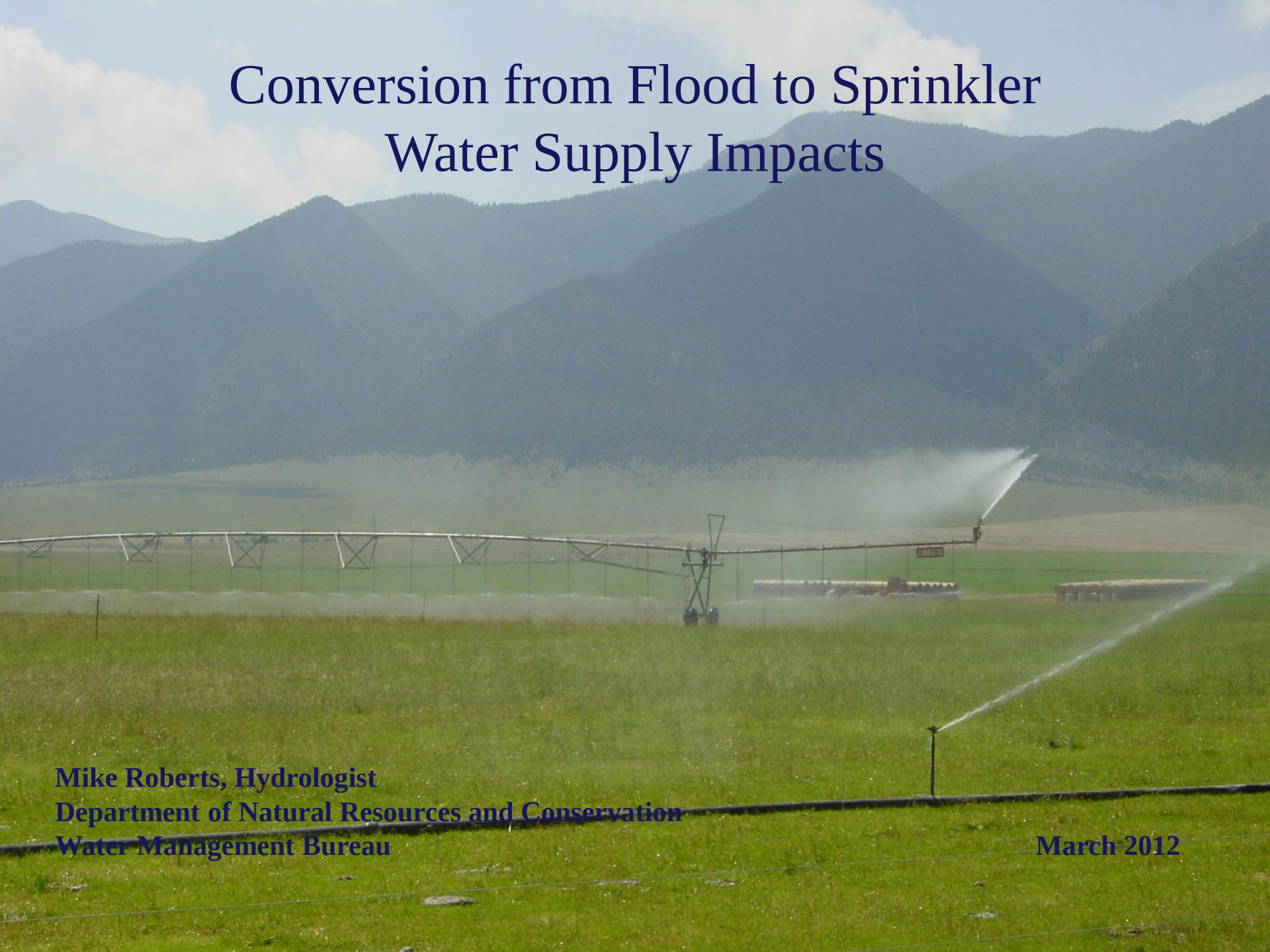
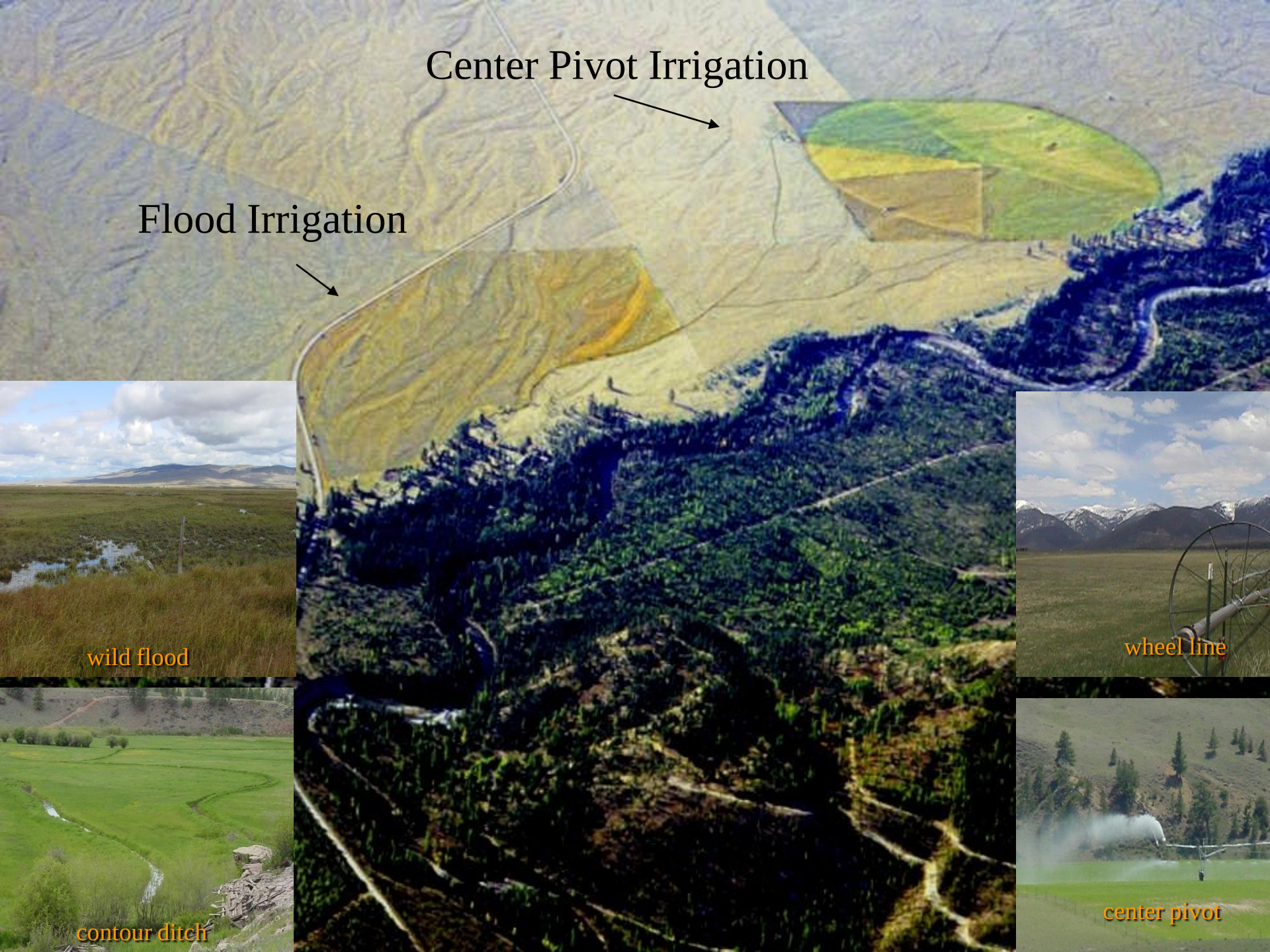
Conversion from Flood to Sprinkler Water Supply Impacts



