Challenges of Protecting and Restoring a Groundwater - Dependent Prairie Stream: Iron Springs Creek, Southeastern North Dakota

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Midwest Groundwater Conference 2012
Groundwater Opportunities and Conflicts in the 21st Century: Economy to Ecology

THE UNIVERSITY OF NORTH DAKOTA

The Nature Conservancy
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Some Key Background Points –

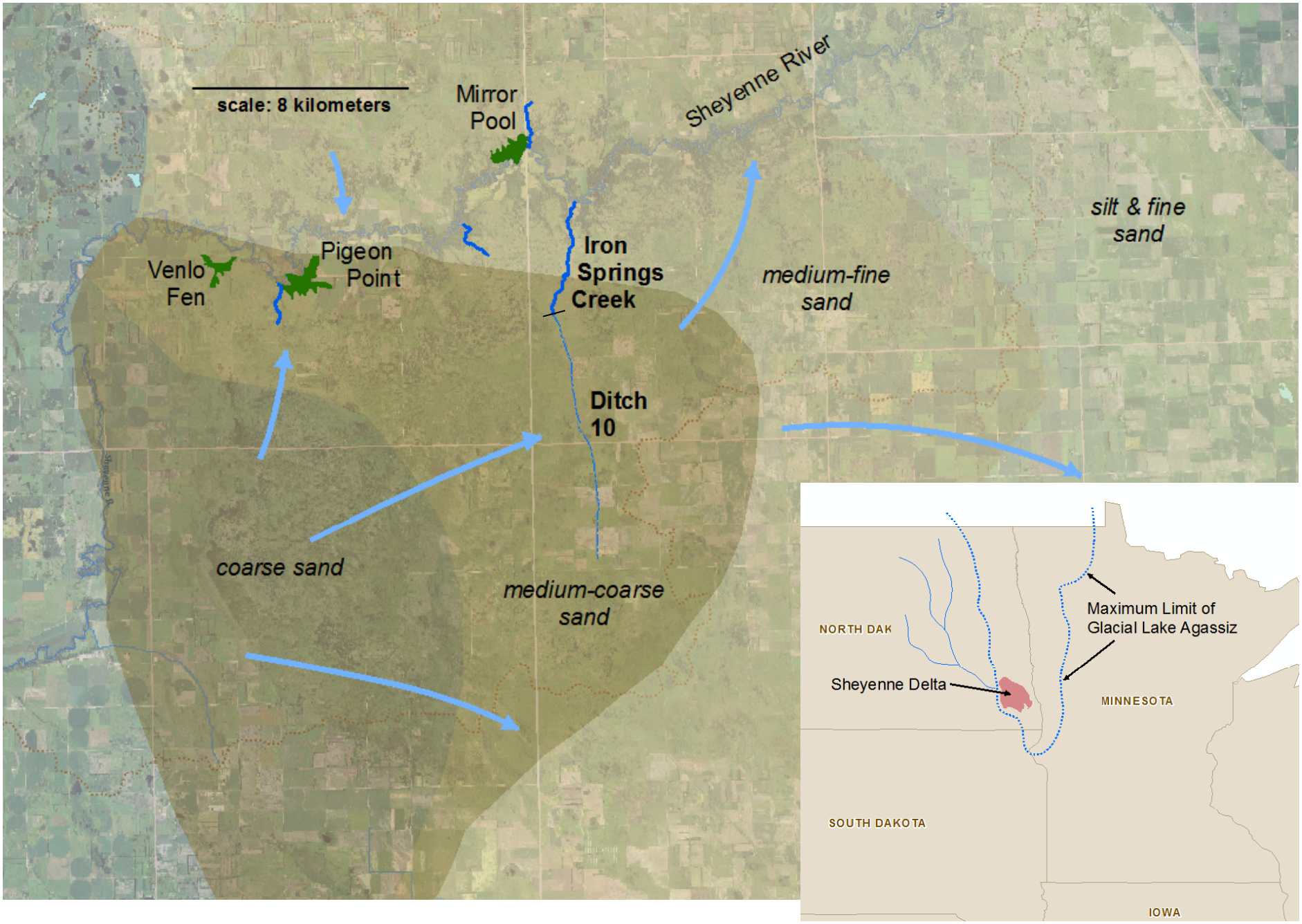
1. Groundwater dependent (GWD) streams often have exceptional ecological, aesthetic, and recreational value

2. Management of GWD streams cannot be complete without considering surface water – groundwater interaction

3. Different regulatory and best-management practices may be needed for protecting the integrity and function of GWD streams

Sheyenne Delta of southeastern North Dakota hosts a few unique groundwater-dependent streams and wetlands

