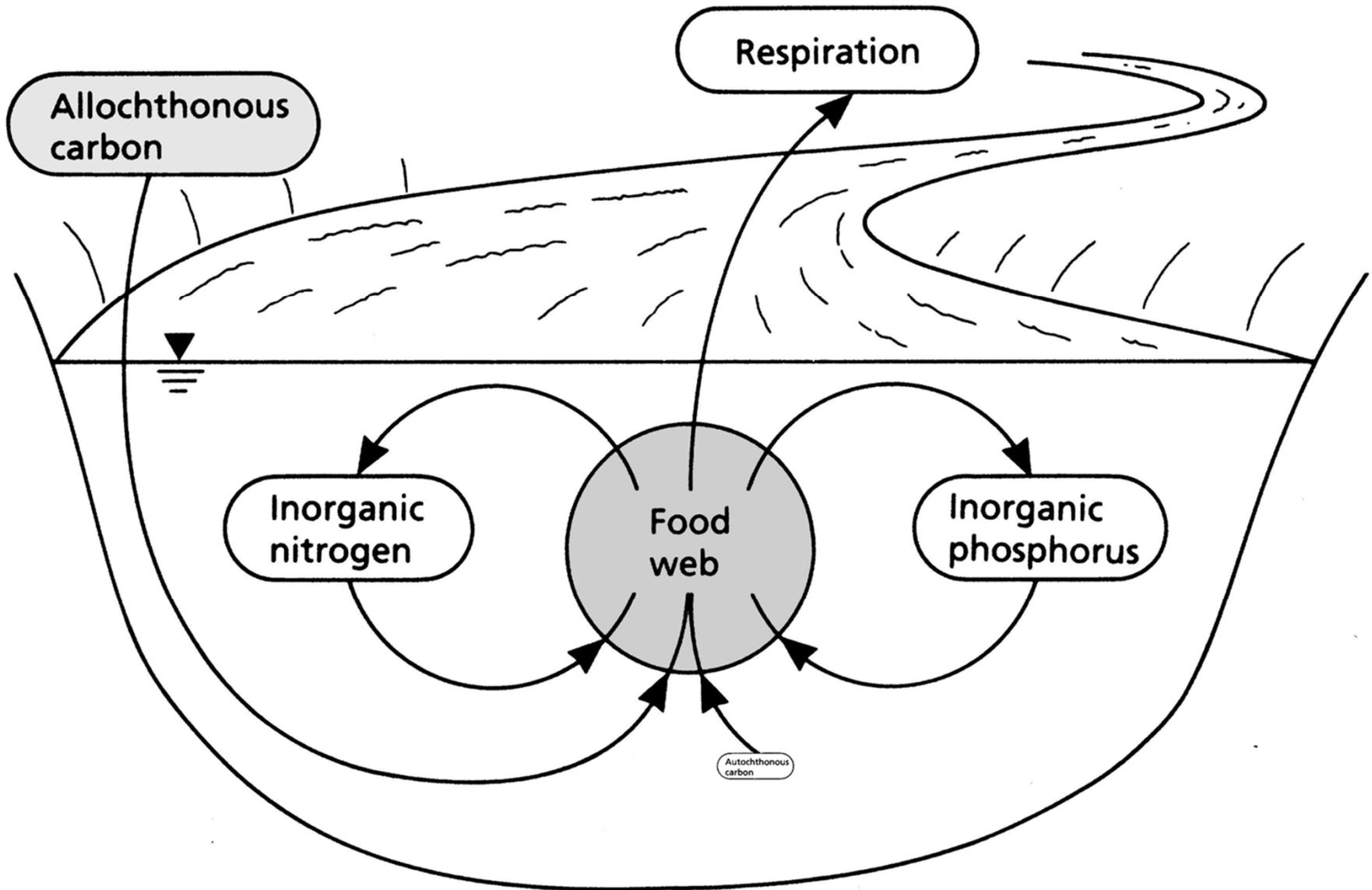


Pointer 42°38'32.62" N 96°43'05.38" W elev 1115 ft Streaming ||||| 100%

Eye alt 26492 ft

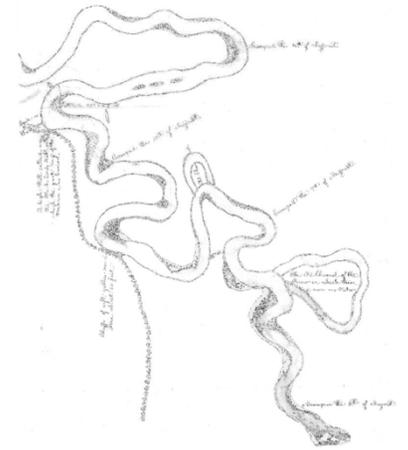


Missouri River nutrients

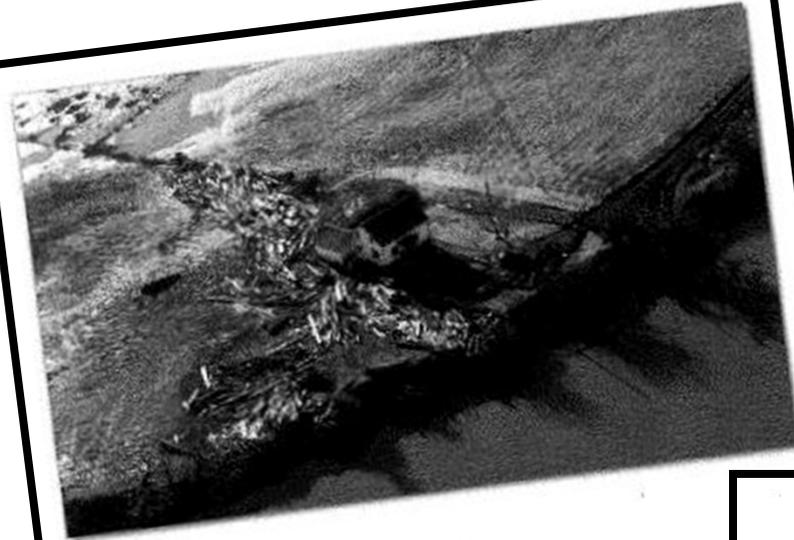
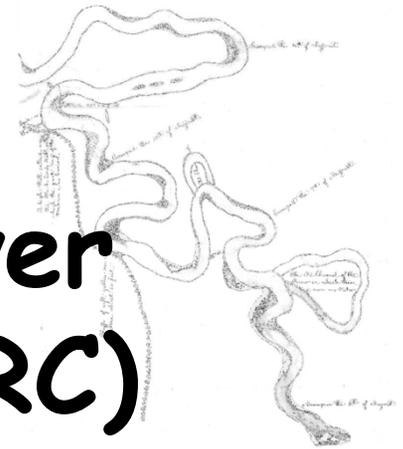


