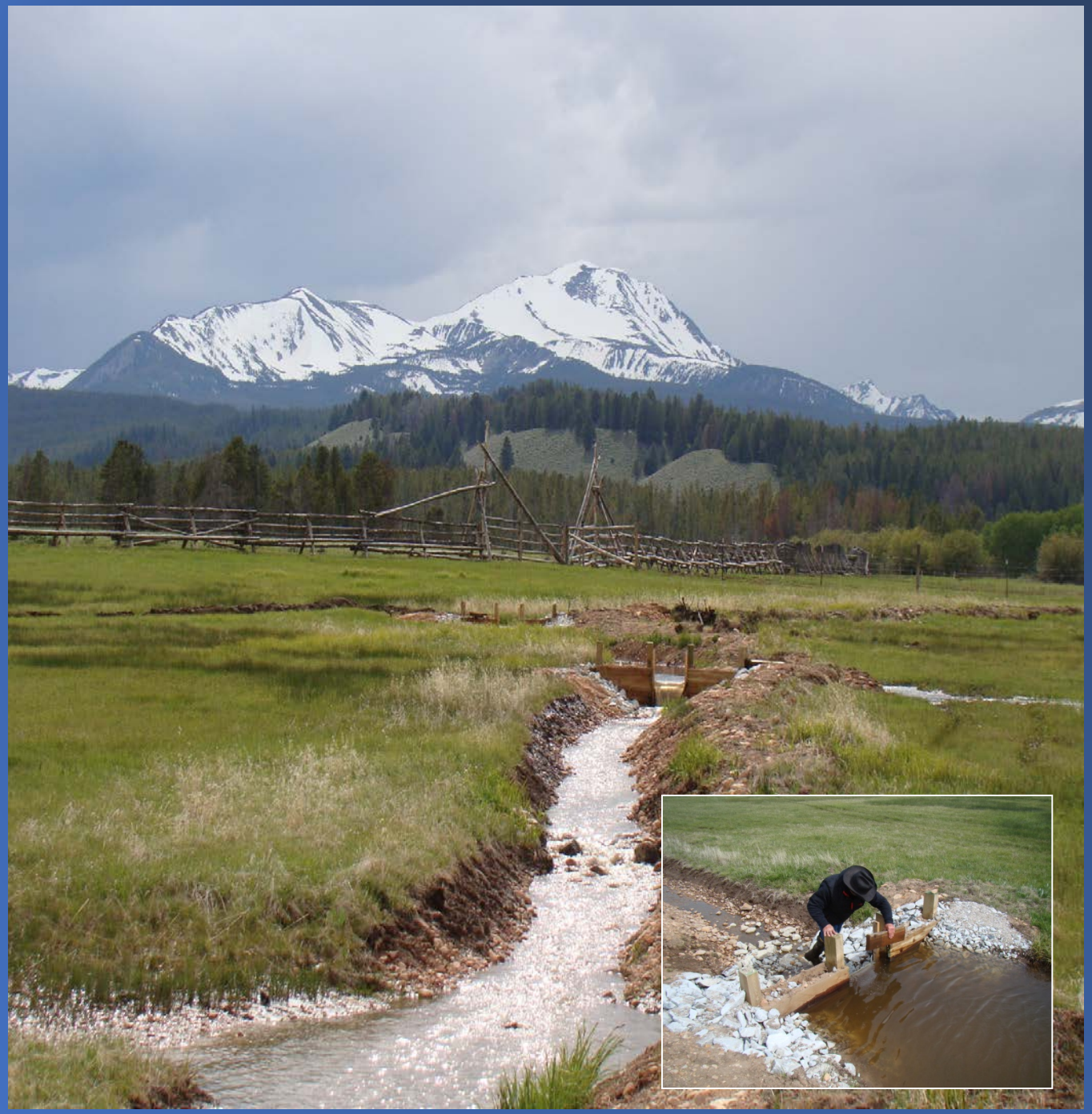

Irrigation Efficiency and Water Conservation

March 2018

Mike Roberts, Hydrologist

Montana Water Summit

The Montana Department of Natural Resources & Conservation

Irrigation Efficiency and Water Conservation

What is Irrigation Efficiency?

What is Water Conservation?

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Irrigation Efficiency and Water Conservation

What is Irrigation Efficiency?

What is Water Conservation?

Hydrologic considerations of converting from flood to center pivot irrigation

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Key Definitions

Consumptive Use: Water used by the crop through evapotranspiration

Evapotranspiration: Loss of water from soil evaporation and transpiration of plants. i.e. plant use

Irrecoverable Losses: Direct evaporation from static water, wind drift, etc.

Key Definitions

Return Flow: Diverted water applied to the field that seeps into ground and returns to the source.

Seepage: Diverted water that leaks through the bottom of the ditch.

Tail Water: Diverted water that is not consumed and returns to a surface source.