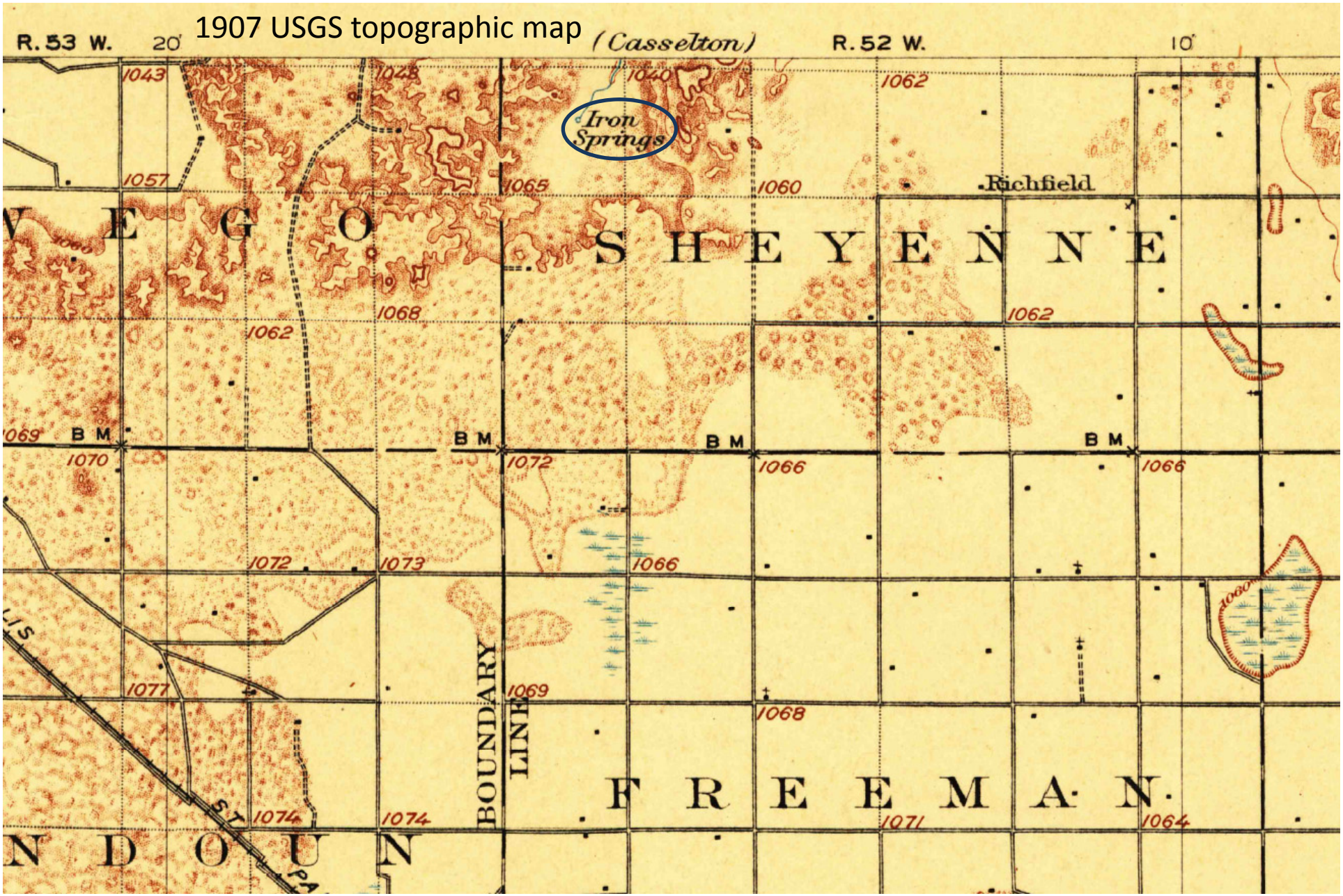
Purpose of the presentation – Case study that demonstrates how drainage mismanagement irreversibly damaged Iron Springs Creek


scale: 8 kilometers
Mirror Pool
Sheyenne River
Venlo Fen
Pigeon Point
Iron Springs Creek
silt & fine sand
medium-fine sand
Ditch 10
coarse sand
medium-coarse sand
NORTH DAK
Maximum Limit of Glacial Lake Agassiz
Sheyenne Delta
MINNESOTA
SOUTH DAKOTA
IOWA

Why these few seeps and streams are important –

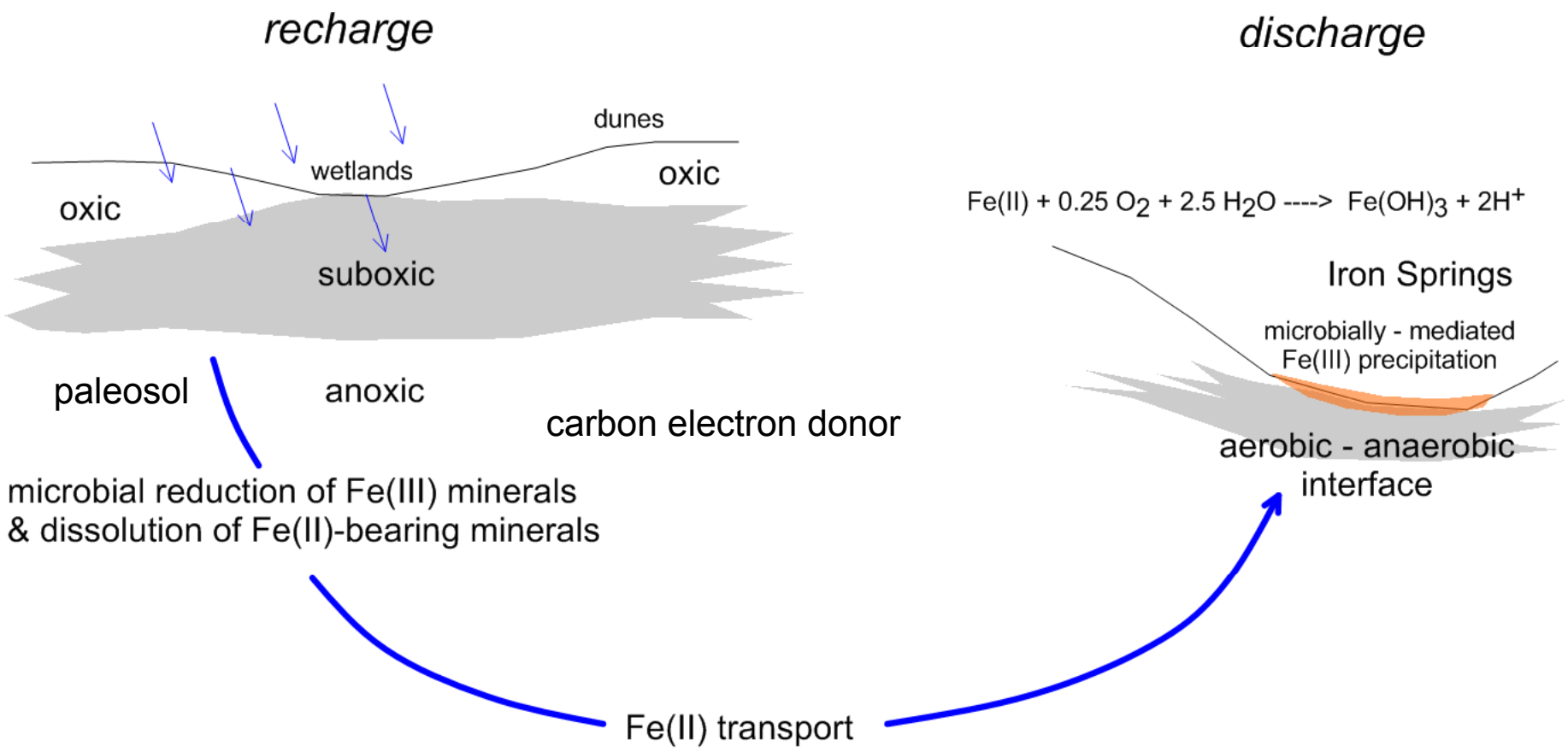
Wetland / dune habitat – western prairie fringed orchid
Drought-resistant woods and prairie
Host relic ice-age plants
Endemic fish and unusual macroinvertebrates
Groundwater storage and release moderates downstream flow