NGPC Proposal

- Establish an erodible river corridor
- Morphological and ecological configuration with contemporary magnitudes and rates of fluvial processes



Erodible River Corridor (ERC)



A Framework for Delineating Channel Migration Zones

November 2003
Ecology Publication #03-06-027 (Final Draft)

Washington State
Department of Transportation

RIVER RESEARCH AND APPLICATIONS

River Res. Applic. 21: 773–789 (2005)

Published online in Wiley InterScience

(www.interscience.wiley.com). DOI: 10.1002/rra.881

A REVIEW OF TECHNIQUES AVAILABLE FOR DELIMITING THE ERODIBLE RIVER CORRIDOR: A SUSTAINABLE APPROACH TO MANAGING BANK EROSION

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^a UMR 5600 CNRS, 18 rue Chevreul, 69 362 Lyon cedex 07, France

^b School of Geography, University of Southampton, Highfield, Southampton, SO17 1BJ, UK

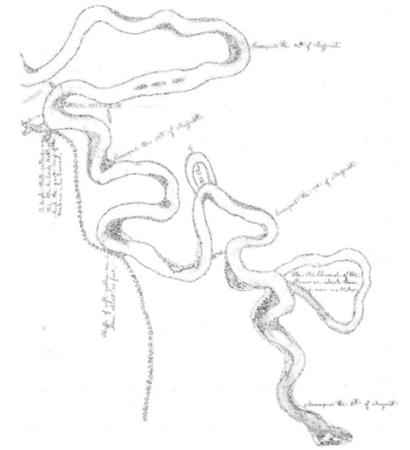
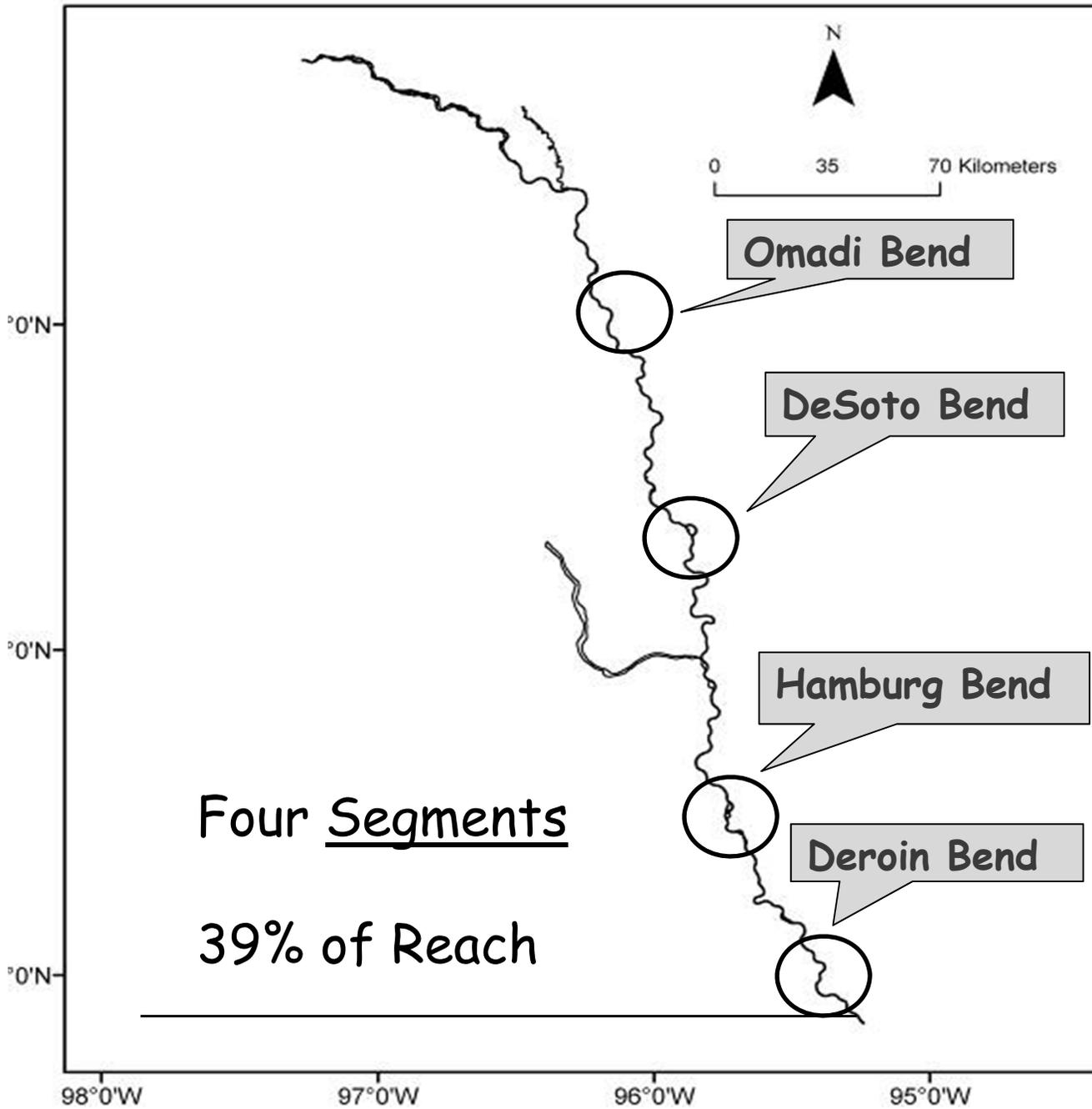
^c Delft University of Technology and WL/Delft Hydraulics, PO Box 177, 2600 MH Delft, The Netherlands

^d Dipartimento di Geografia, Università di Padova, via del Santo 26, 35123 Padova, Italy

ABSTRACT

Traditional policies for managing river bank erosion are currently being reconsidered as a result of increased awareness regarding the unsustainable nature of some forms of bank protection, and the role played by bank erosion in providing ecosystem services and supporting geomorphological functions. River managers are therefore increasingly seeking to preserve bank erosion within a defined erodible corridor. This paper provides an overview of the erodible corridor concept, focusing on the provision of guidelines for applying the concept in practice. We argue that a nested approach is required to address management objectives across a range of scales (network scale, reach scale, local scale) and review the different geomorphic tools that are available to help managers define the extent and inner sensitivity of the erodible corridor. These tools include simple rules of thumb such as evaluation of the equilibrium meander amplitude, historical approaches based on overlays of historical channel position, and simulation modelling. The advantages and limitations of each of these tools are discussed. Copyright © 2005 John Wiley & Sons, Ltd.