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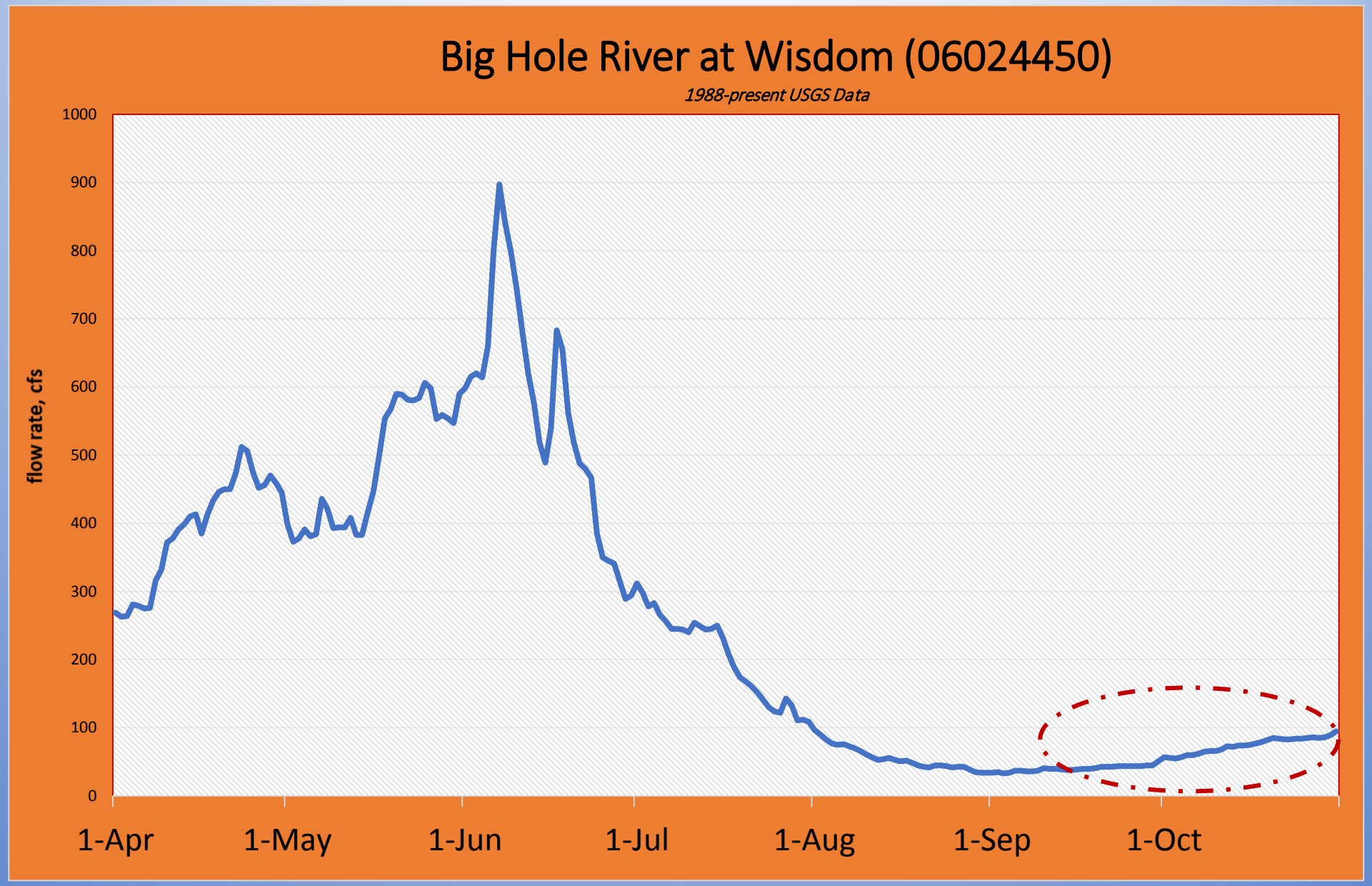

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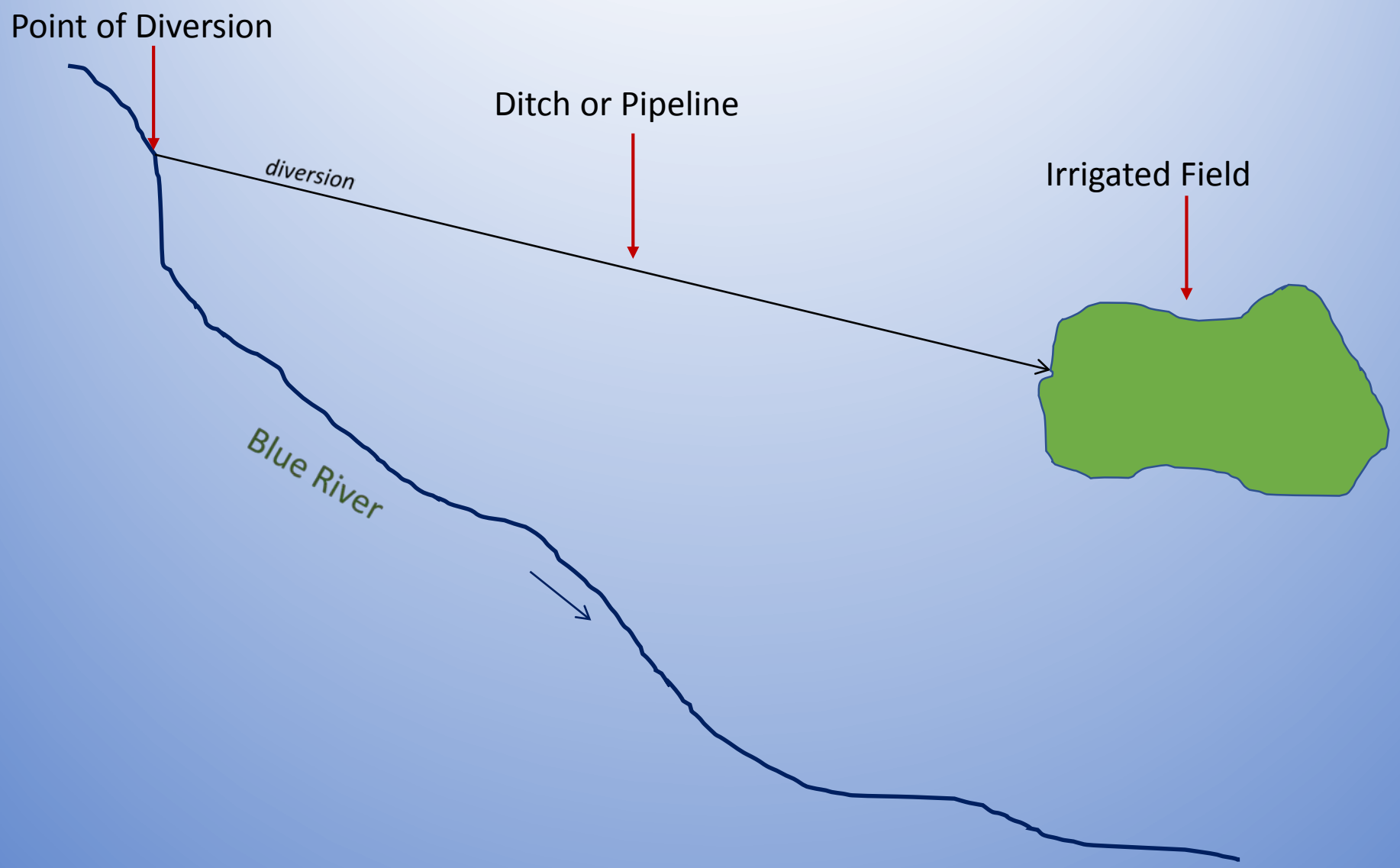

