

Rethinking Infrastructure

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Wetland History

(natural resource management)

- ▶ **In conterminous US, many wetland areas purchased for wildlife**
 - ❑ Initially focused on more permanent wetlands (i.e., reliability of water)
 - ❑ Seasonal and temporary wetlands under-represented
- ▶ **Management agencies often “inherited” infrastructure developed for purposes other than wildlife**

1941



Wetland History

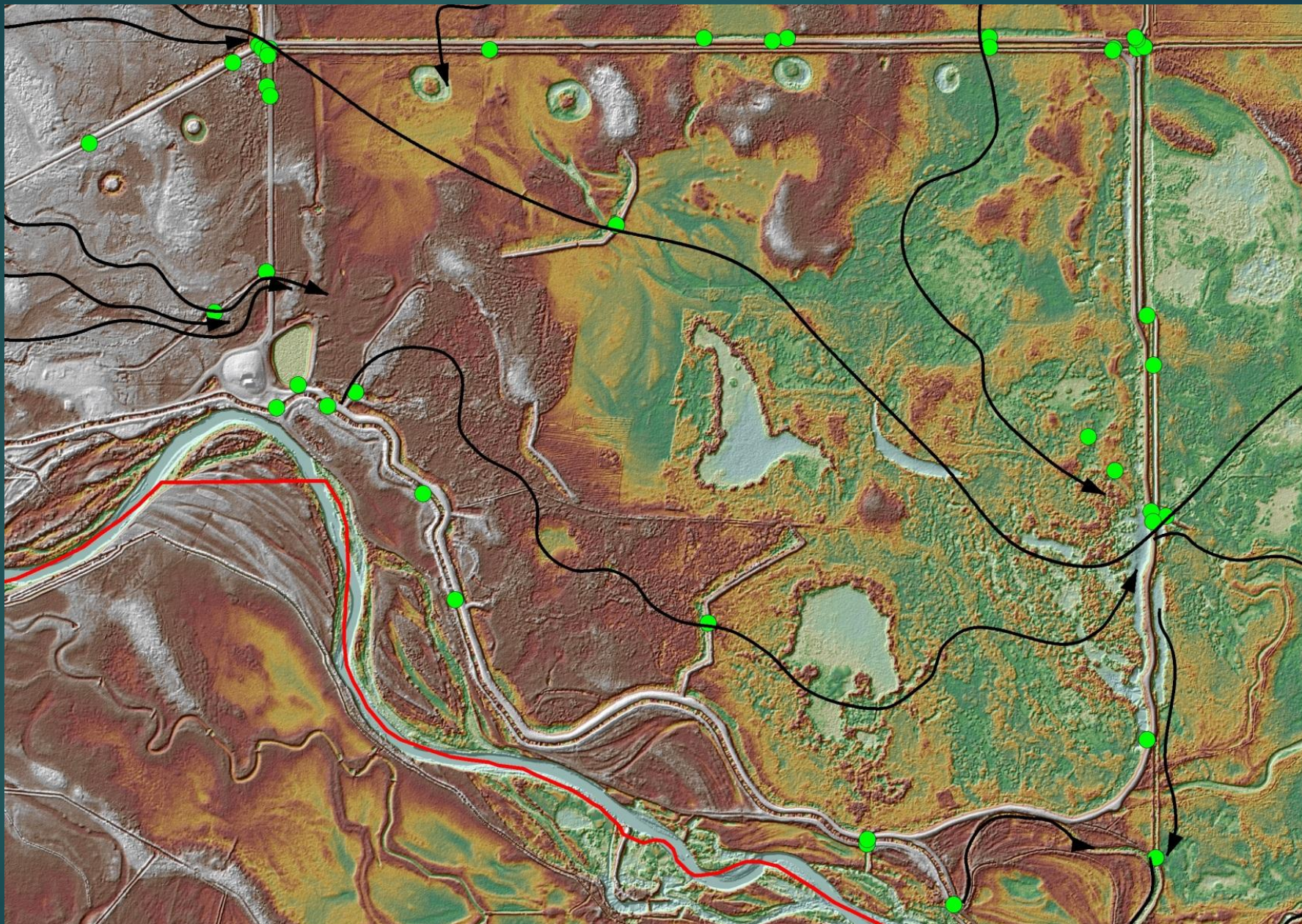
(natural resource management)

► In many cases, managers continued to use this infrastructure

- ❑ Management workforce small
- ❑ Budget for restoration minimal to nonexistent
- ❑ Focus on providing resources for single guild (e.g., waterfowl)
- ❑ Lack of knowledge regarding wetland structure and function

► As funds became available

- ❑ Additional infrastructure added (e.g., cross-dikes, lateral ditches) to “solve” problems
- ❑ Added without consideration of geomorphology and abiotic factors