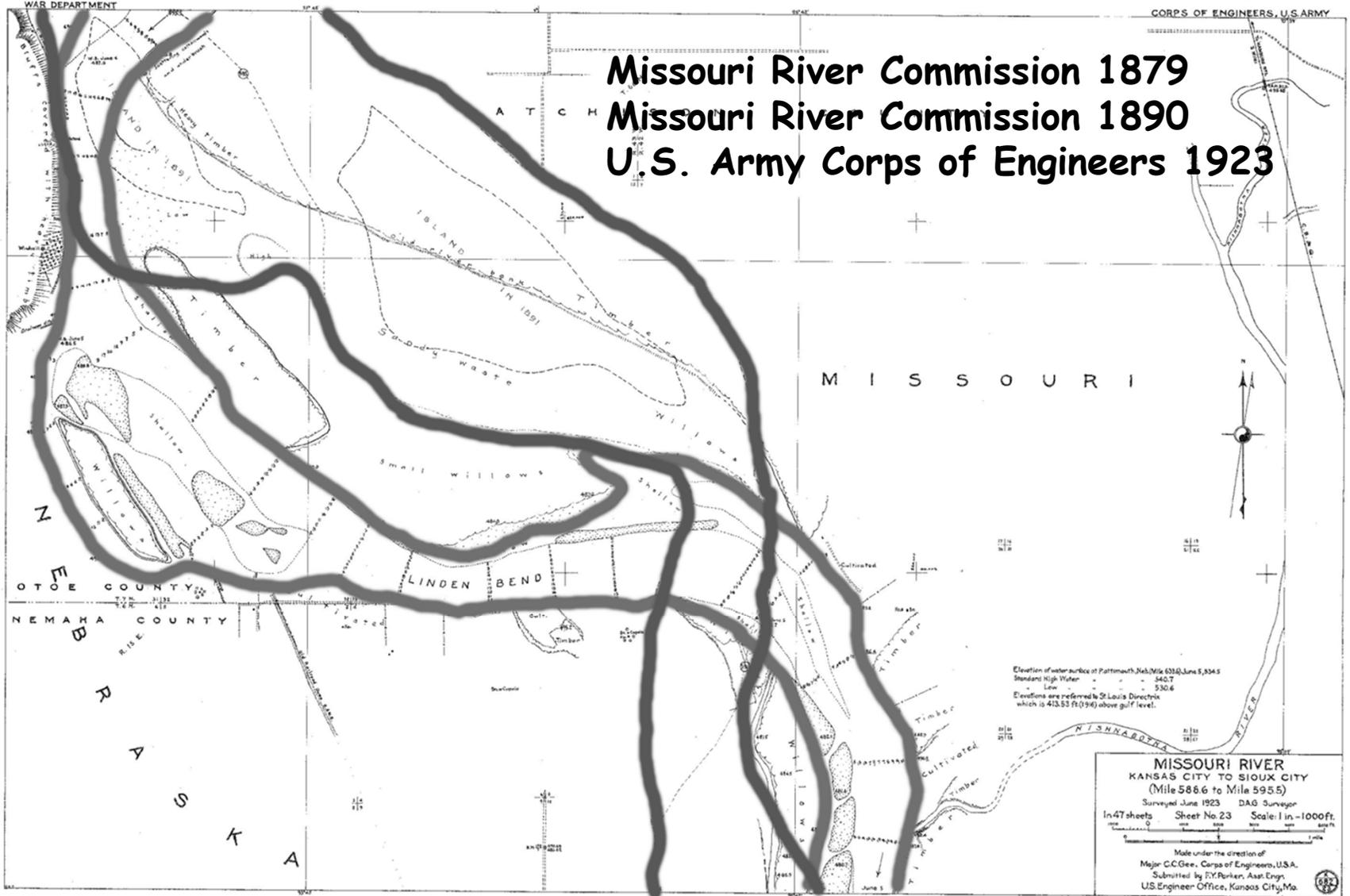
KEY WORDS: channel shifting; bank erosion; sustainable management; ecological benefit; human alteration; river functions; hydraulic model; historical analysis; hazard mapping; cost–benefit analysis



WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY

Missouri River Commission 1879
Missouri River Commission 1890
U.S. Army Corps of Engineers 1923



Elevation of water surface at Plattsmouth, Mo., June 5, 1923
 Standard High Water - - - - - 540.7
 Low - - - - - 530.6
 Elevations are referred to St. Louis Directrix
 which is 433.53 ft. (0.94) above gulf level.

MISSOURI RIVER
KANSAS CITY TO SIOUX CITY
 (Mile 586.6 to Mile 595.5)
 Surveyed June 1923 DAG Surveyor
 In 47 sheets Sheet No 23 Scale 1 in = 1000 ft.
 Made under the direction of
 Major C.C. Geen, Corps of Engineers, U.S.A.
 Submitted by F.Y. Parken, Asst. Engr.
 U.S. Engineer Office, Kansas City, Mo.