Iron Springs – former headwaters for a 6-km groundwater-dependent stream




1.5 m
08/08/2012

Iron Transport in Circumneutral Groundwater



8 November 1906

Iron Springs Drain No. 10.

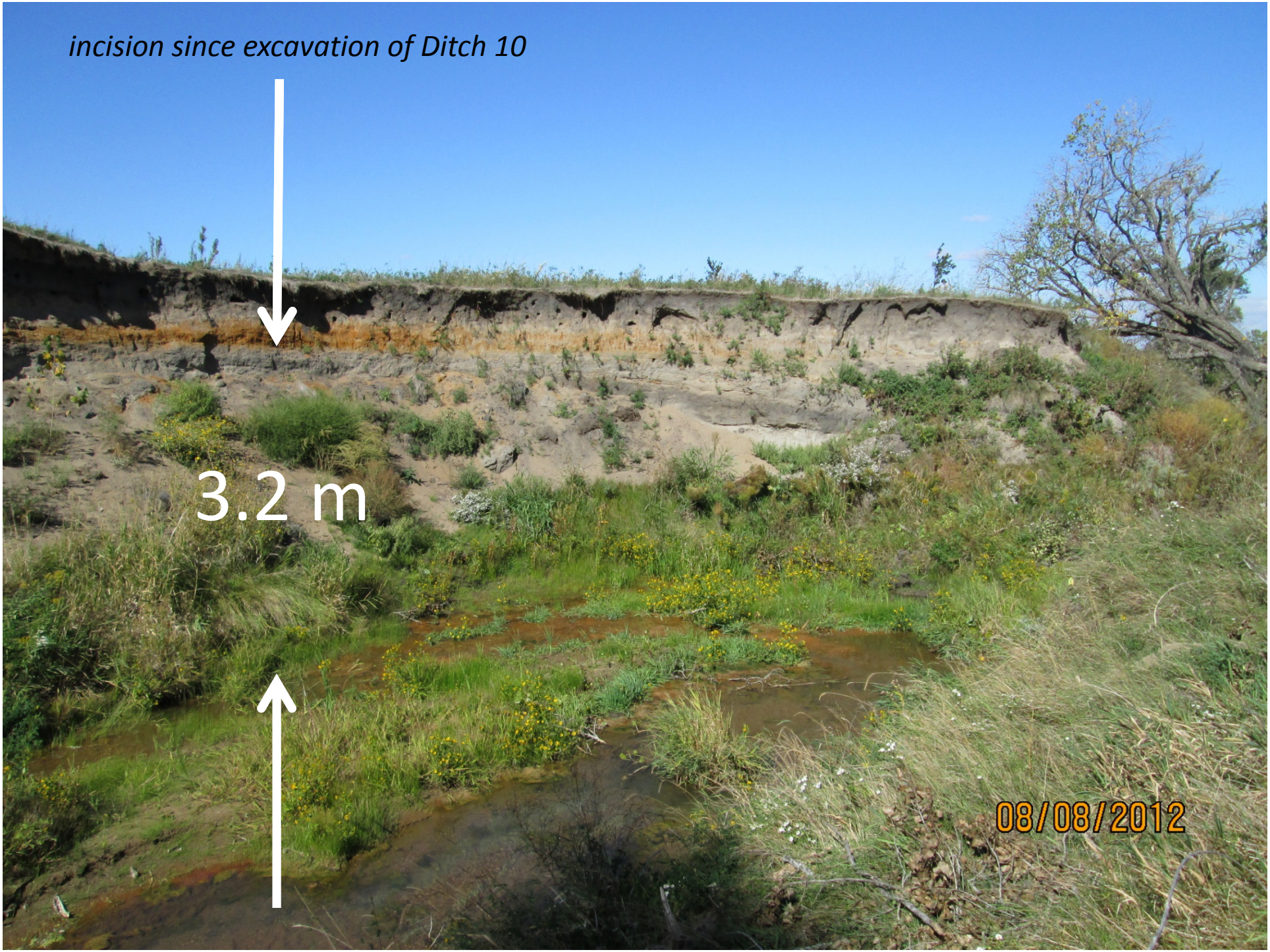
Notice of assessments, Review of assessments and letting of Contract

State of North Dakota, } ss.
County of Richland. }
Before the Board of County, Drain Commissioners.
In the Matter of the Establishment of a Drain in Freeman, and Sheyenne Townships, Richland County, } Assessment on, Account

Sec. 20, Twp. 134, Range 52.	
NeX	.01572
NwX	.01572
SwX	.01572
SeX	.01572
Sec. 21, Twp. 134, Range 52.	
NeX	.00943
NwX	.01572
SwX	.01258

164 degrees 46 minutes 30 seconds E. a distance of 448.80 feet to the north and south quarter line of said section, thence north following said quarter line a distance of 5017.65 feet, thence at an angle of 157 degrees 51 minutes 30 seconds E. a distance of 720 feet, thence at an angle of 156 degrees 37 min. 30 sec. W.