2011

Wetland History

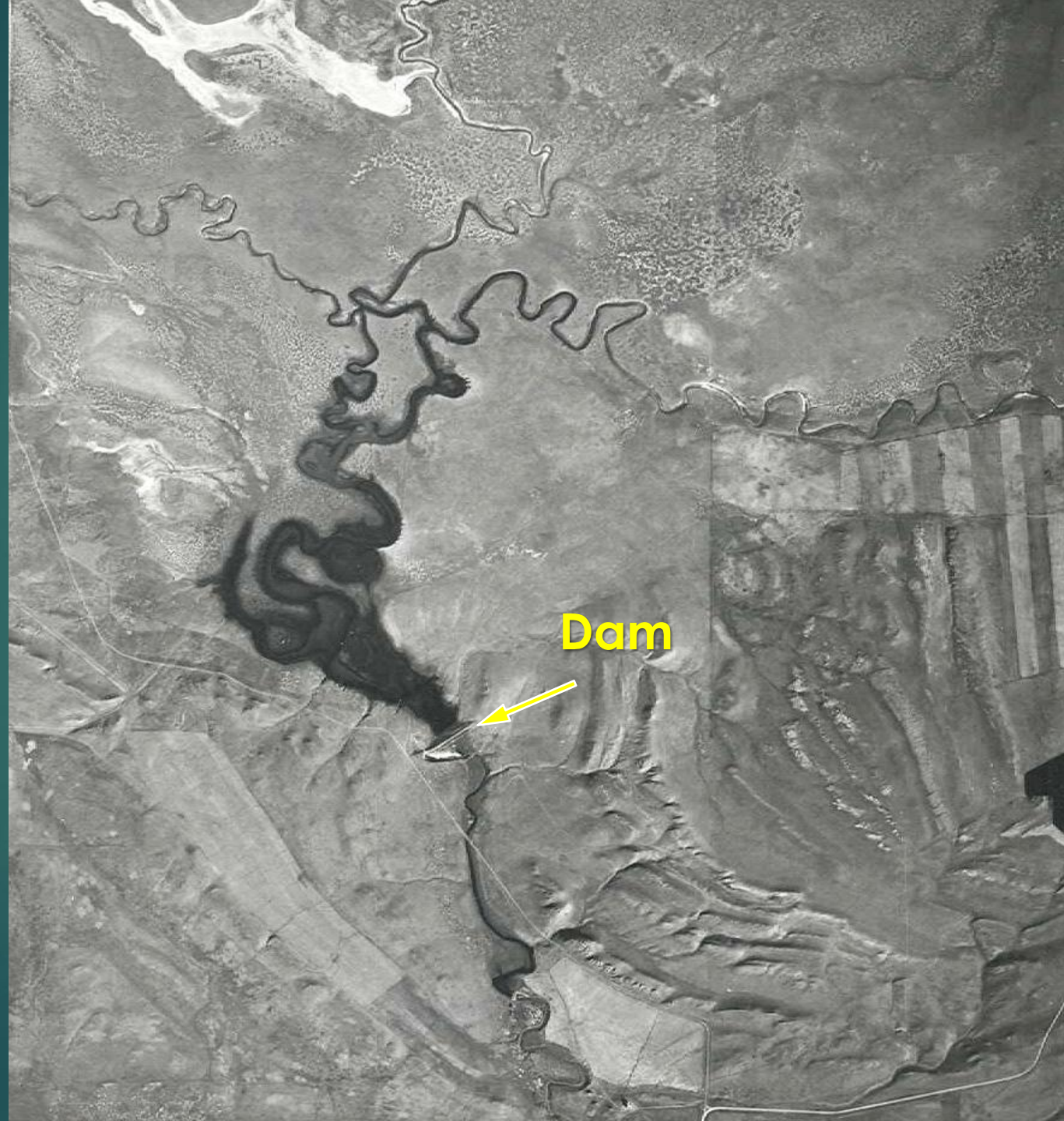
(natural resource management)

- ▶ **Gradually awareness increased regarding importance of**
 - ❑ Environmental factors (e.g., Silent Spring 1962, EPA founded 1970)
 - ❑ Status of other wetland-dependent species (e.g., 1973 ESA)
- ▶ **In response, management broadened to include**
 - ❑ Greater diversity of species/guilds
 - ❑ Wetland structure and function
 - ❑ Role of abiotic factors in wetland sustainability
- ▶ **Often addressed with more infrastructure**
 - ❑ In part due to tech advancements that facilitated watershed conversions

Wetland History

(natural resource management)

- ▶ **Management conflicts started to increase**
 - ❑ Need to provide resources for multiple taxa
 - In-stream flows (fish)
 - Diversity of wetland types (pollinators, herps)
 - ❑ Off-site watershed alterations that impact wetland function
 - Water quantity (groundwater depletion, streamflow reduction)
 - Water quality (nutrient, chemical, sediment)
 - ❑ Difficulty emulating critical wetland processes often due to infrastructure not designed to
 - Address abiotic issues that reduce productivity
 - Facilitate independent management of wetlands
 - Allow important connections among wetland types (riverine-associated)