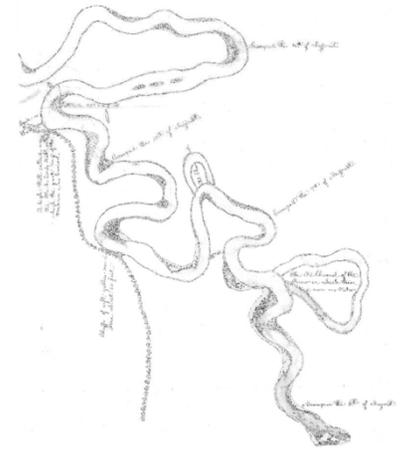
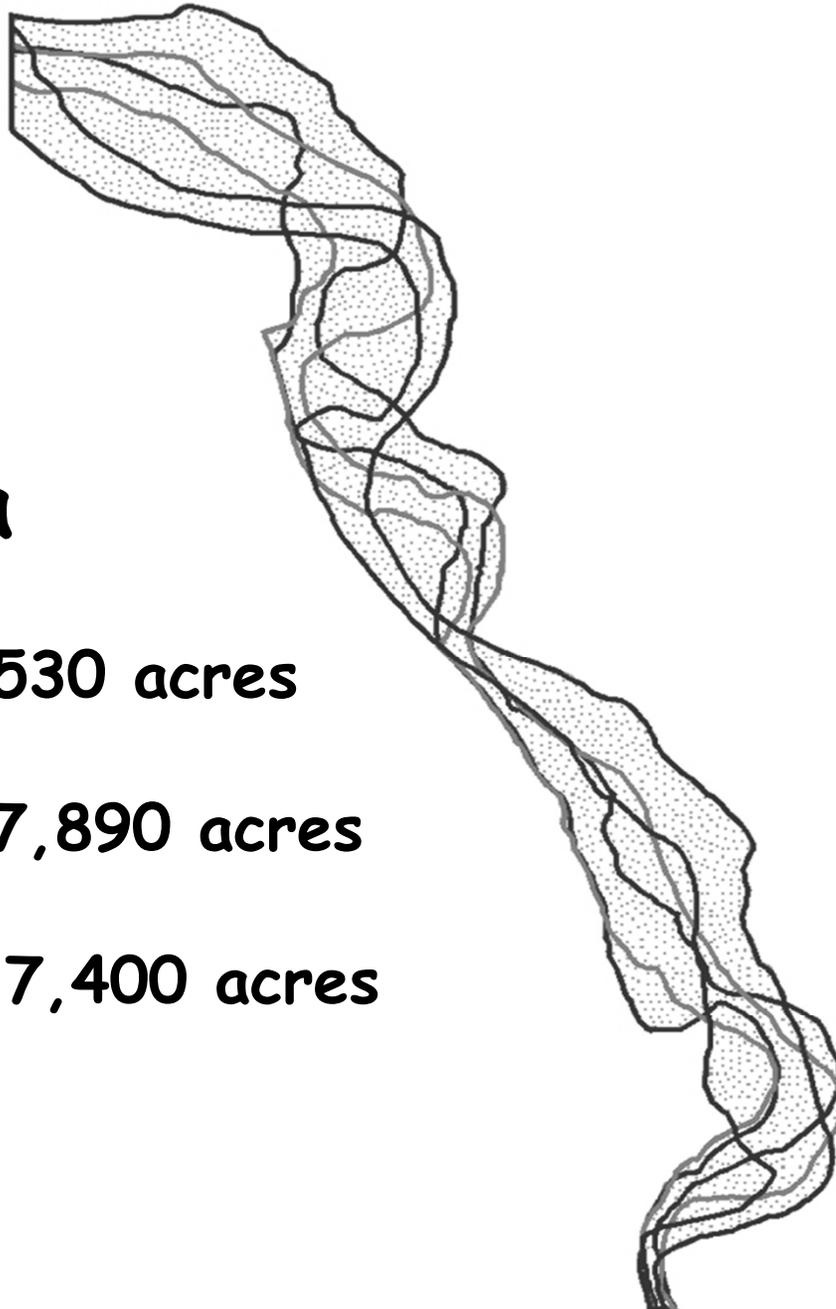