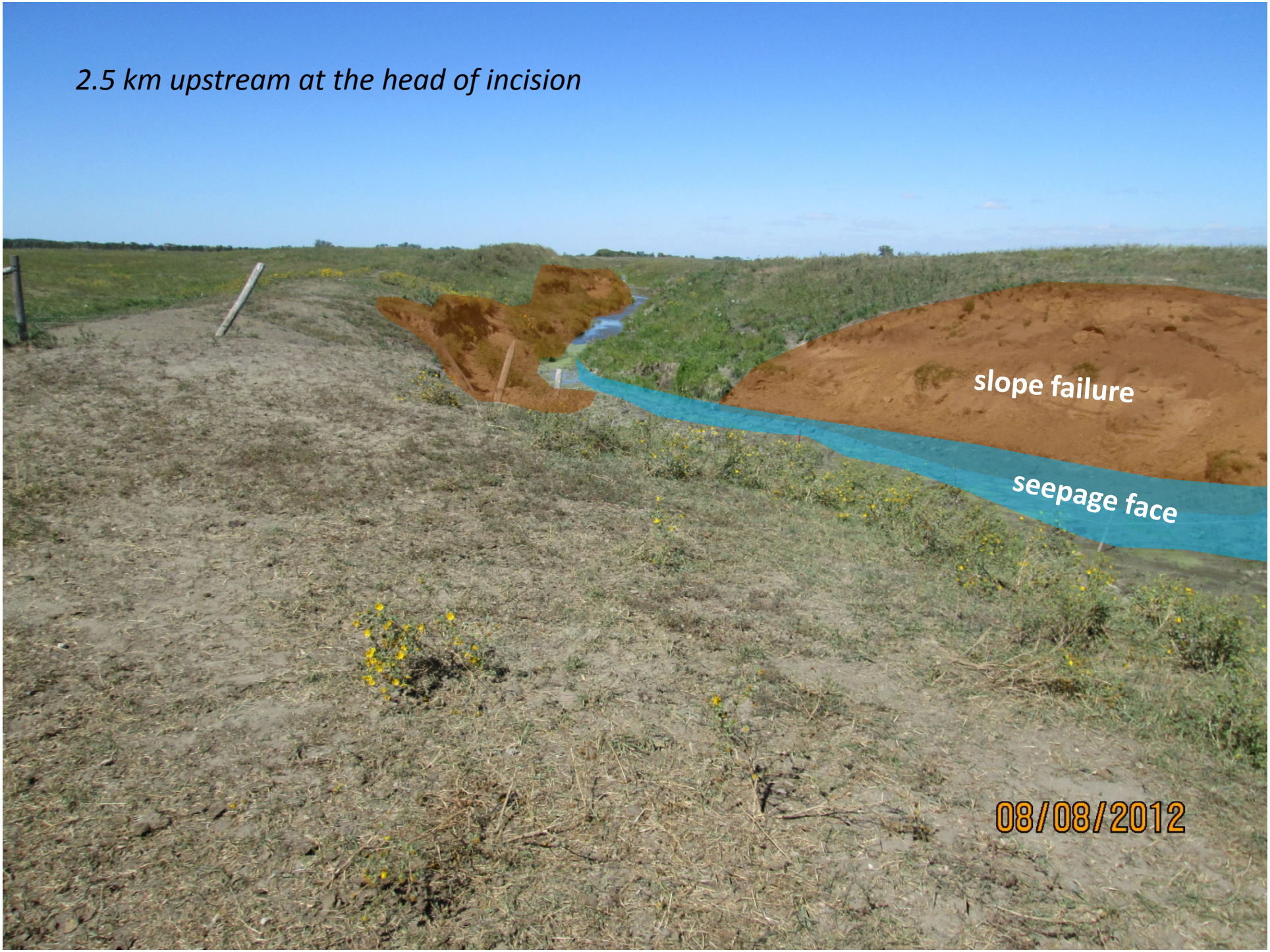
What were the consequences to Iron Springs and Iron Springs Creek?