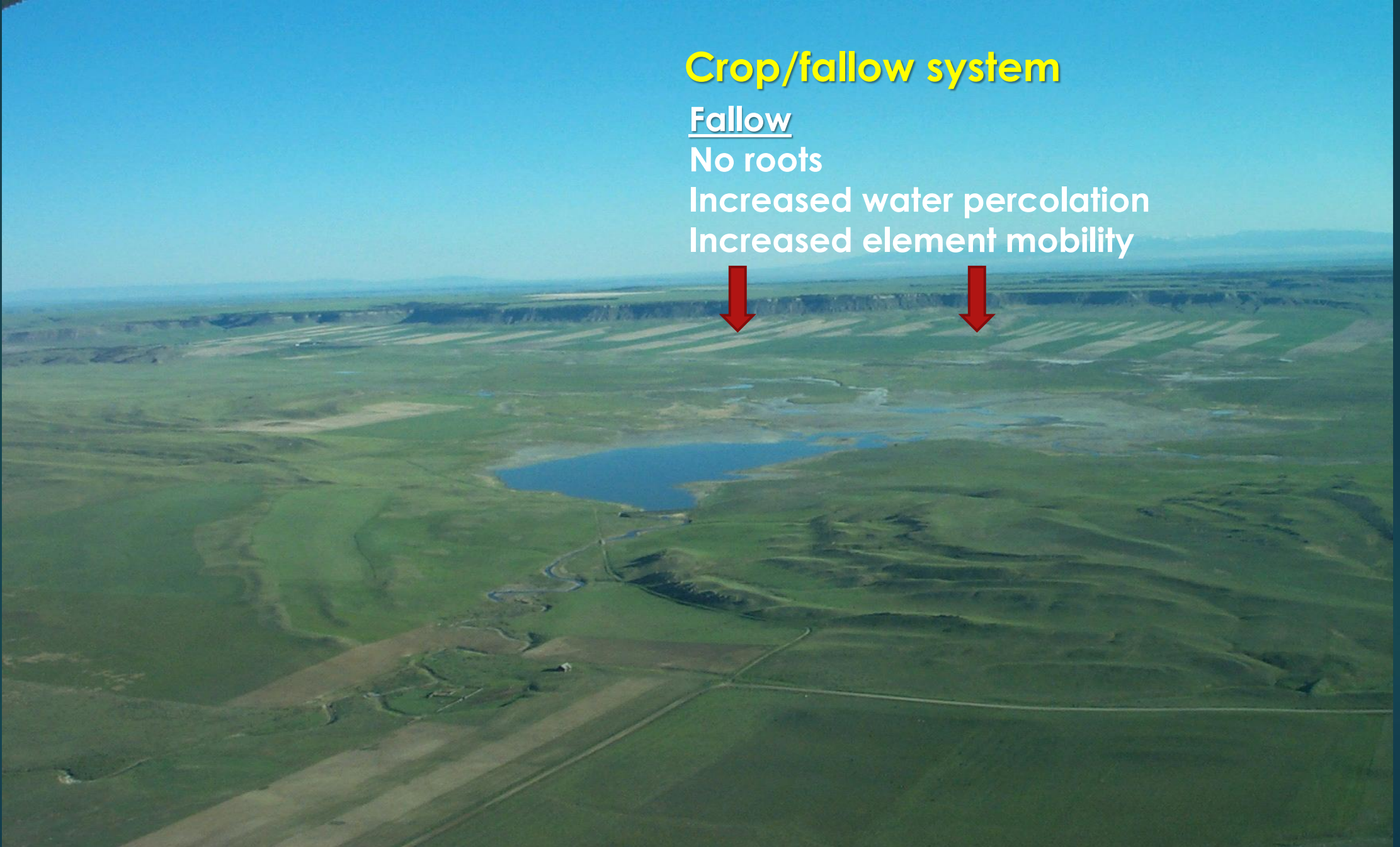
Crop/fallow system

Fallow

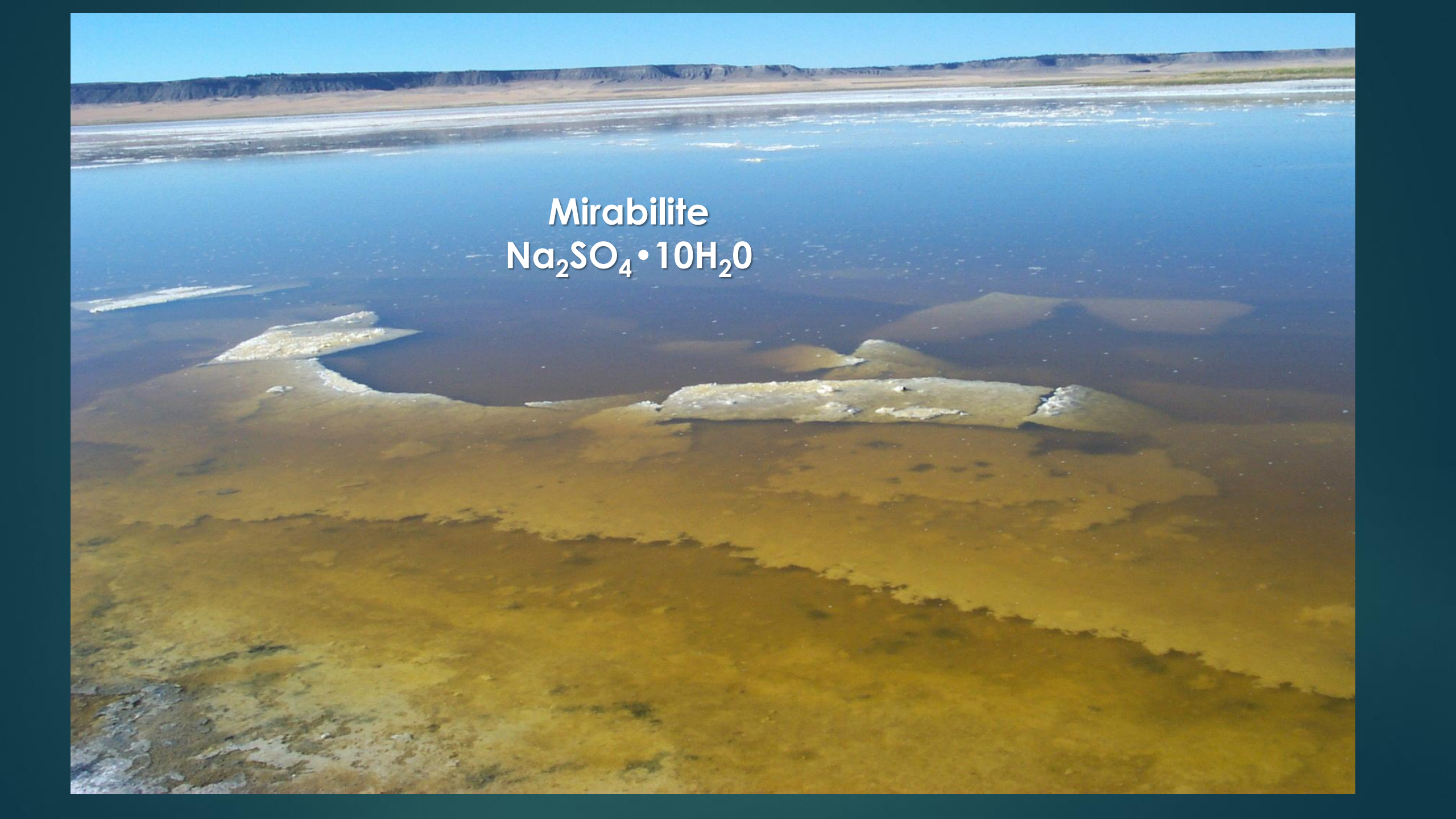
No roots

Increased water percolation

Increased element mobility



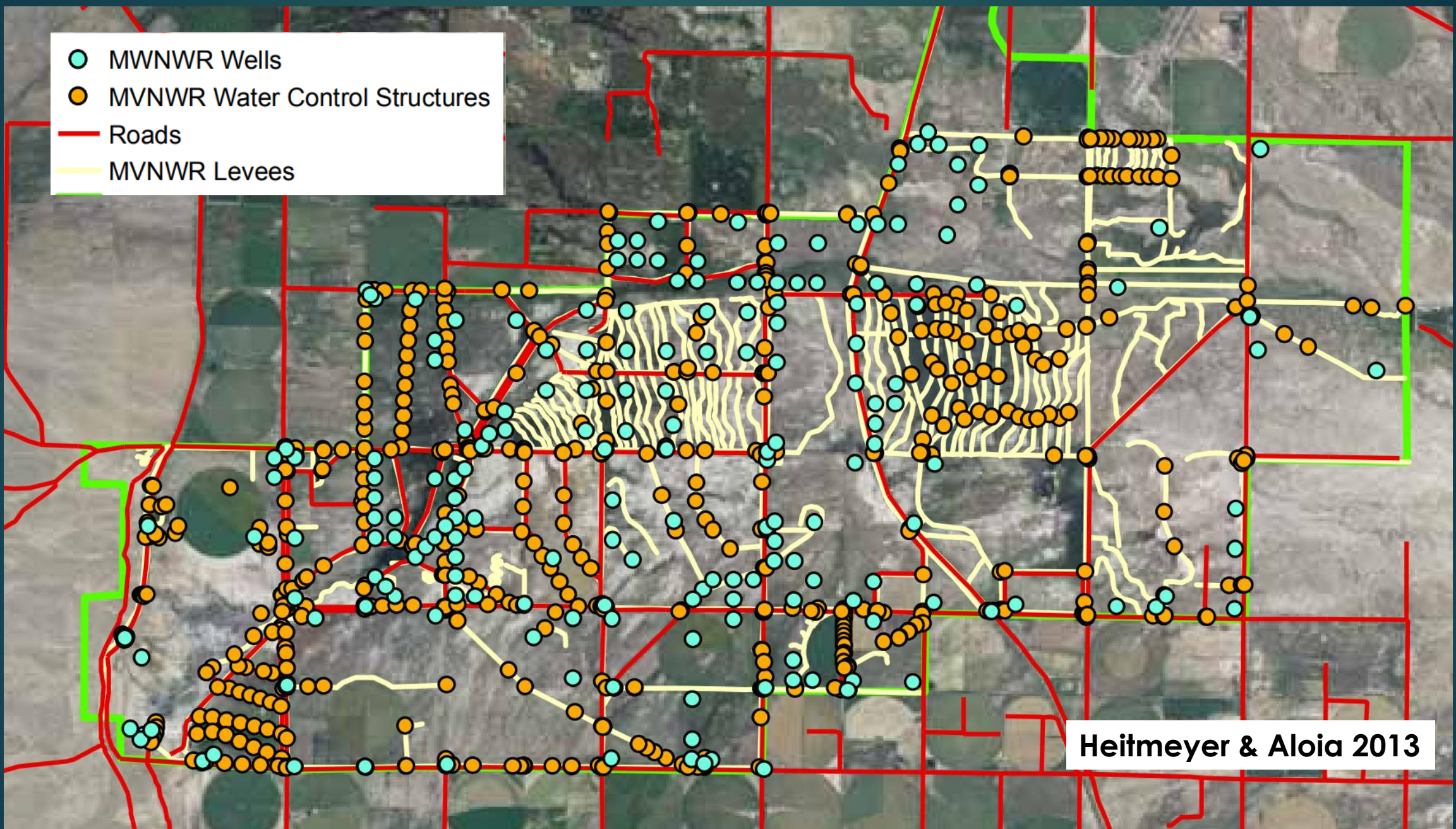


An aerial photograph of a vast, flat landscape under a clear blue sky. The foreground and middle ground are covered in a yellowish-brown, textured material, likely dried mud or salt. Several irregular, light-colored patches are visible, representing deposits of mirabilite. In the background, a wide, shallow body of water reflects the sky, with a distant, flat horizon line.

Mirabilite
 $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$

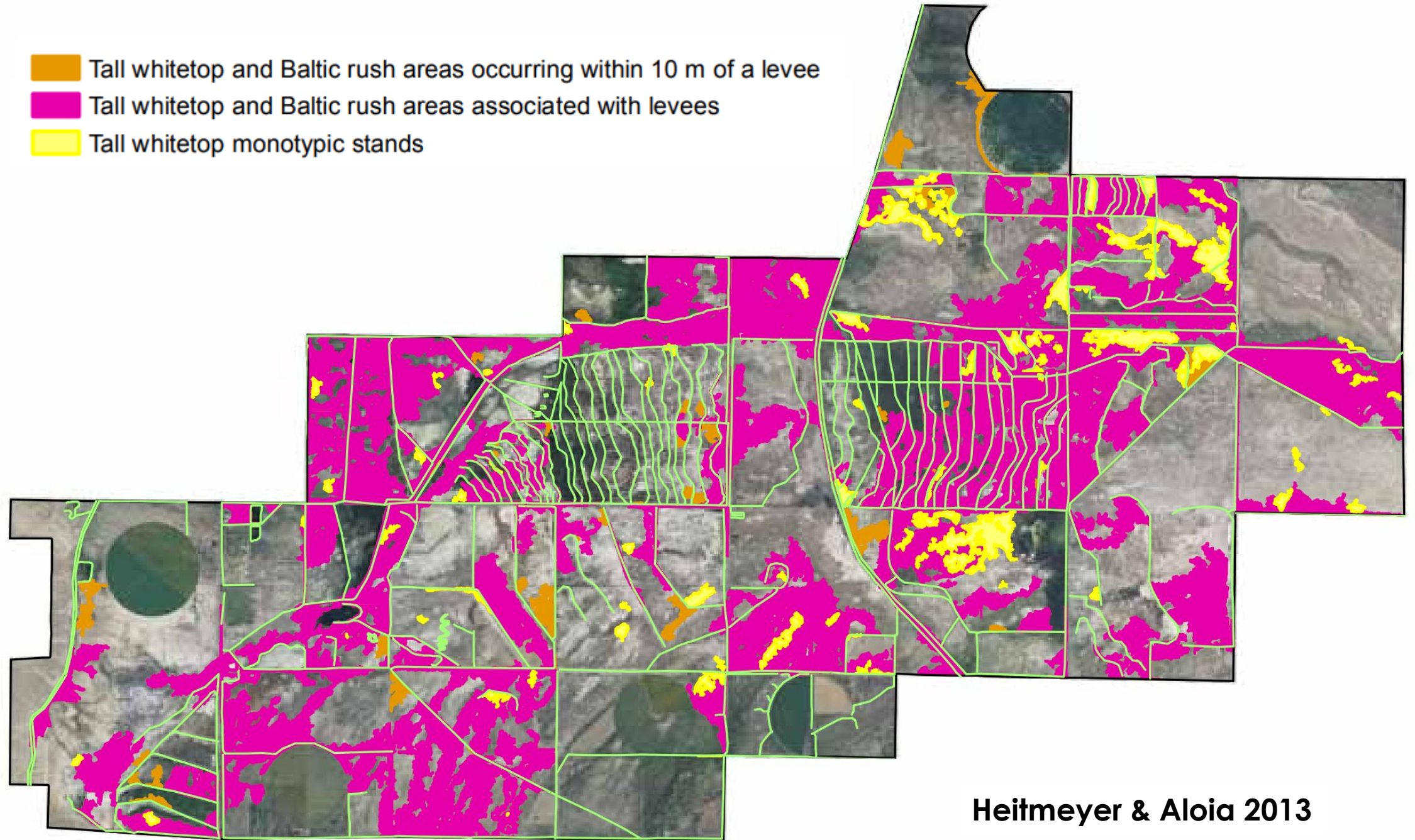


- MWNWR Wells
- MVNWR Water Control Structures
- Roads
- MVNWR Levees



Heitmeyer & Aloia 2013

- Tall whitetop and Baltic rush areas occurring within 10 m of a levee
- Tall whitetop and Baltic rush areas associated with levees
- Tall whitetop monotypic stands



Heitmeyer & Aloia 2013



Phragmites



Sesbania



Reed canarygrass

Rethinking Infrastructure

► What was the original purpose?

- ☐ Did it work?
- ☐ Does it still work?
- ☐ Do I still need it?
- ☐ Does it cause problems?

► Can I remove or modify?

- ☐ Is there a better method or approach?
- ☐ Would it improve wetland function?
- ☐ Would it improve management efficiency?
- ☐ Would it lower annual costs?