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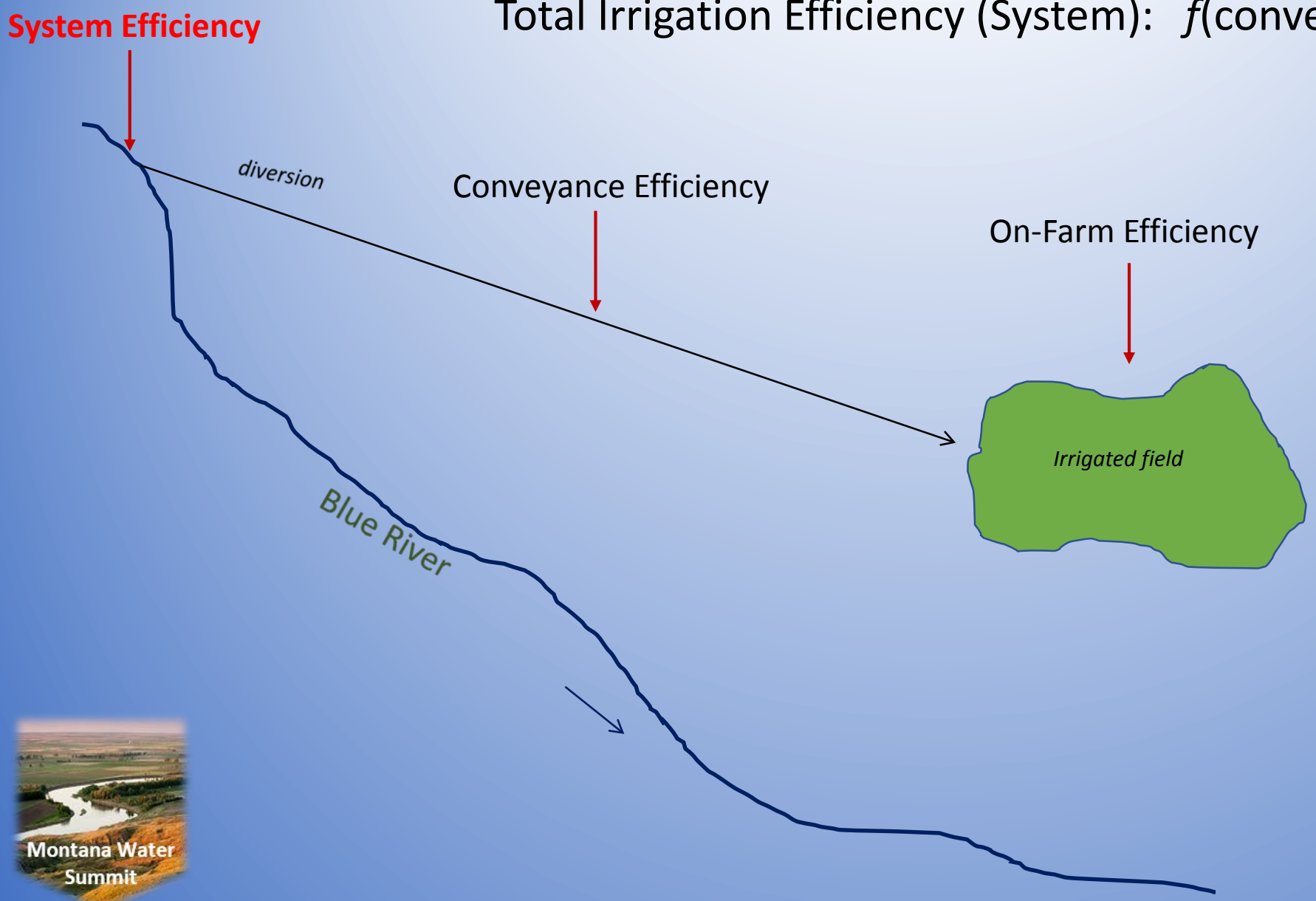
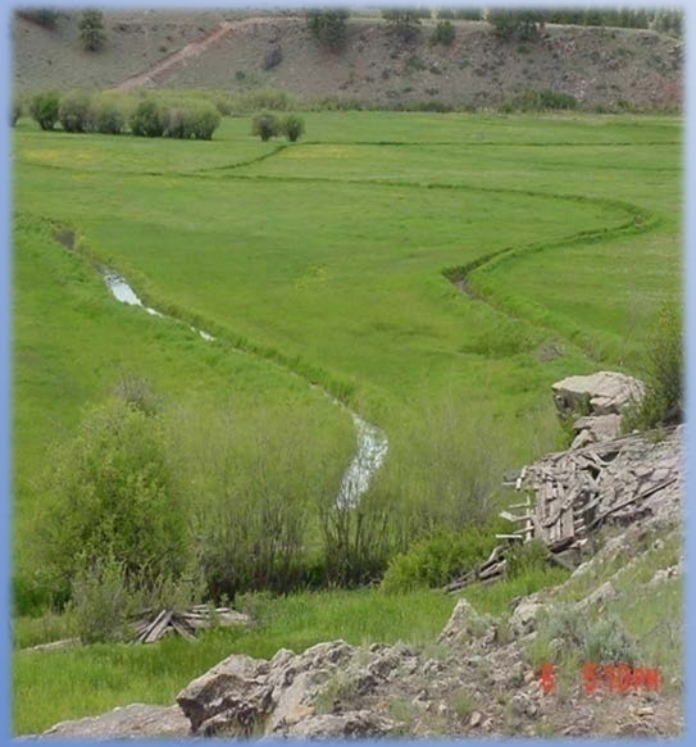
Total Irrigation Efficiency (System): *f*(conveyance, on-farm)



Total Irrigation Efficiency (%)

$$\text{System Efficiency} = \frac{\text{Water Consumed by the Crop}}{\text{Diverted Amount}}$$



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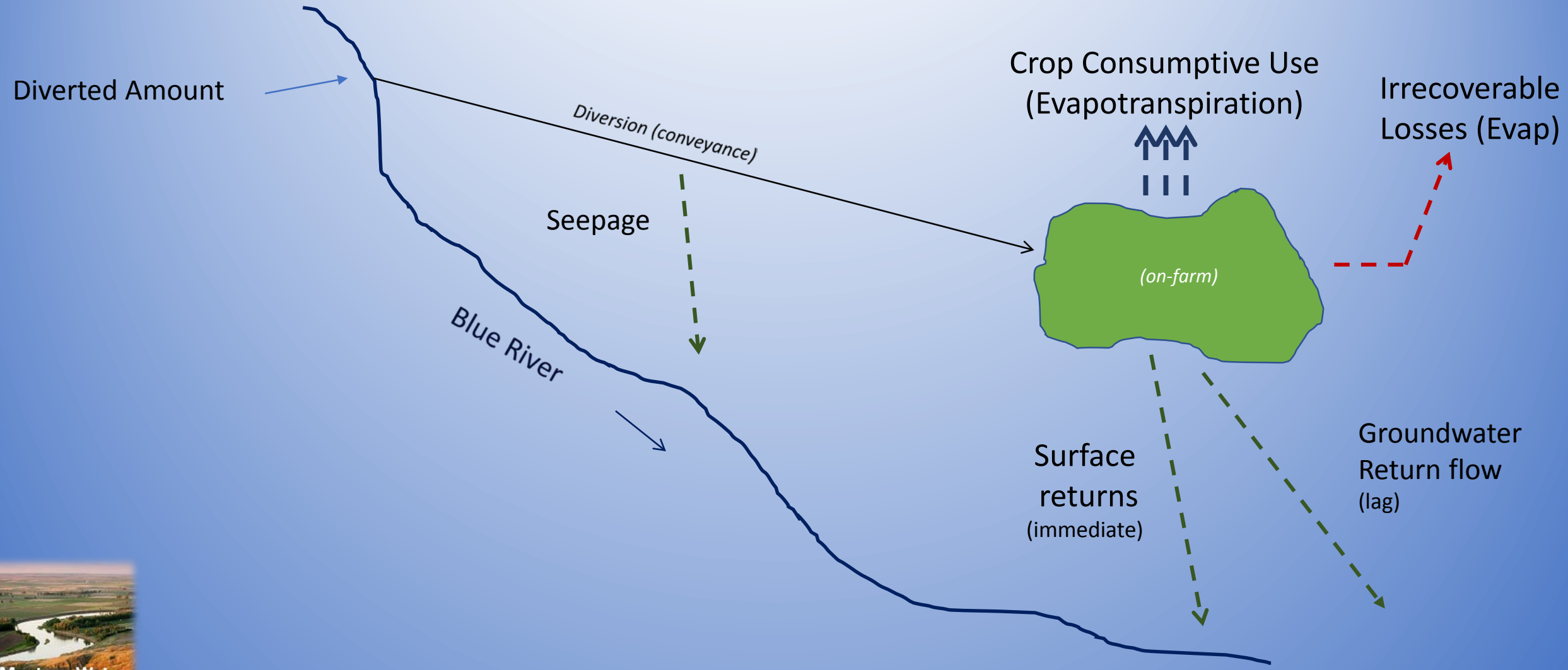
Example: Flood Irrigation