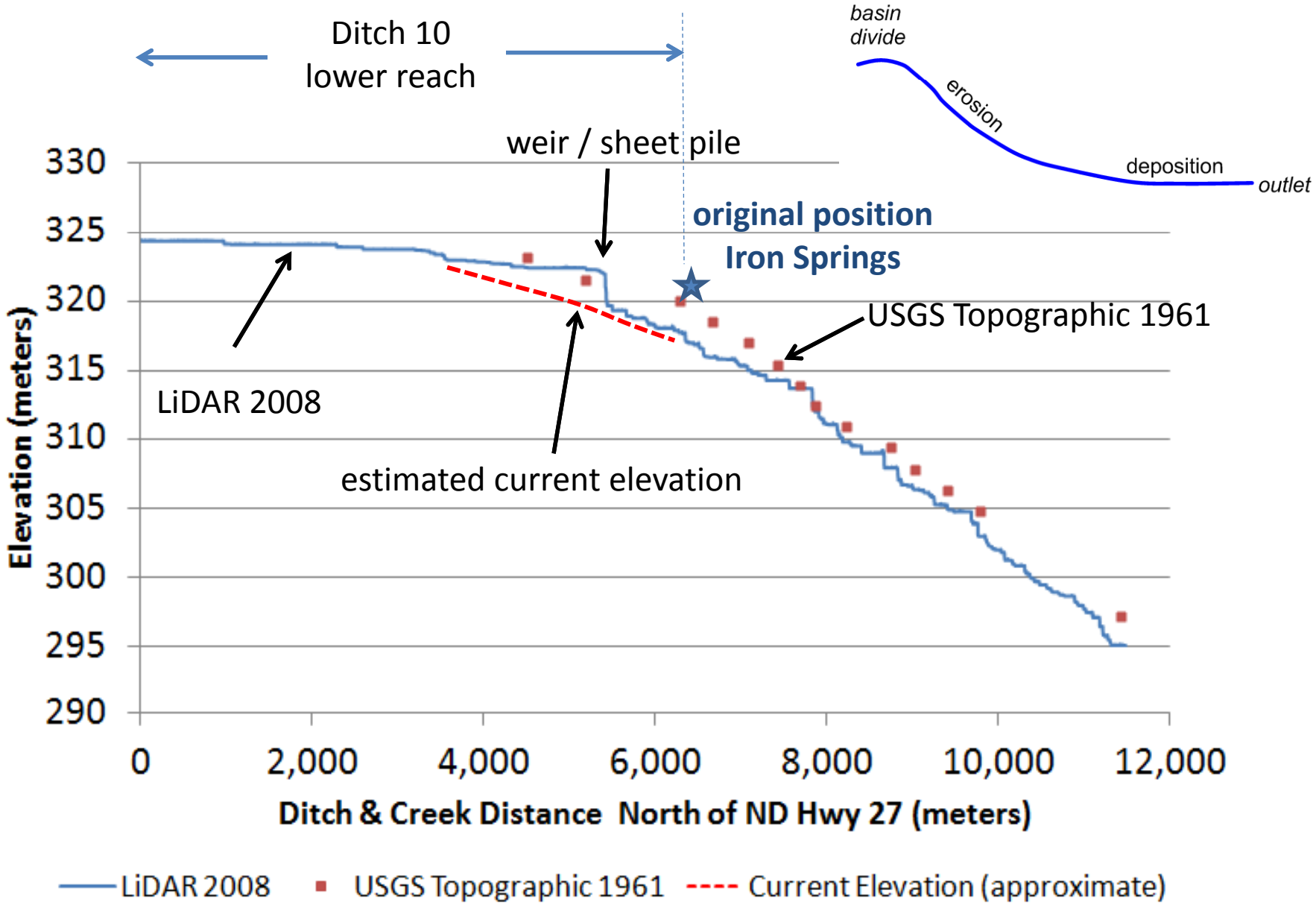

incision since excavation of Ditch 10
3.2 m
08/08/2012

1 km upstream: weir and gauge at the crossing, installed circa 2000

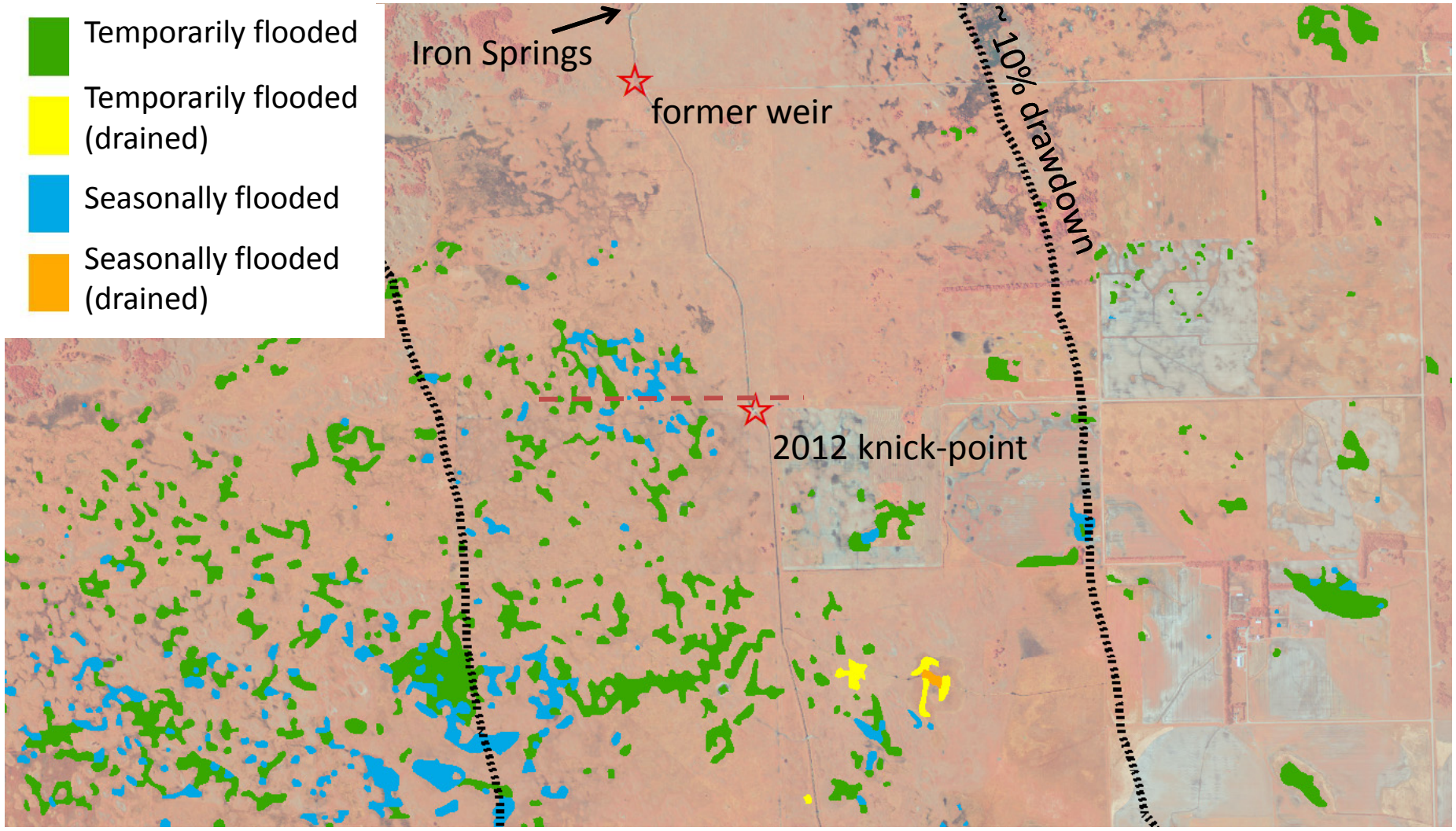
photo provided by B. Braun, U.S. Forest Service


same location in 2012; sheet pile washed out in 2011
former top of sheet pile
08/08/2012