Infrastructure Considerations

► Ecological

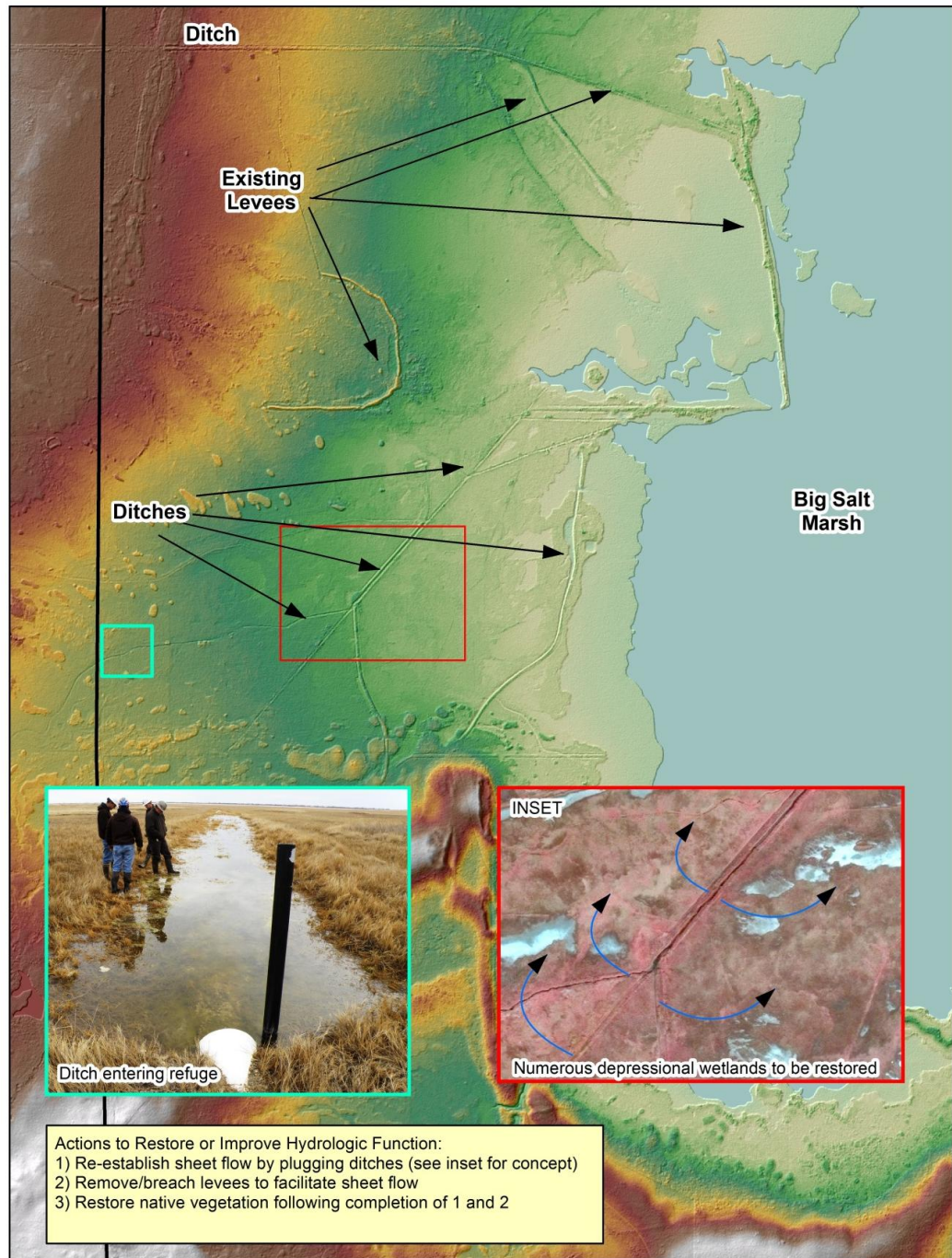
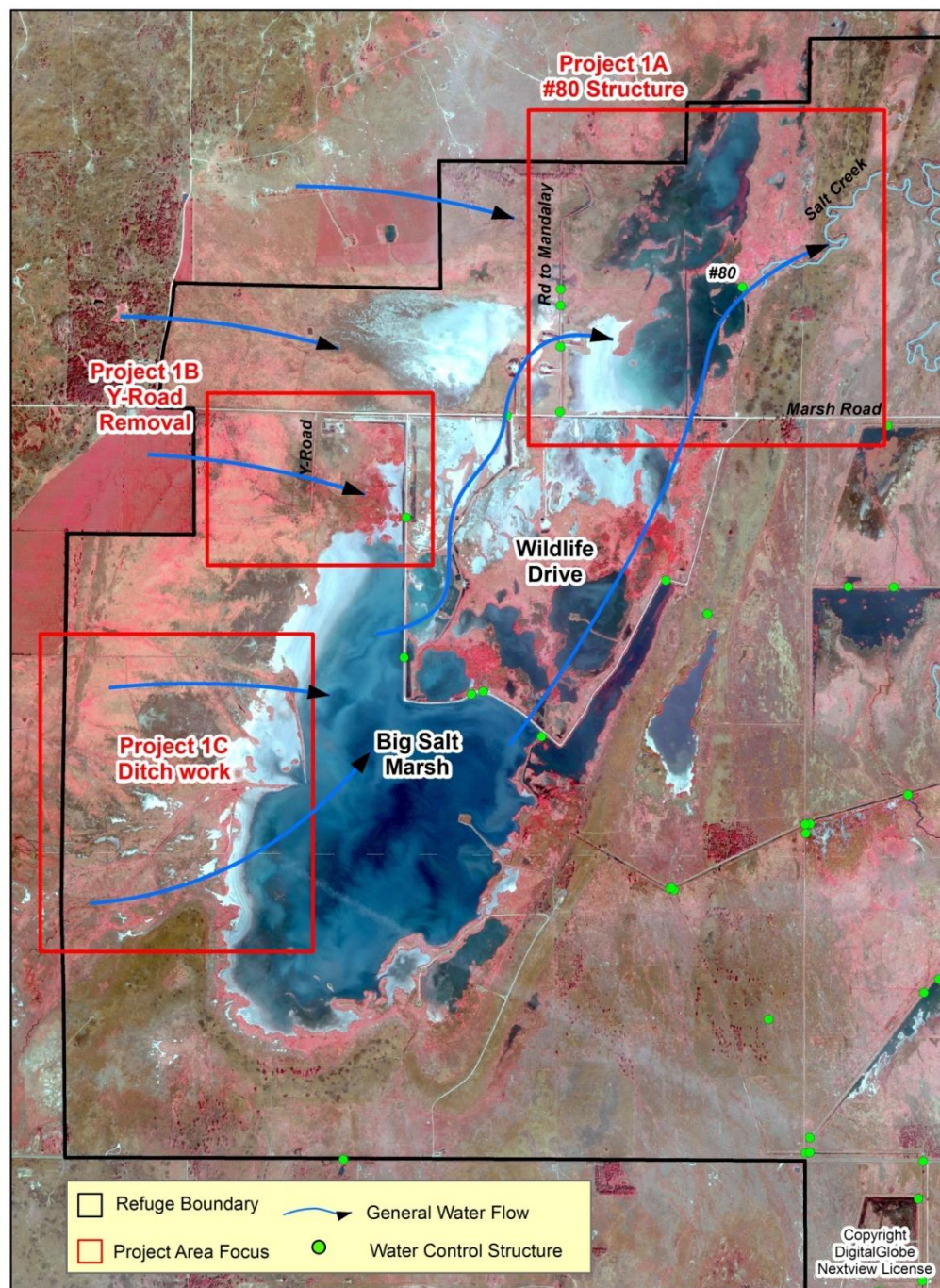
□ Abiotic factors / Processes