$$\text{System Efficiency} = \frac{\text{Water Consumed by Crop}}{\text{Diverted Amount}}$$



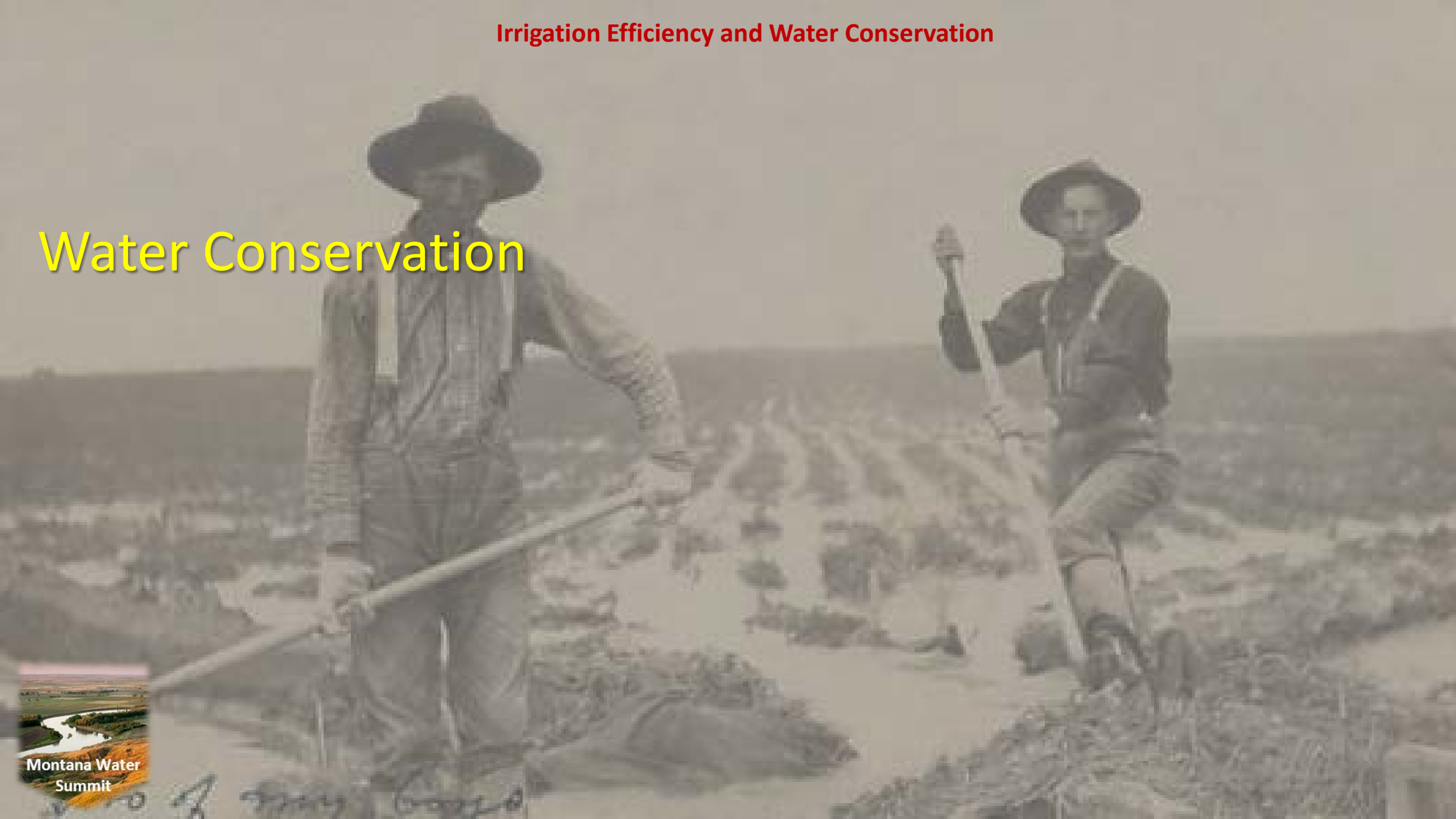
$$\text{System Efficiency} = \frac{\text{Water Consumed by Crop}}{\text{Diverted Amount}}$$

For Example:

Crop consumption = 50 acre-feet
Diverted water = 100 acre-feet

System Efficiency = (50/100)*100 = **50%**

Water Conservation



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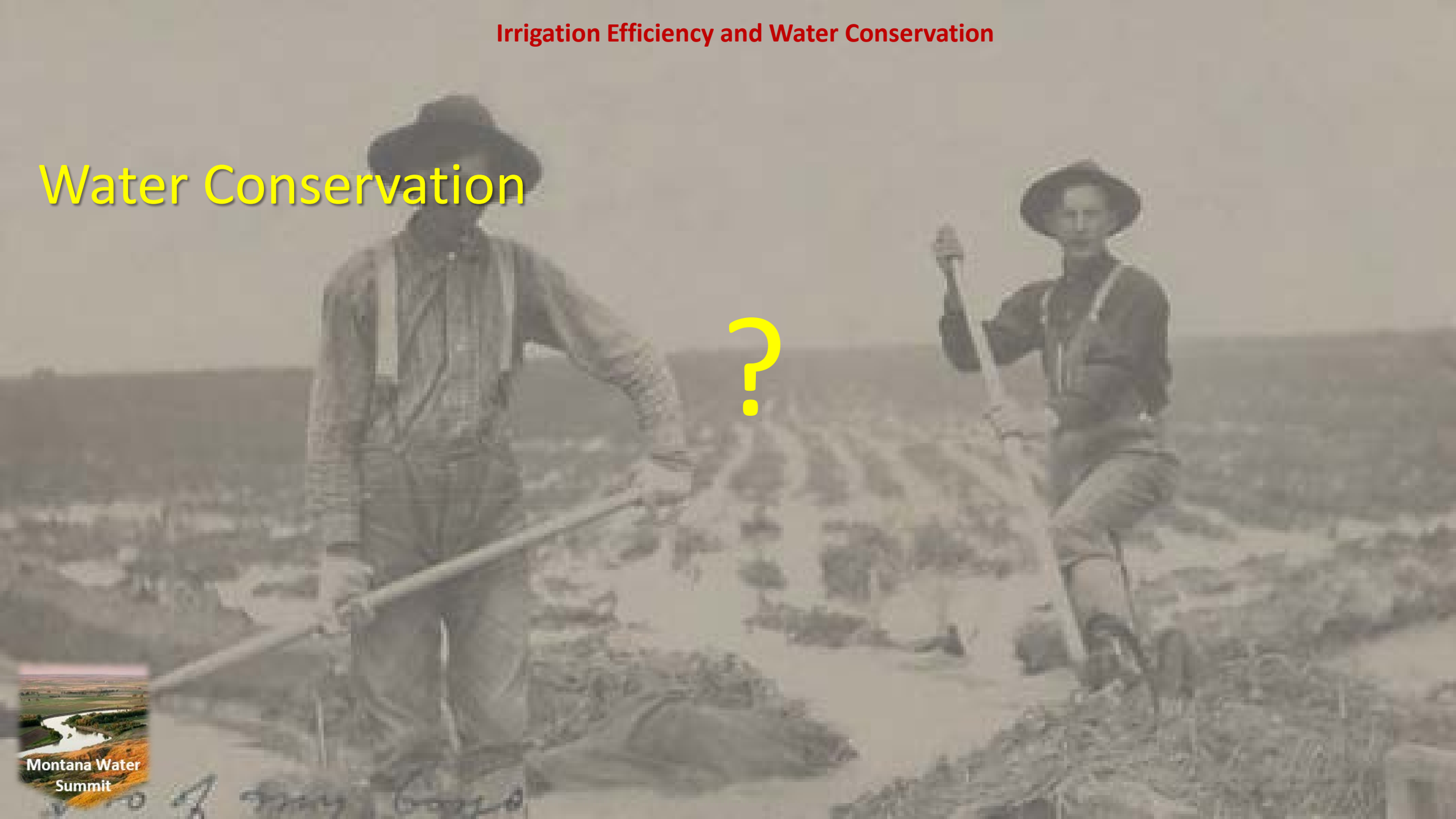
Water Conservation



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Water Conservation

→ Sustainable management of water to meet current and future demands

Water Conservation

Sustainable management of water to meet current and future demands

Preservation and Protection

Water Conservation

Sustainable management of water to meet current and future demands

Preservation and Protection

Consuming less water

Hydrologic considerations of converting from flood to center pivot irrigation

Why Convert?

- labor costs or loss of labor force
- financial incentives
- site limitations

  (soils, water availability, etc.)
- conservation

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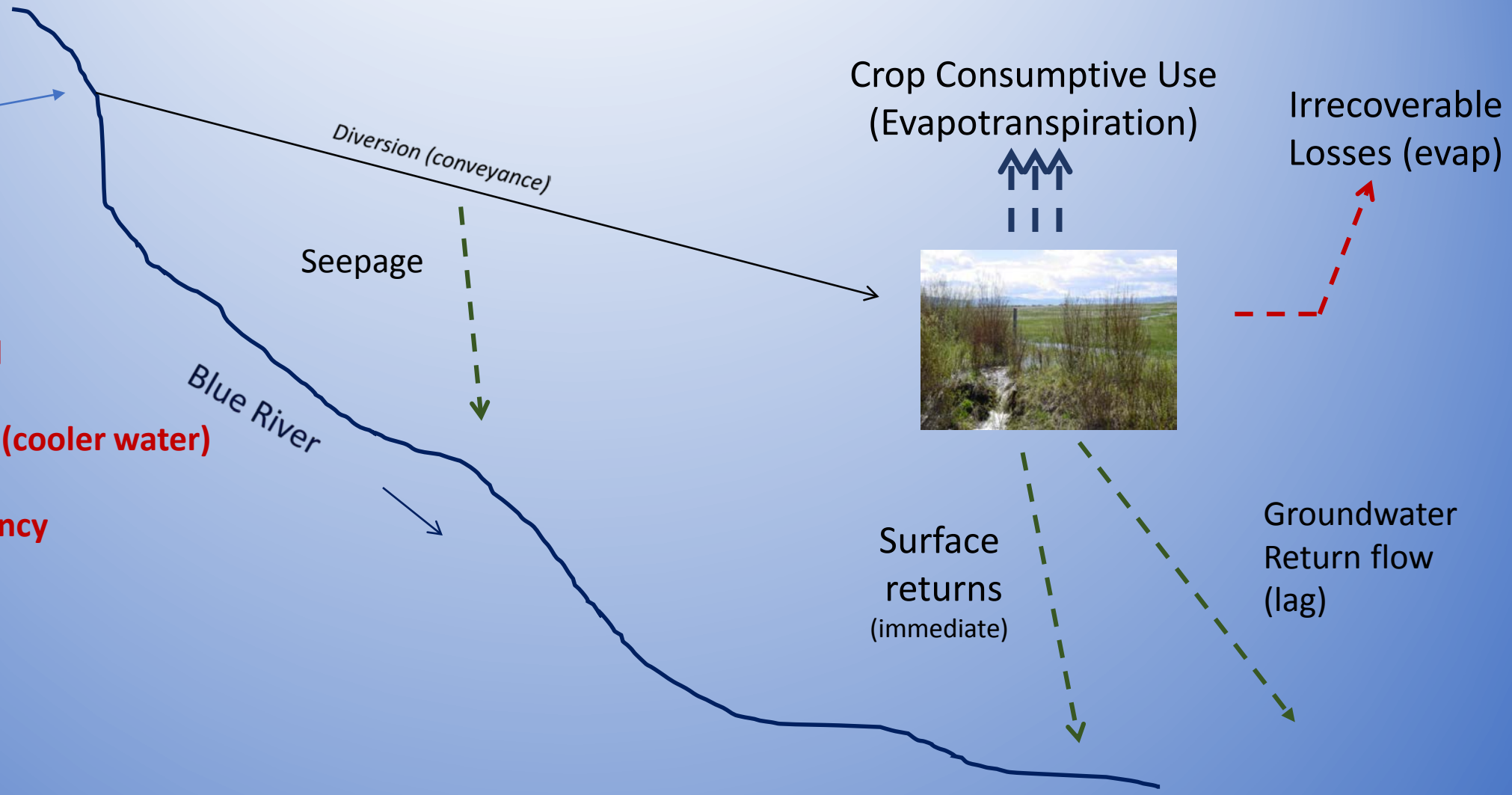
increase production