Deroin Area

1879-red line-7,530 acres

1890-green line-7,890 acres

1923-purple line-7,400 acres

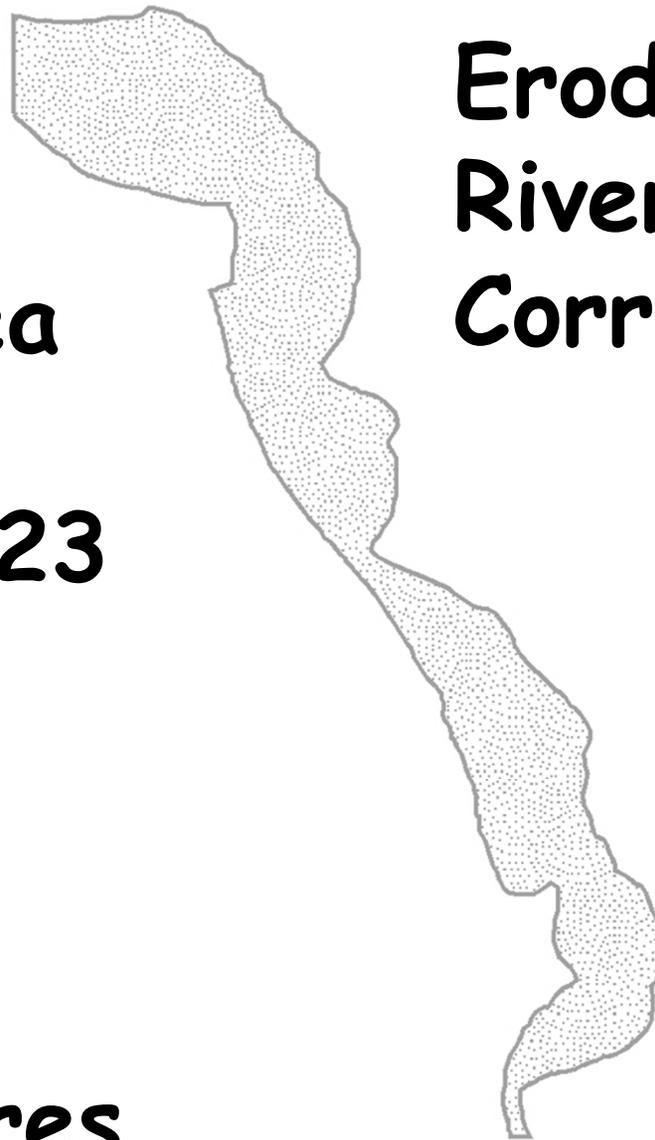


Deroin Area

1879 - 1923

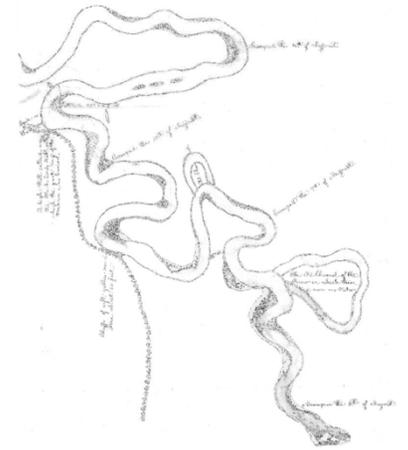
**24.2 miles
reach**

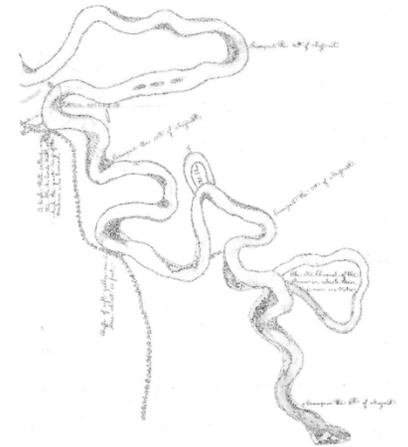
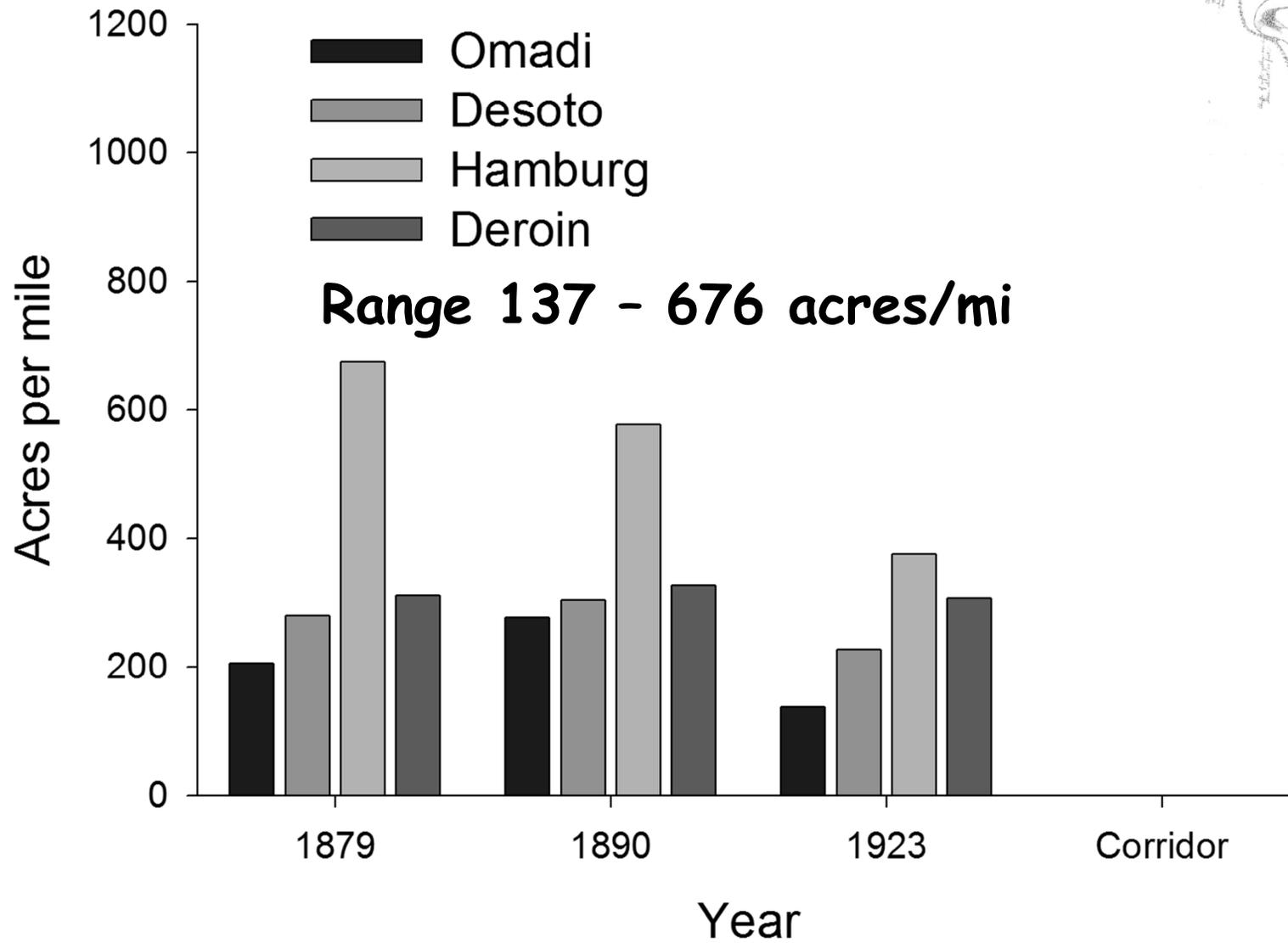
18,480 acres