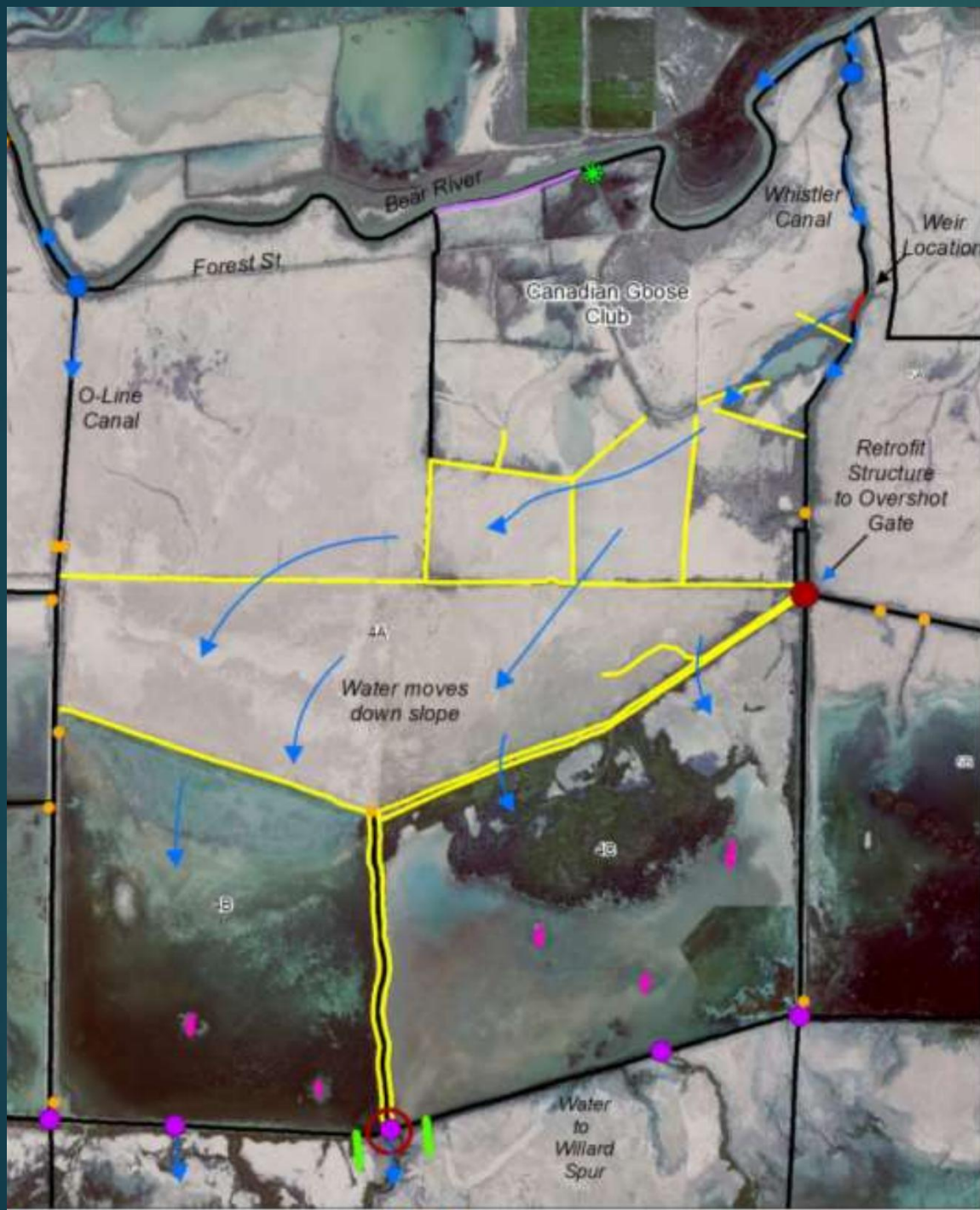
- Hydrology (time, duration, extent)
- Topography
- Nutrient dynamics
- Sediment dynamics

□ Biotic factors

- Plant community dynamics
- Waterbird food/structure
- Fish passage
- Amphibian metapopulation dynamics







Infrastructure Considerations (levee / ditch location)

▶ Topography

- ❑ Natural contours/features

▶ Soils

- ❑ Seepage (surface & subsurface)