Flood Irrigation



- **Gravity, requires head**
- **Saturates soil profile**
- **Provides return flows (cooler water)**
- **Storage?**
- **20-60% system efficiency**

Center Pivot Irrigation

Diverted Amount

Diversion (piped)

Crop Consumptive Use
(Evapotranspiration)

Irrecoverable
Losses (evap)

- **Piped and pumped**
- **Manages crop requirement**
- **Uniform distribution of water**
- **Can extend irrigation season**
- **Return flows negligible**
- **60-85% system efficiencies**

Seepage
negligible
if piped

Blue River

Surface and
Groundwater returns

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1979

2011

Water use changes as a function of Flood to Sprinkler conversion

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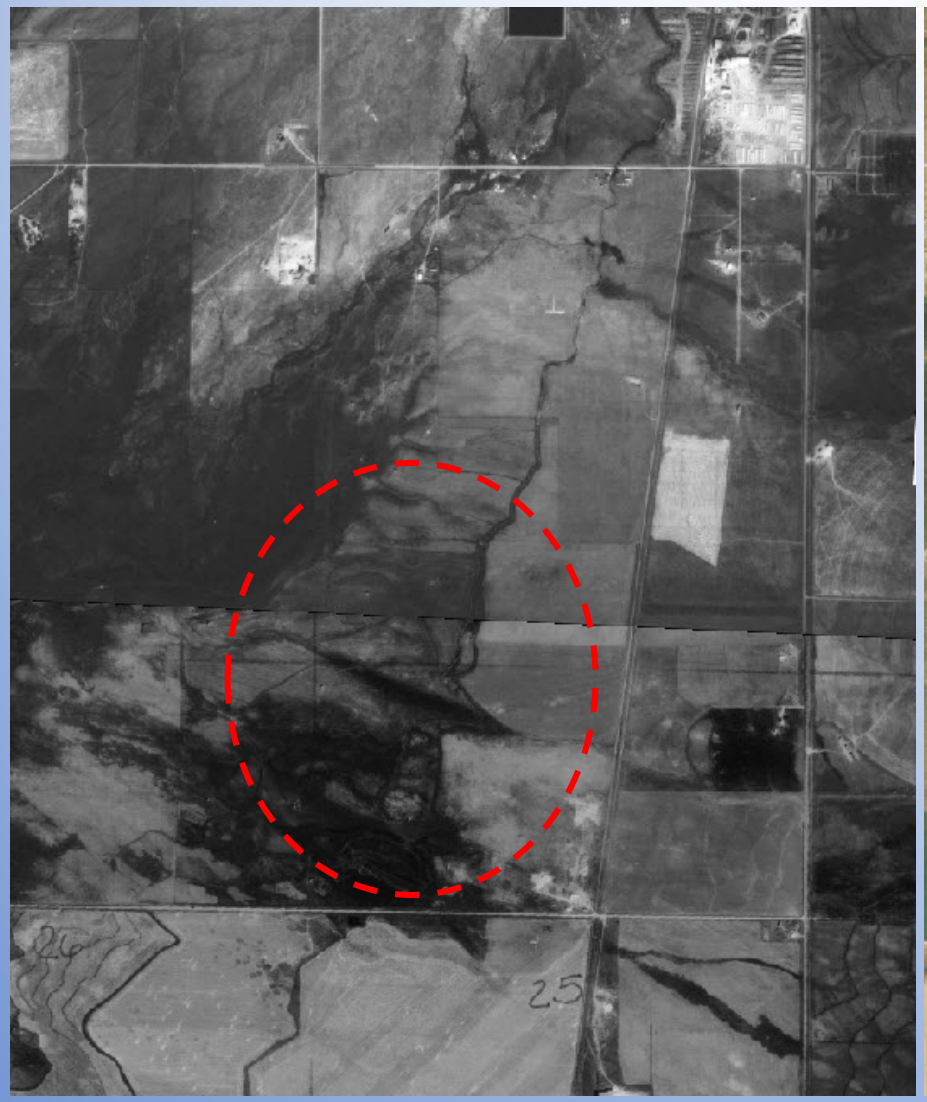

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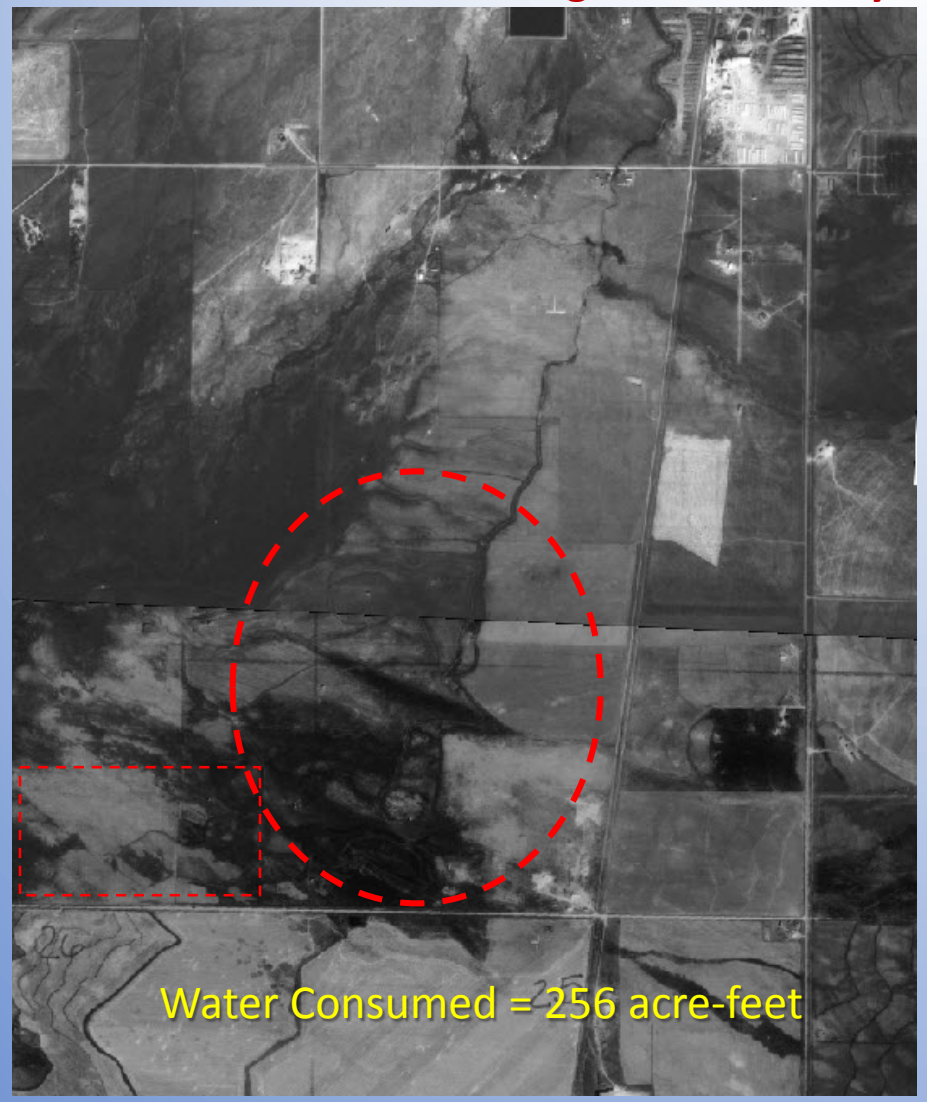