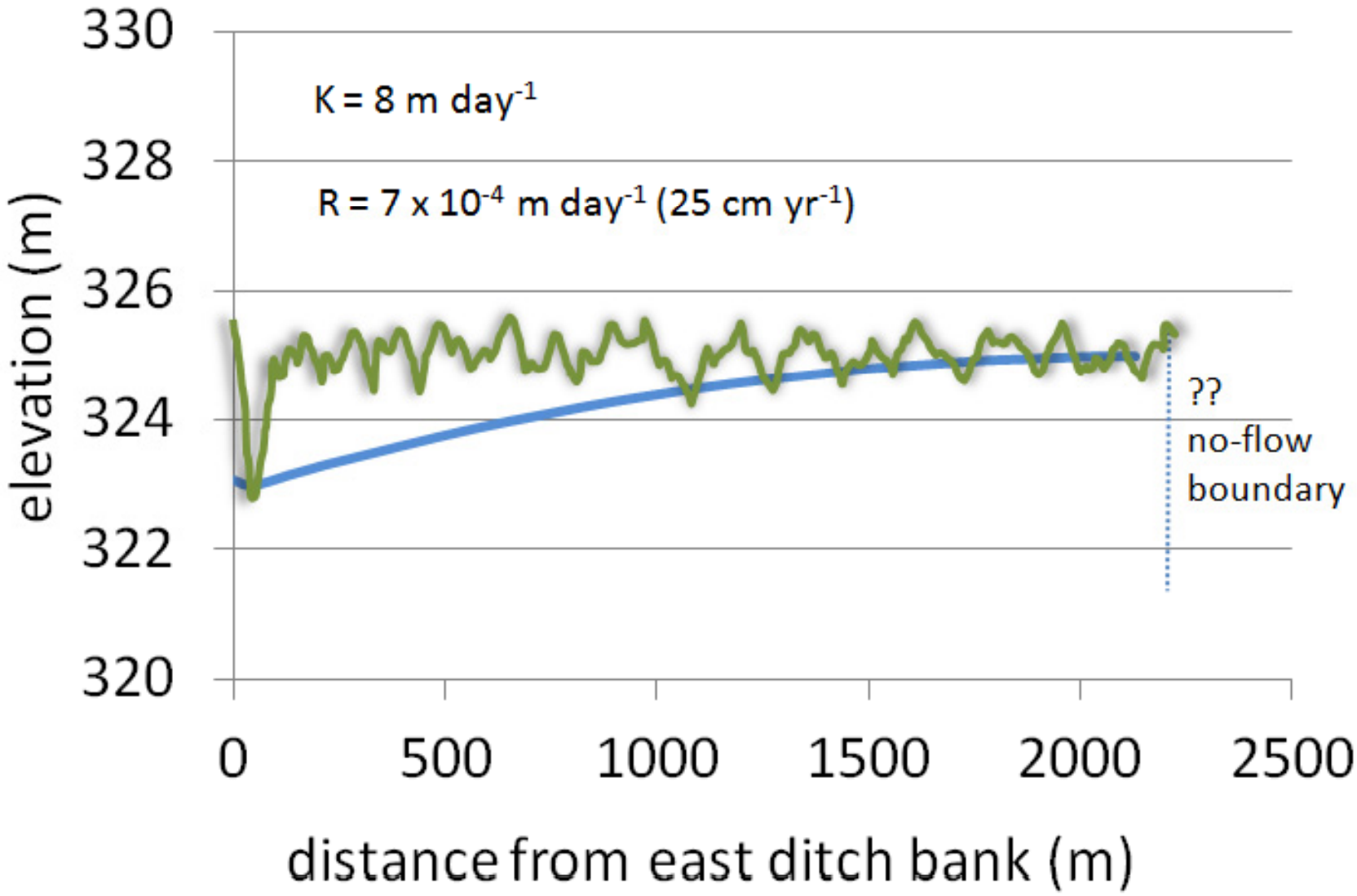

2.5 km upstream at the head of incision
slope failure
seepage face
08/08/2012


Ditch 10
lower reach
basin
divide
erosion
deposition
outlet
weir / sheet pile
original position
Iron Springs
USGS Topographic 1961
LiDAR 2008
estimated current elevation
Elevation (meters)
330
325
320
315
310
305
300
295
290
0
2,000
4,000
6,000
8,000
10,000
12,000
Ditch & Creek Distance North of ND Hwy 27 (meters)
LiDAR 2008
USGS Topographic 1961
Current Elevation (approximate)