▶ Hydrology

- ❑ Drying of root zone & seed bank
- ❑ Independent control

▶ Sediment dynamics

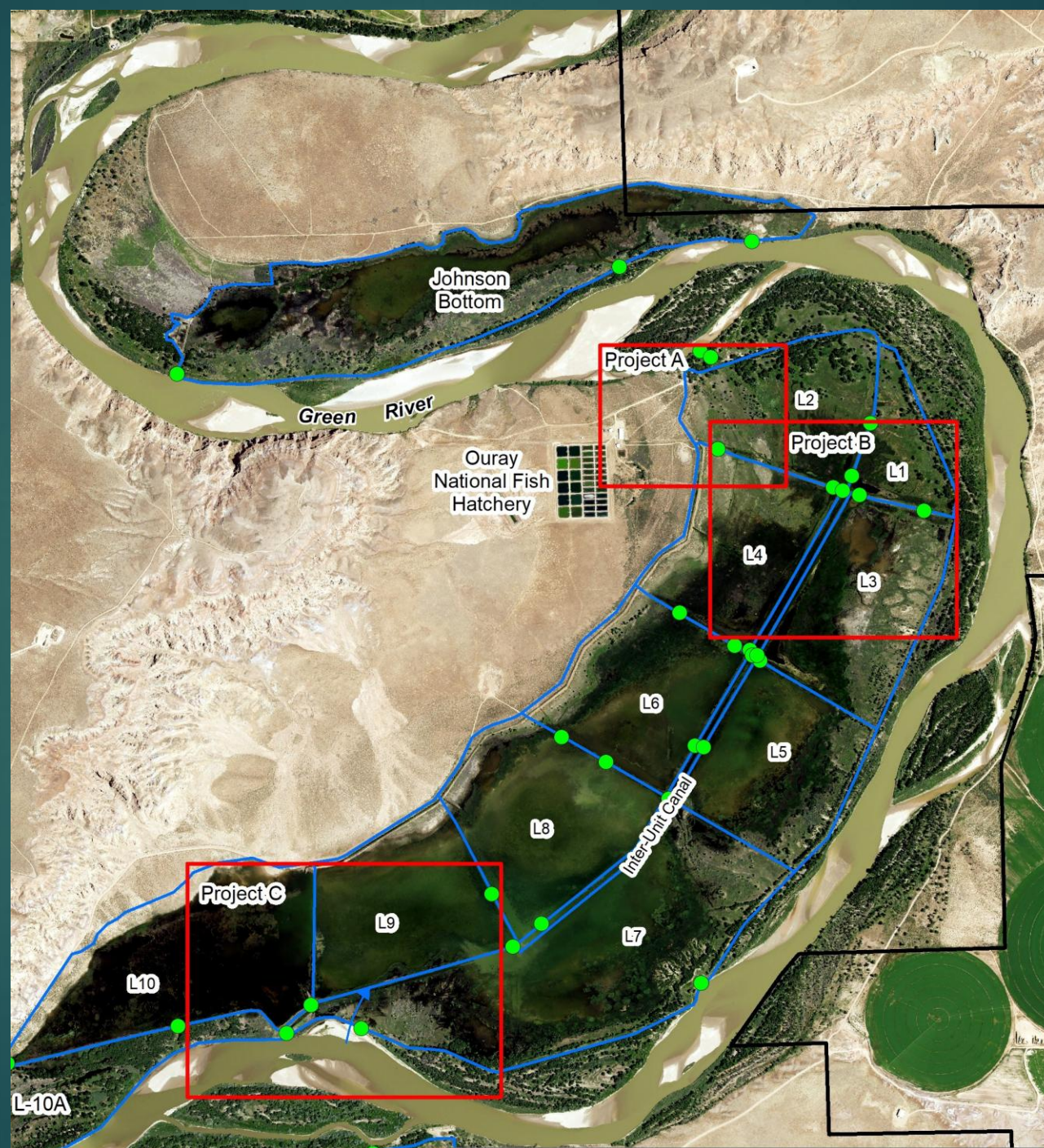
- ❑ Minimize localized erosion
- ❑ Natural deposition pattern

Geoeye 1 - August 16, 2014 - Leota Bottom Upper Breach



► **Inappropriate structure location**

- ❑ Altered sediment deposition
- ❑ Disconnection from backwater
- ❑ Channel movement



Infrastructure Considerations (levee design)

► Dimensions

- ▣ Height
 - Floodplain connections
- ▣ Slope
 - Soil moisture dynamics
 - Sediment dynamics
- ▣ Crown
 - Vegetation control (access)

► Construction

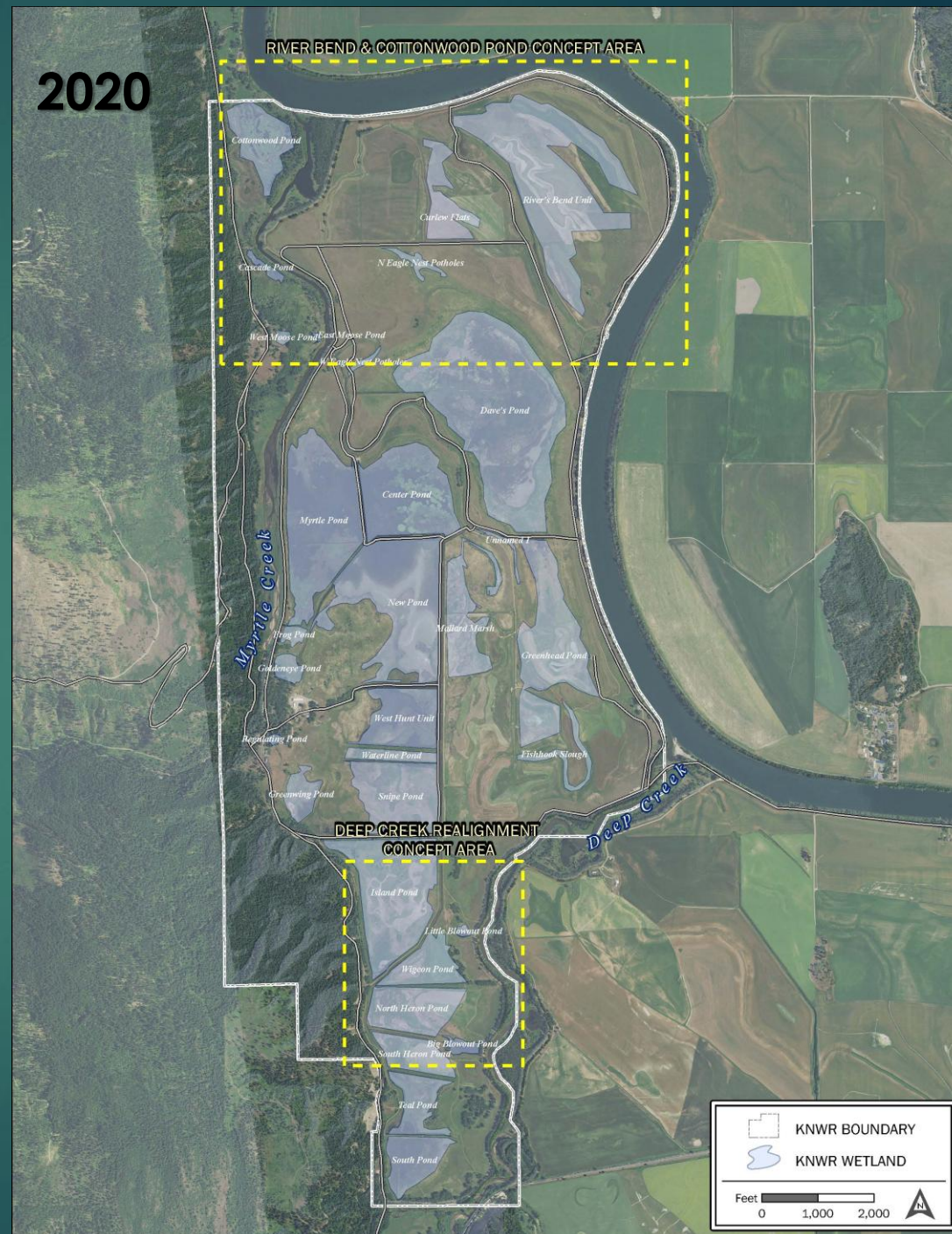
- ▣ Material
 - Texture (seepage)
 - Armor type (plant, cobble)
- ▣ Method
 - off-site vs on-site
 - Cored vs not cored