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Water use changes as a function of Flood to Sprinkler conversion

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Increased Efficiency can lead to:

- Increased Consumptive Use
- Decreased Return Flows
- Decreased diverted amounts

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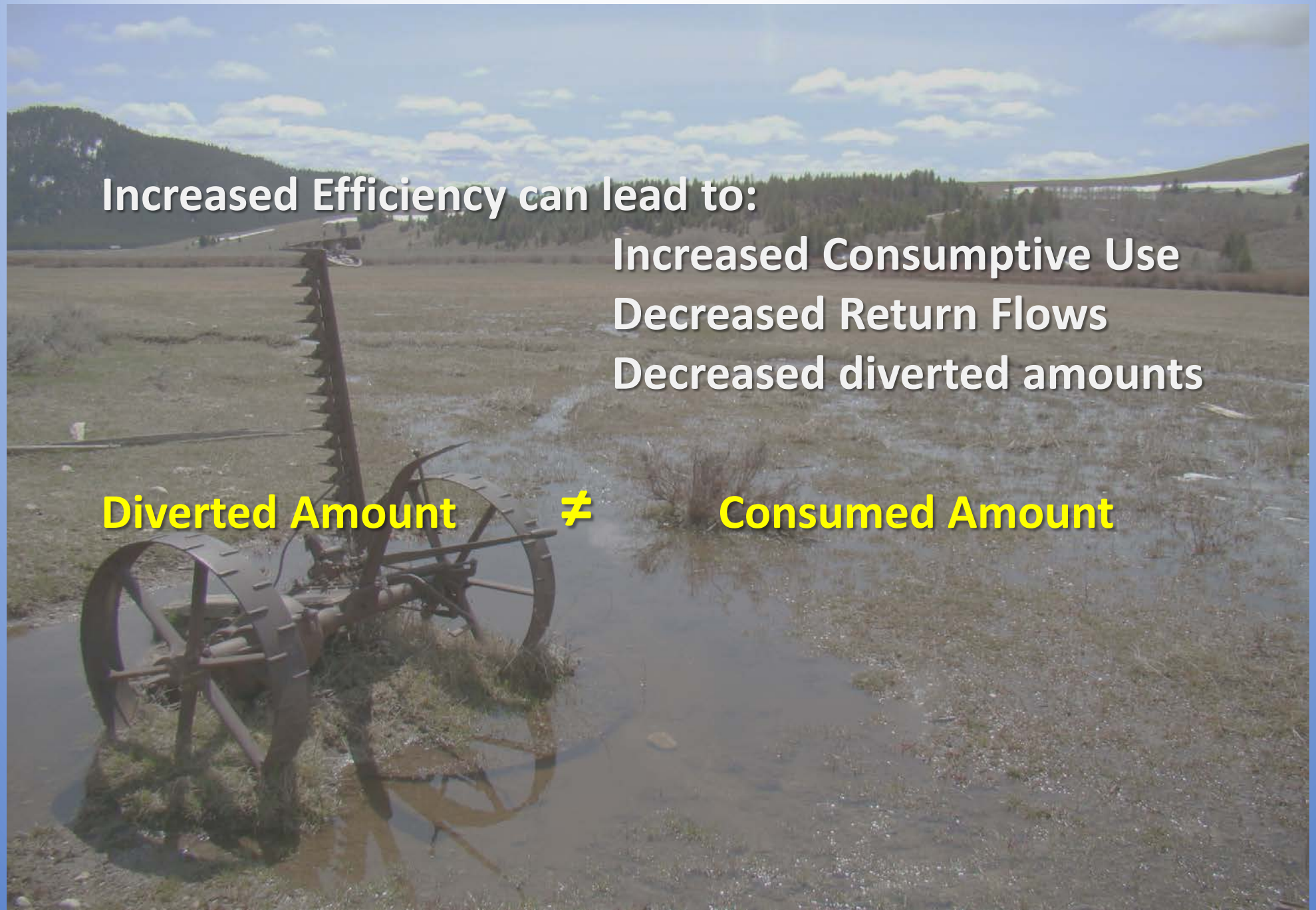

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Diverted Amount ≠ Consumed Amount

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Consider Objective: Temporal and Spatial implications