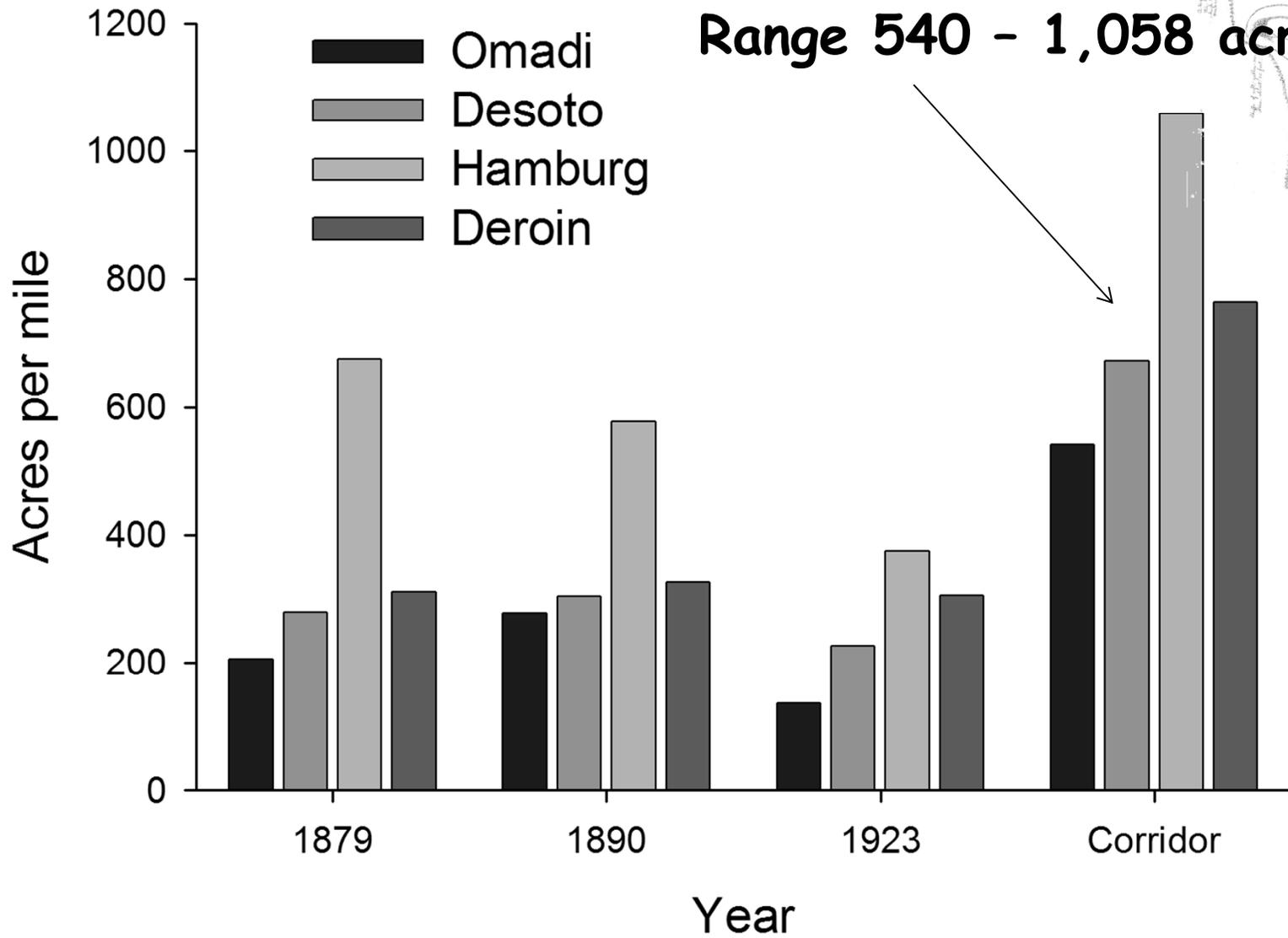


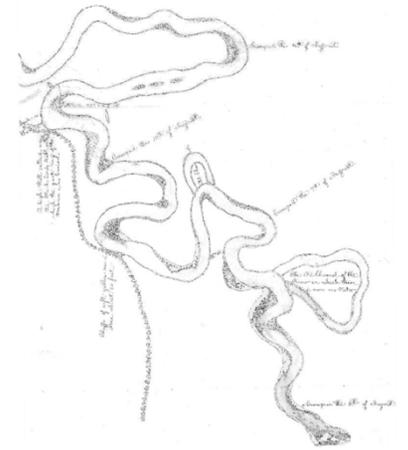
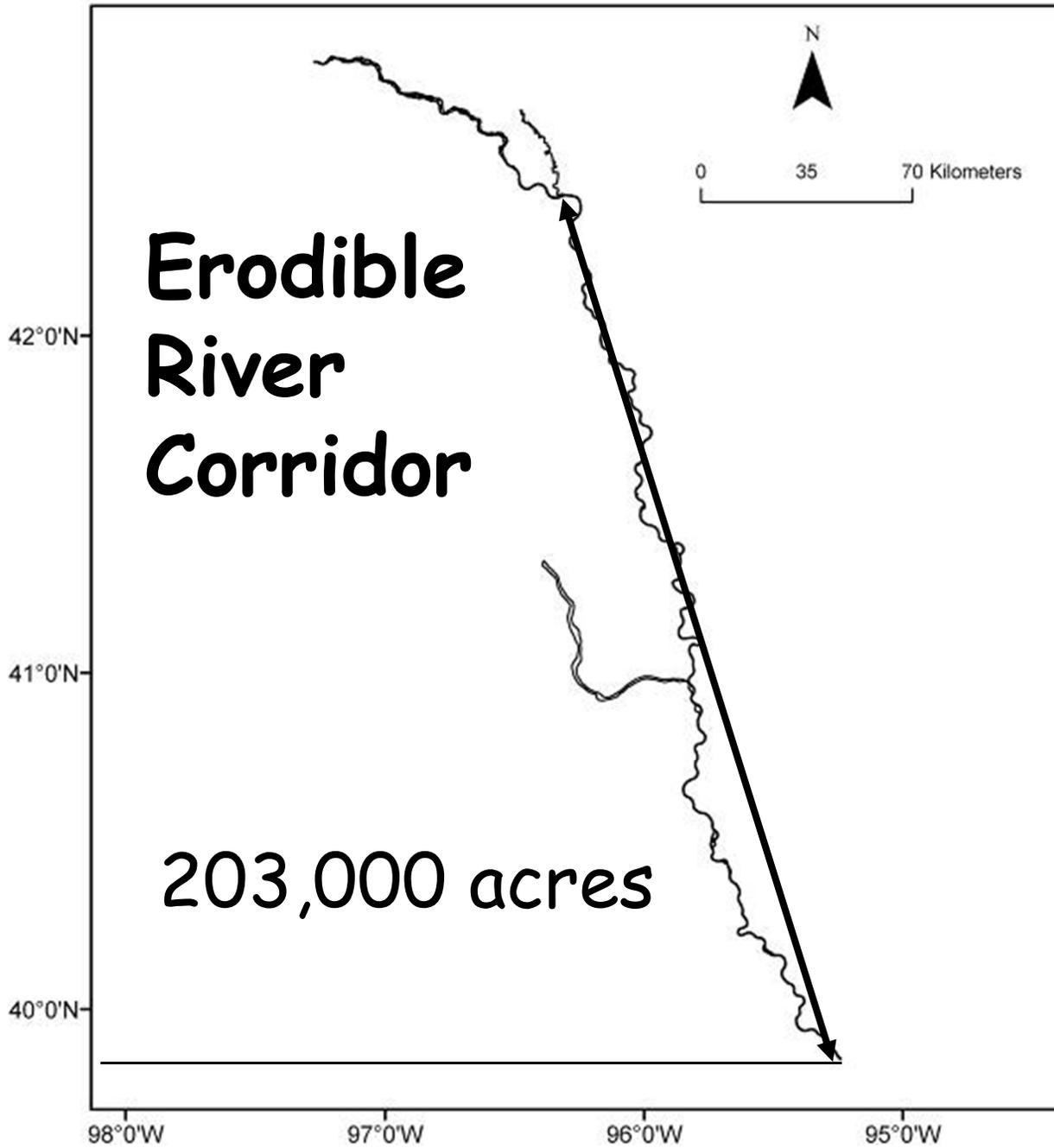
**Erodible
River
Corridor**

44 Years

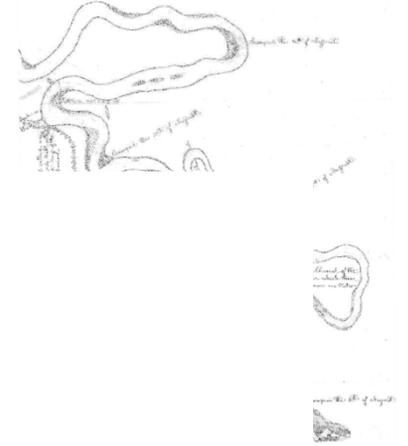




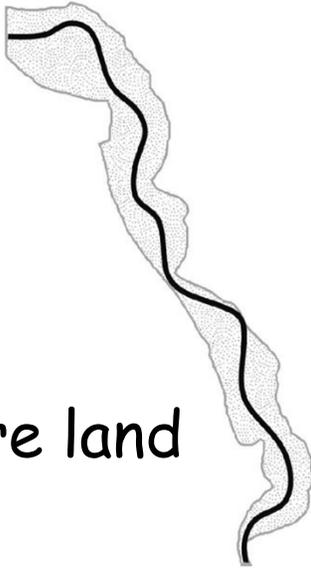




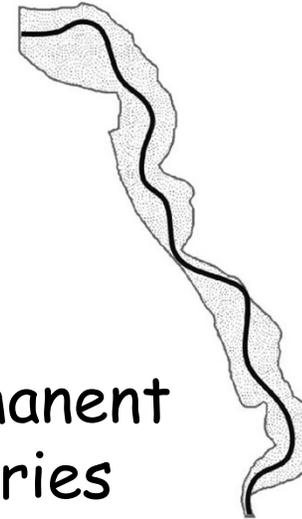
Process to Accomplish?