1965



Wetland Connectivity

2020



Infrastructure (water conveyance)

► Design considerations

□ Location

- Horizontal (flow path connections)
- Vertical (soil moisture dynamics)

□ Type

- Stoplog (surface discharge)
- Waterman gate (variable discharge)
- Radial gate (bottom discharge)

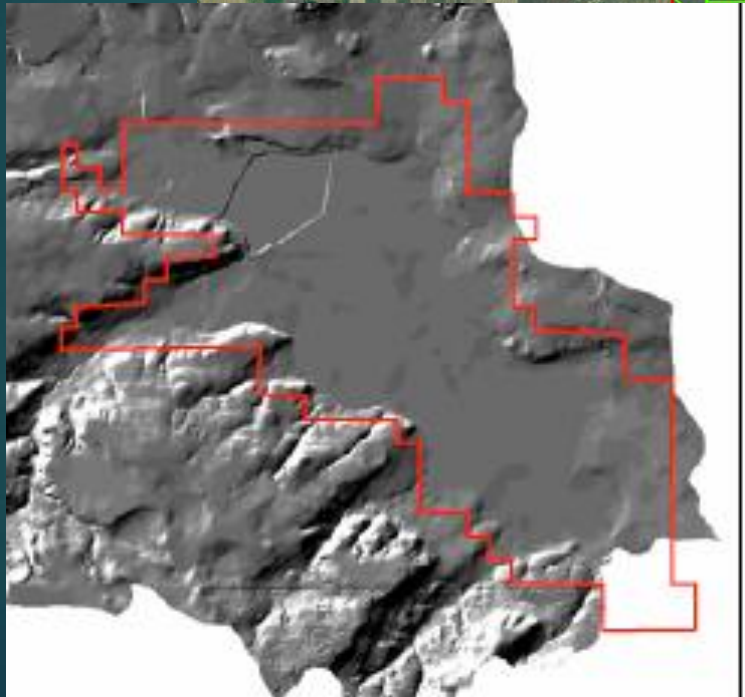
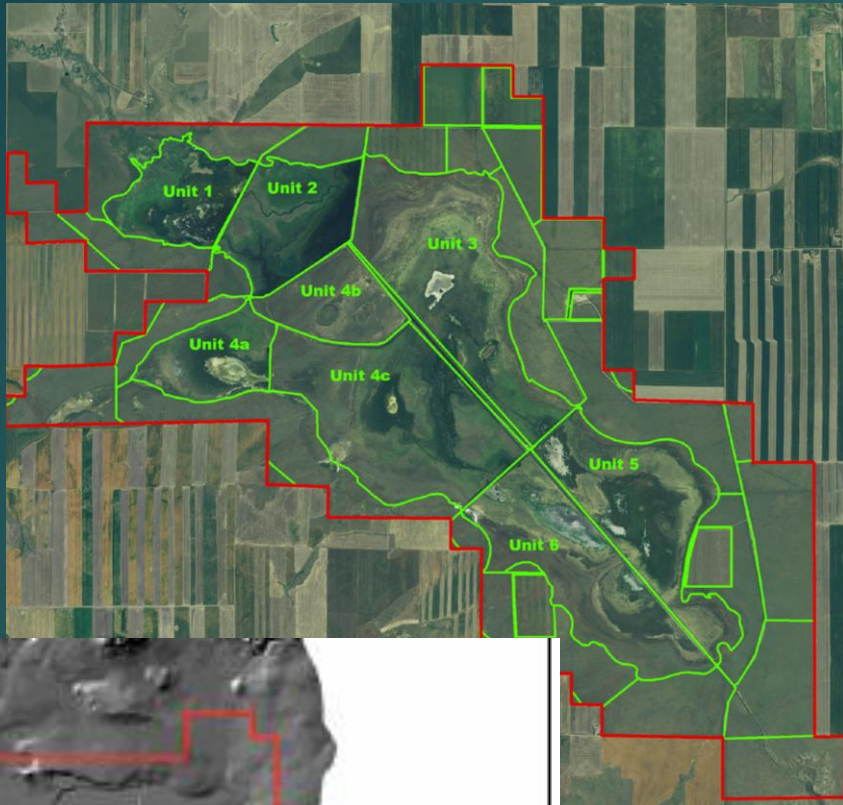
□ Size

- Surface flow volume
- Groundwater flow volume
- Seepage

**Channel incision
below double culvert**



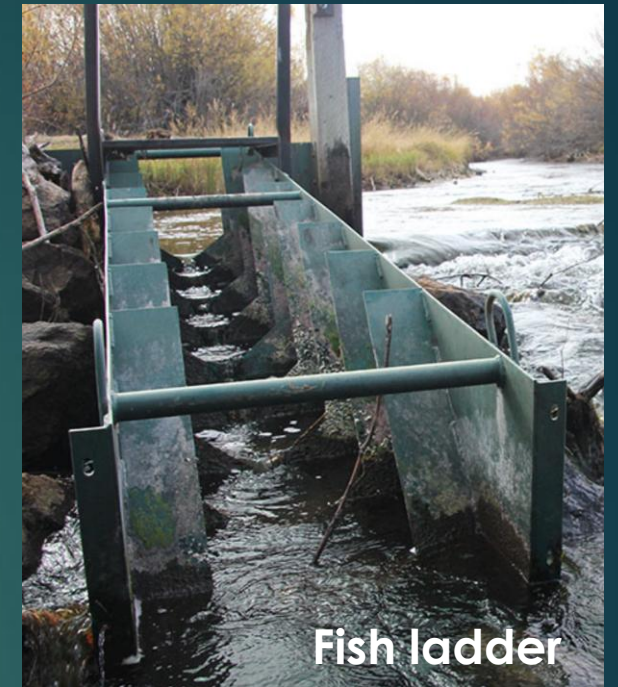
Examples







Waterman gate



Fish ladder



Overshot gate



Fish screen

Sheppard Bottom CIR - August 17, 2017



Sheppard Bottom footprint is approx 575 acres