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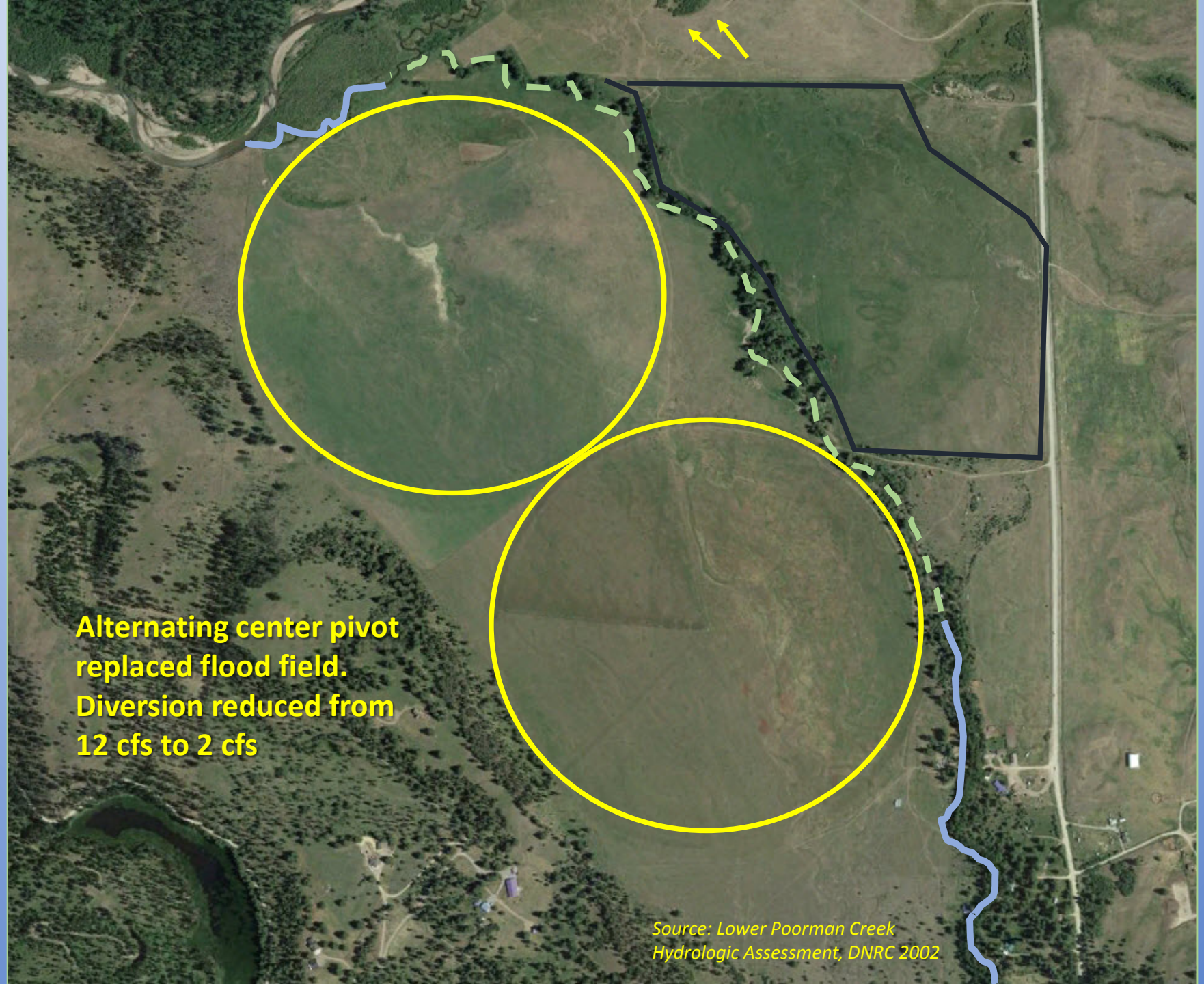

Source: Lower Poorman Creek Hydrologic Assessment, DNRC 2002

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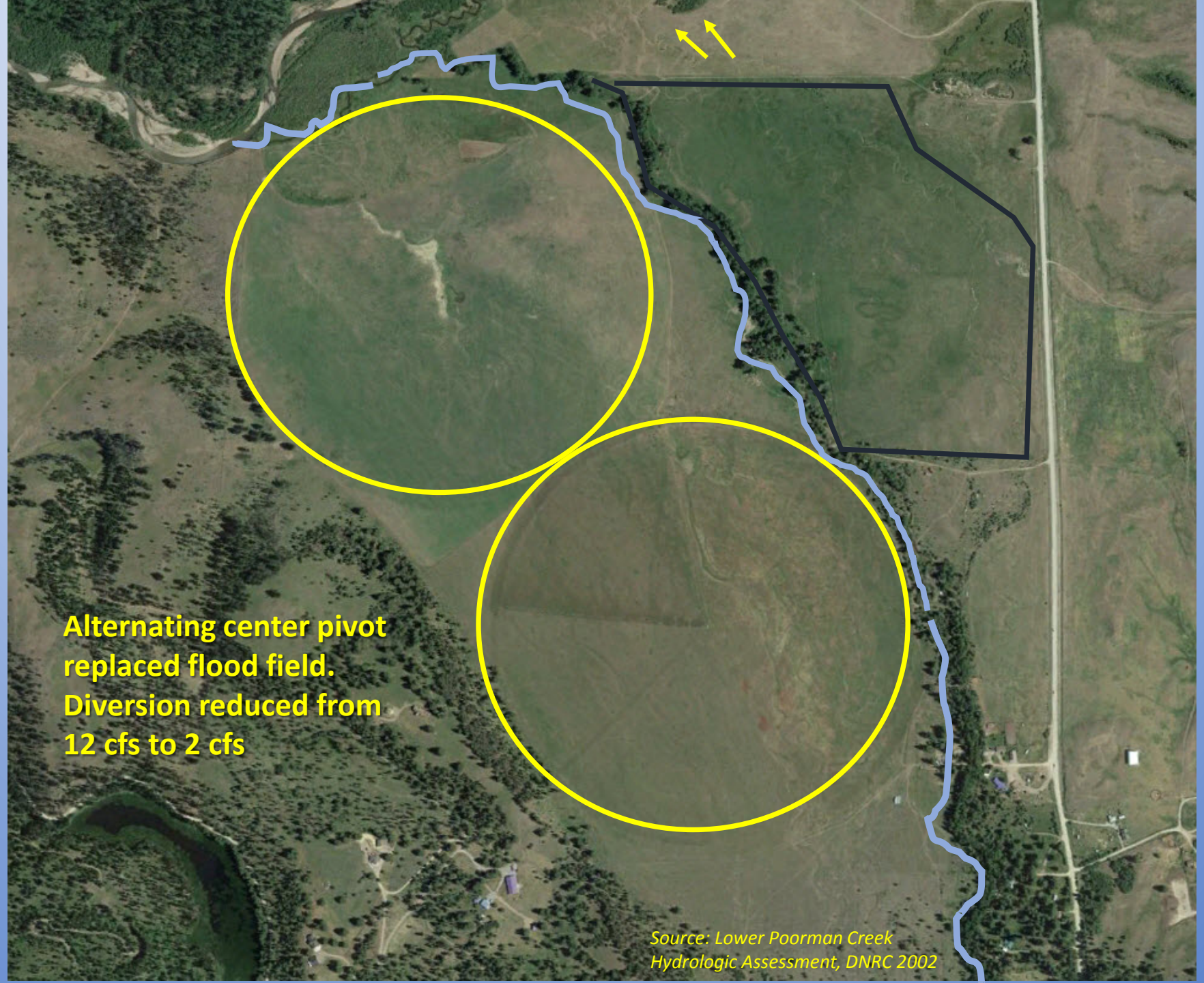

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