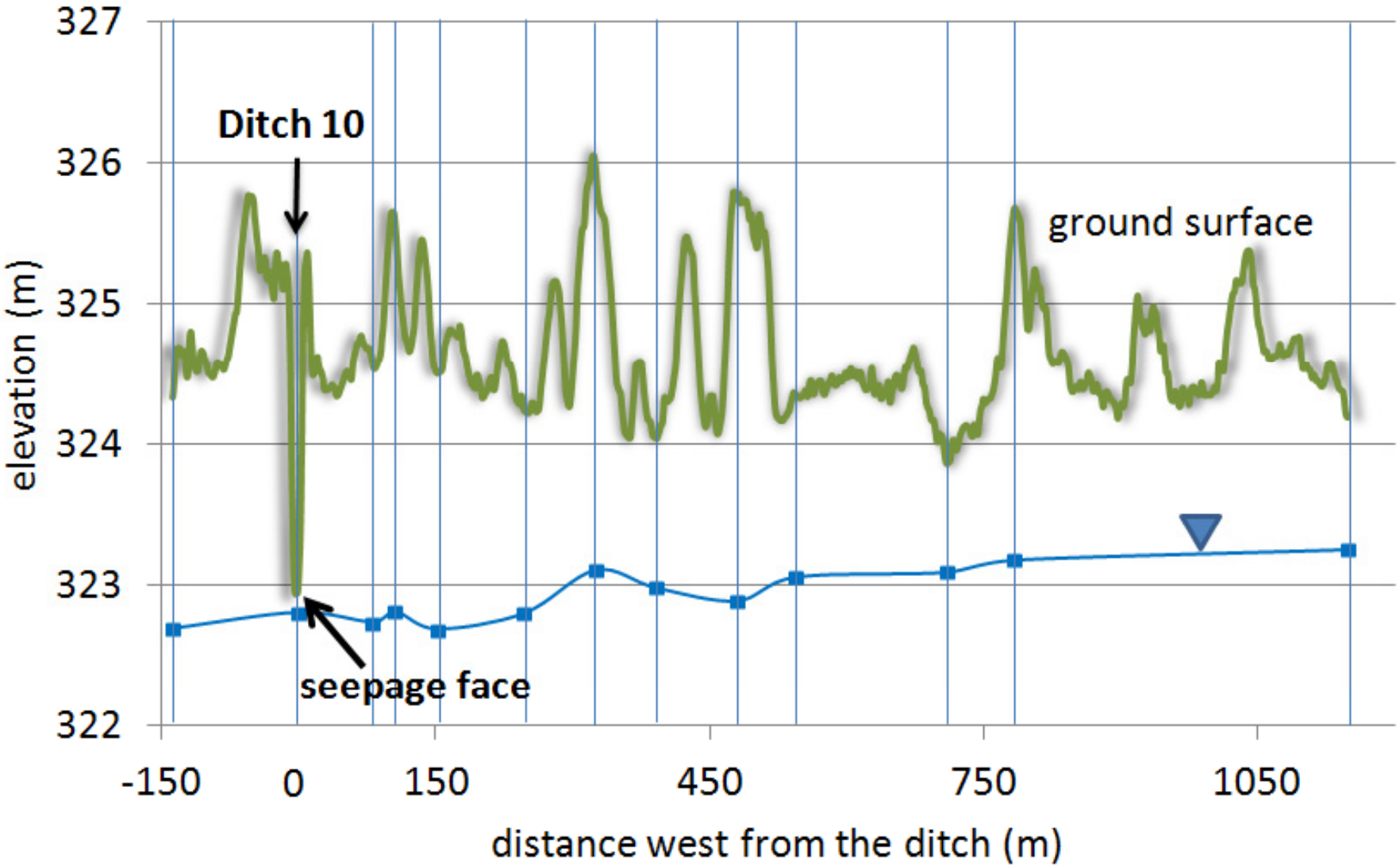
National Wetlands Inventory (1979 imagery)



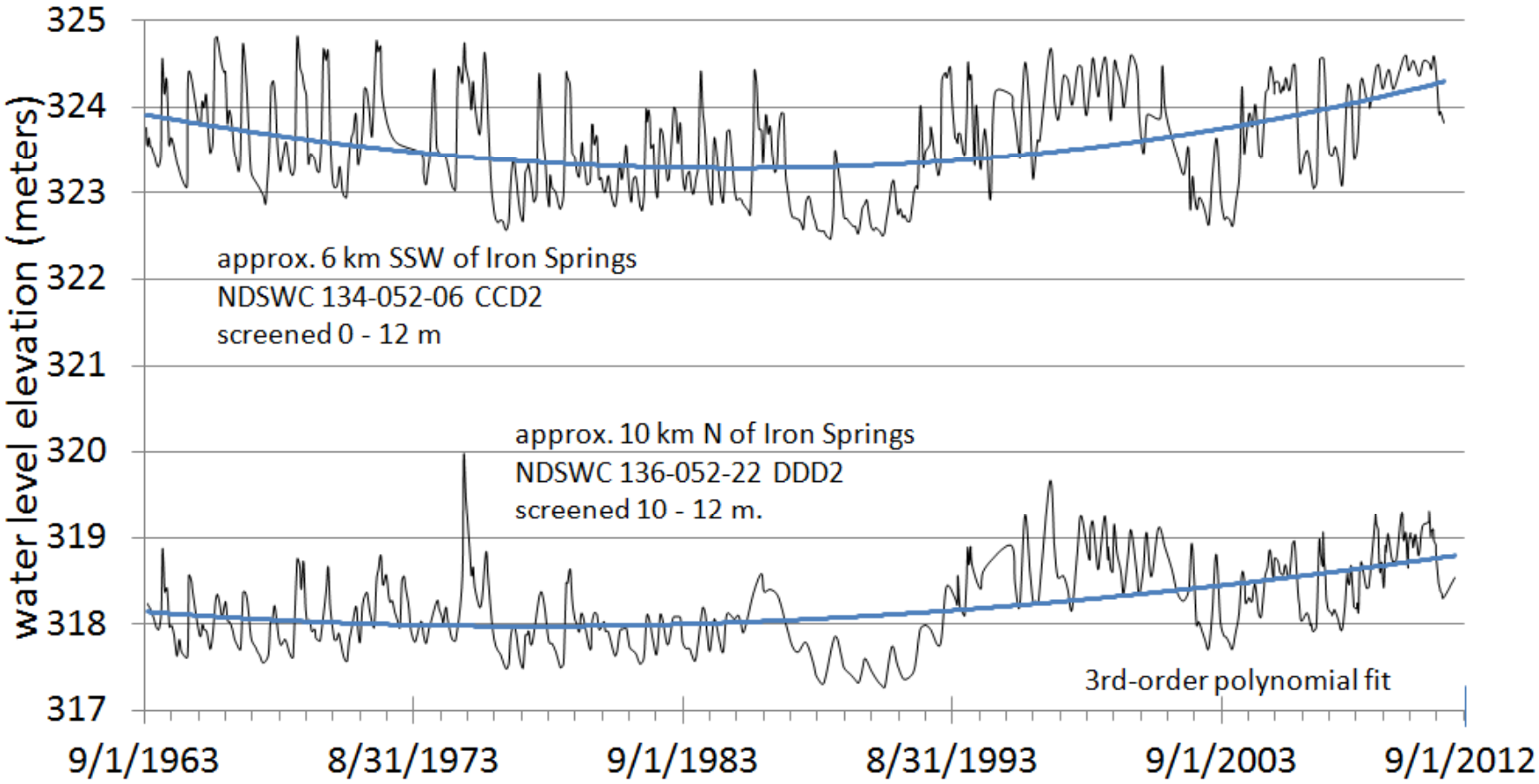
loss of wetlands – basic steady-state model of drainage