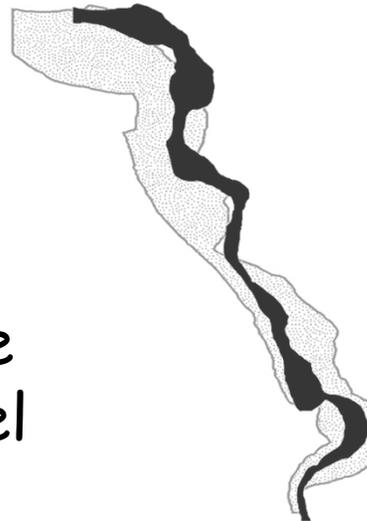
■ Acquire land



■ Construct permanent channel boundaries

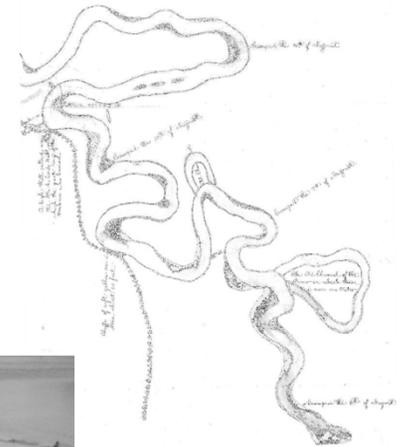
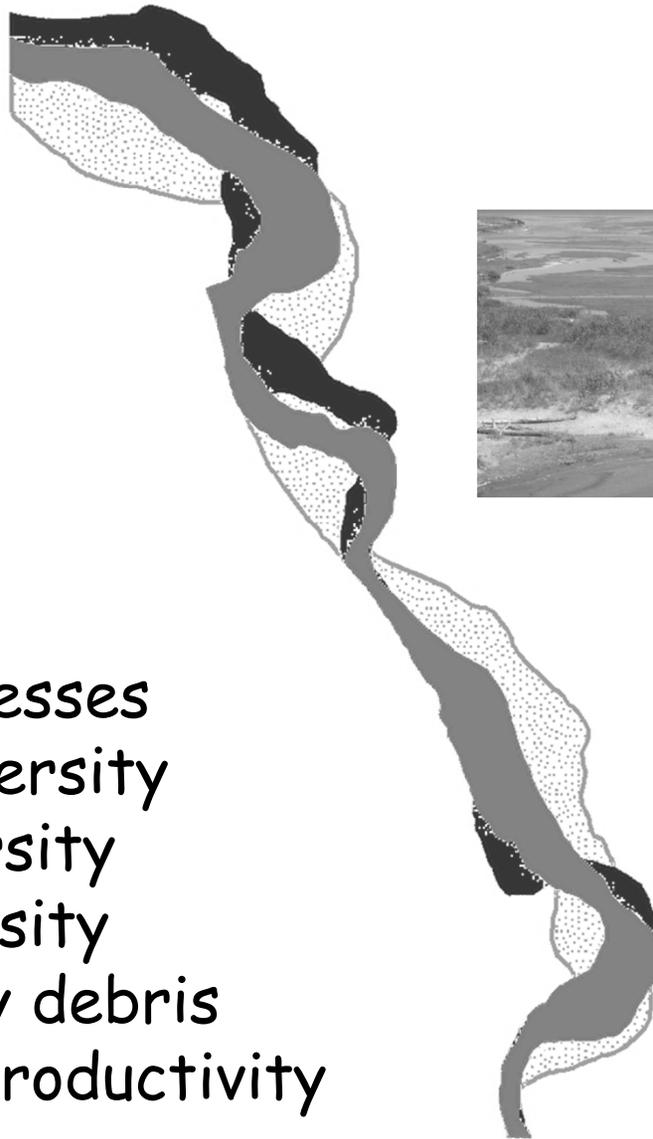


■ Destabilize the current channel



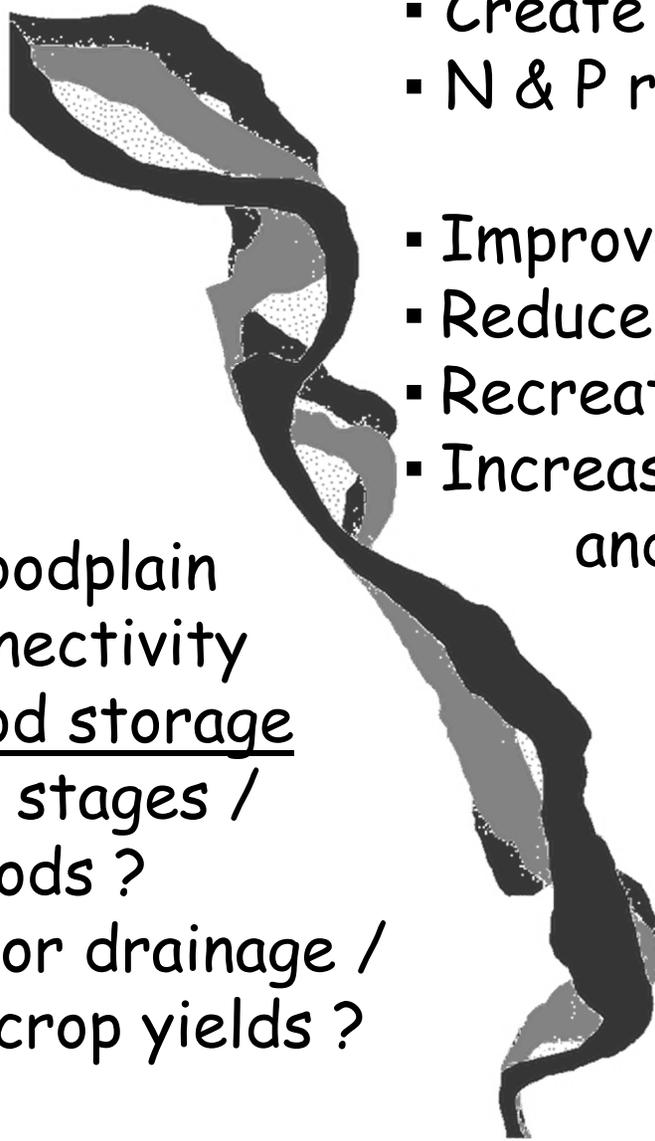
Benefits

- Fluvial processes
- Velocity diversity
- Width diversity
- Depth diversity
- Large woody debris
- Increased productivity