loss of wetlands – observed drainage

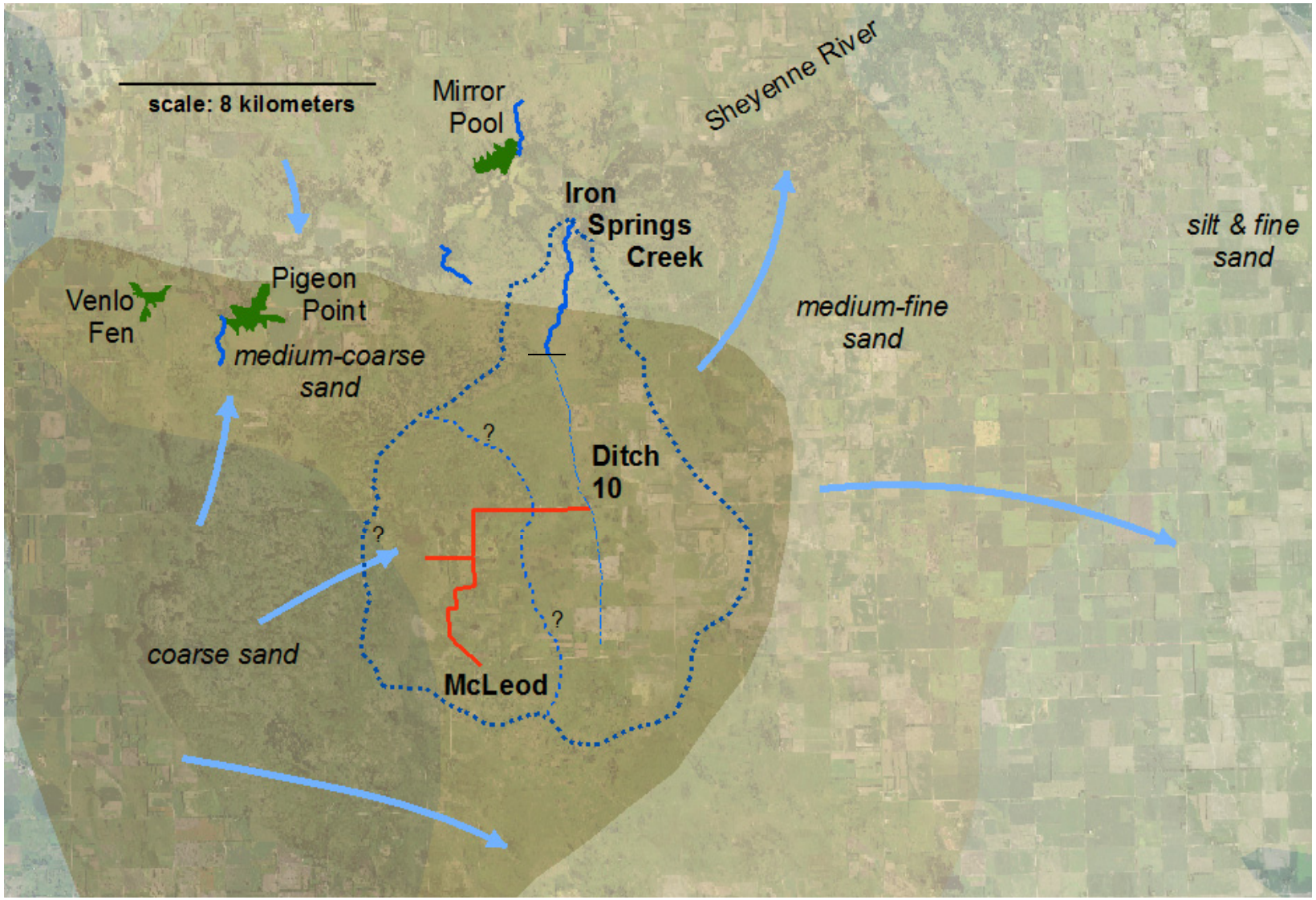


What caused weir failure and resulting rapid incision in 2011? --- historically high water



data from the North Dakota State Water Commission

What caused weir failure and resulting rapid incision in 2011? --- a much larger watershed



So what are some of the problems related to the ditch?

1. Reduced forage
2. Lower water table & increased expense for irrigation
3. Downstream sediment transport
4. Repeated reconstruction of bridges and culverts
5. Degraded water quality
6. Disturbed erodible soils and invasive weeds
7. Unknown environmental effect on species diversity and vigor

What were the alternatives?

1. Divert excess water toward the east and south
2. Compensation fund for flood damage (most times dry)
3. Off-channel impoundment, constructed wetlands

Summary --- Observations from Iron Springs Creek

- Problem with "one-size-fits all" for stream management
- Regional stream classification may be essential
- Delineating recharge / capture zones becomes more important than surface watersheds in areas of permeable soils
- Need to regulate diverted water both to and from GWD streams
- Serious hydrological problems may take decades to appear