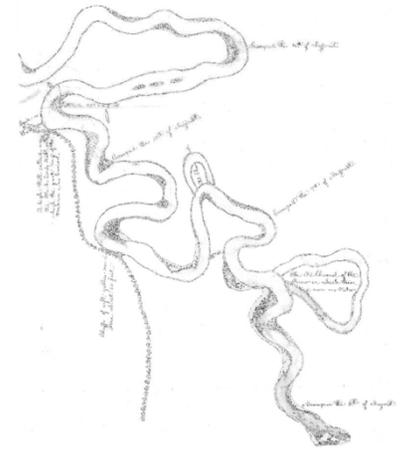
Benefits

- Create new floodplain
- Floodplain connectivity
- Increased flood storage
- Reduced flood stages /
Fewer floods ?
- Enhance interior drainage /
Increase crop yields ?



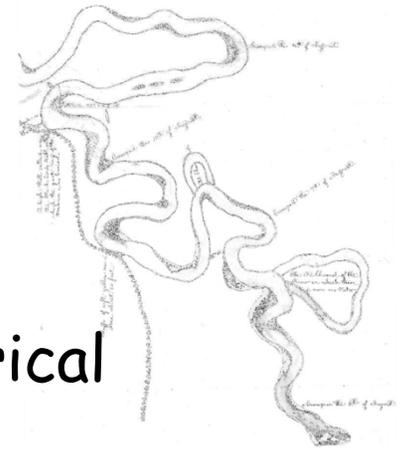
- Create new wetlands
- N & P retention /
processing
- Improve water quality
- Reduce degradation
- Recreation
- Increase ecosystem goods
and services

What would it take ?

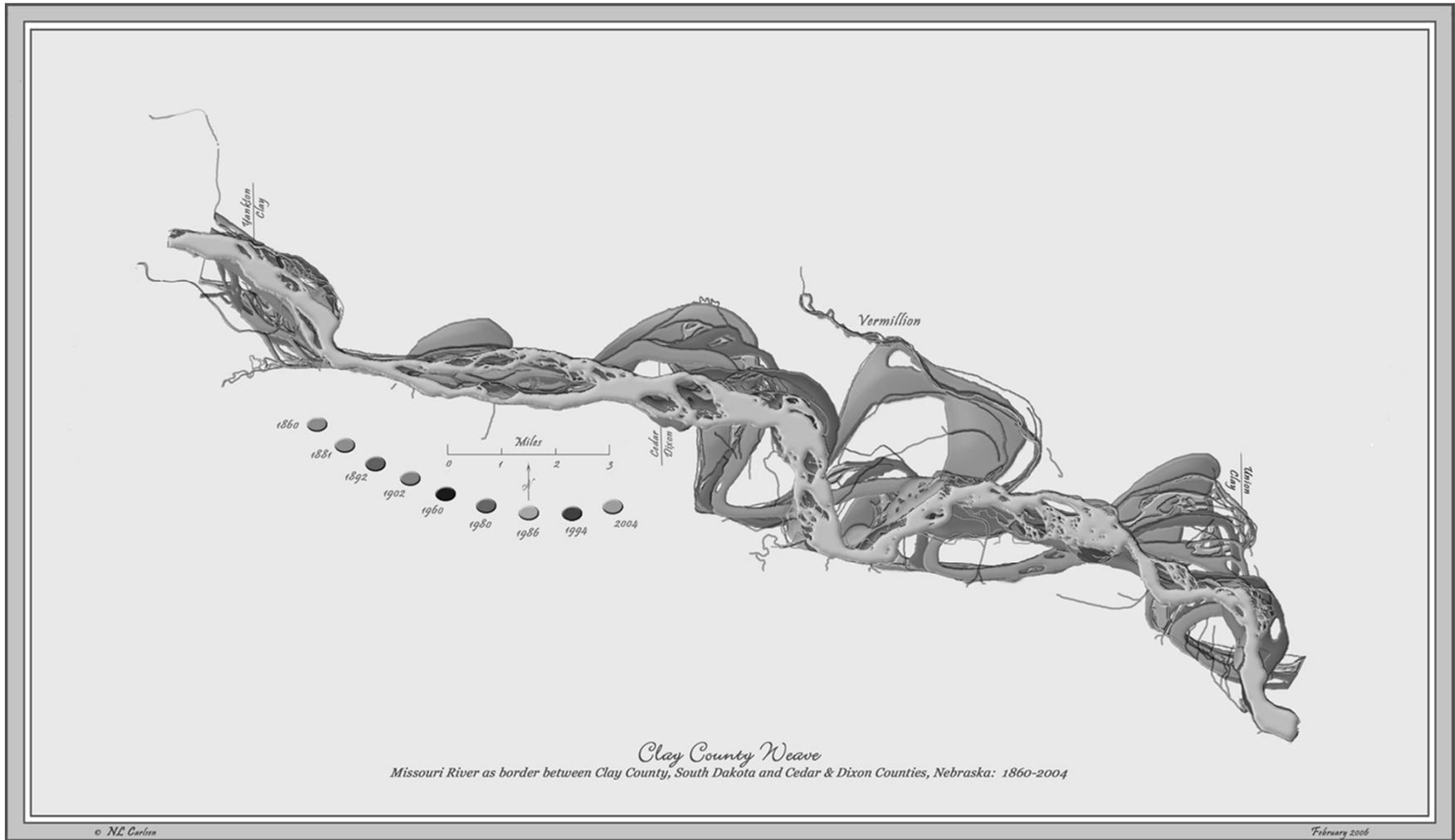


- Deauthorize navigation
- Acquire land ✓
- Construct permanent border
- Sediment source (Lewis & Clark) ✓
- Flow management ✓

Summary



- The erodible corridor is based on a historical evaluation of the Middle Missouri River
- The Middle Missouri River defined its erodible corridor as 203,000 acres from 1879 to 1923
- Create a Sustainable Ecosystem
- Creates an End Point
- This is as good as we can do - do we owe our children's children anything less ?



Nancy Carlson's - Living River

Questions ?