Mike Roberts, Hydrologist
Department of Natural Resources and Conservation
Water Management Bureau

March 2012


Center Pivot Irrigation
Flood Irrigation
wild flood
wheel line
contour ditch
center pivot

What is Consumptive Use?

The volume of water used for a beneficial purpose, such as water transpired by growing vegetation, evaporated from soils or water surfaces, or incorporated into products that does not return to ground or surface water (ARM 36.12.101(15))

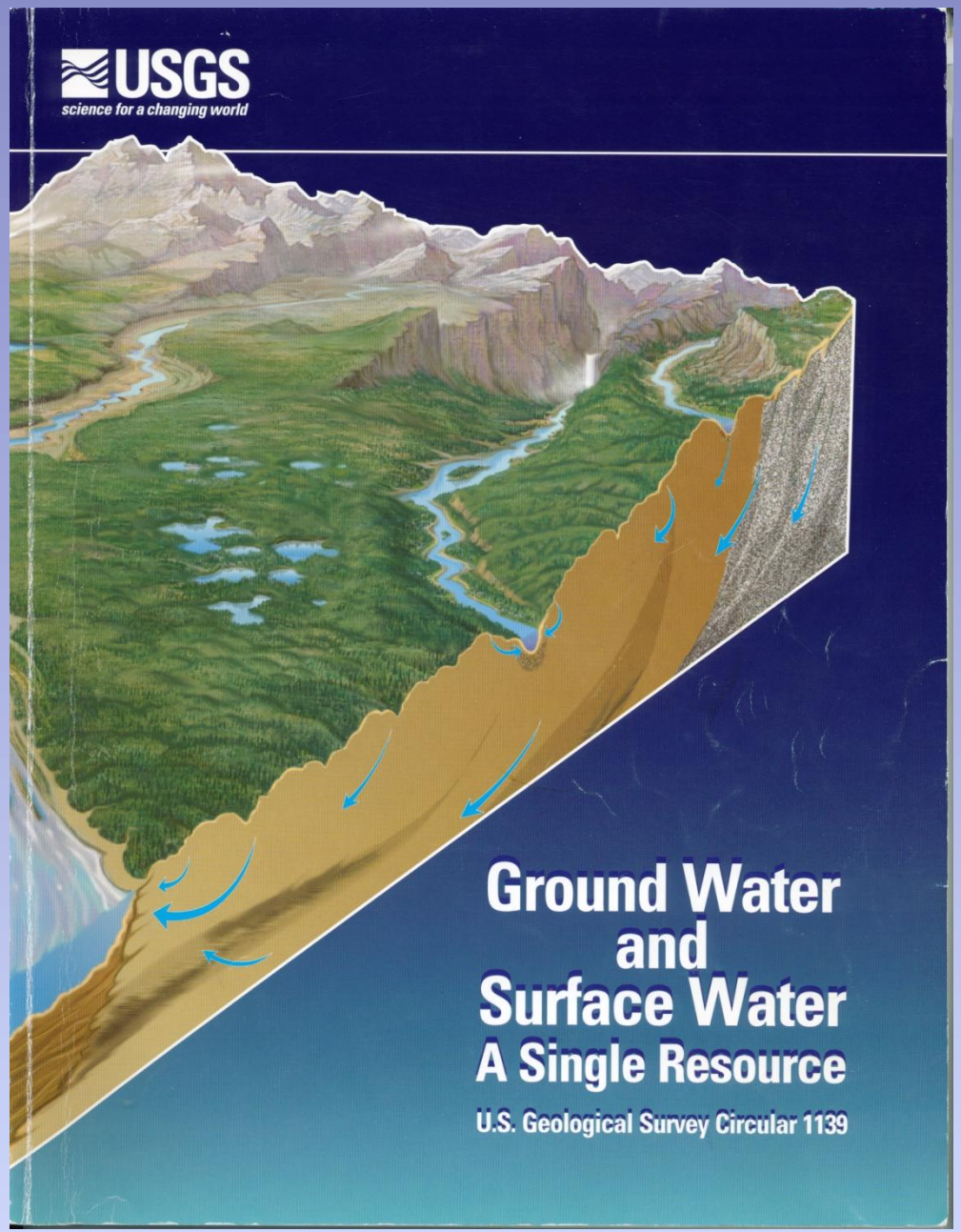
↓

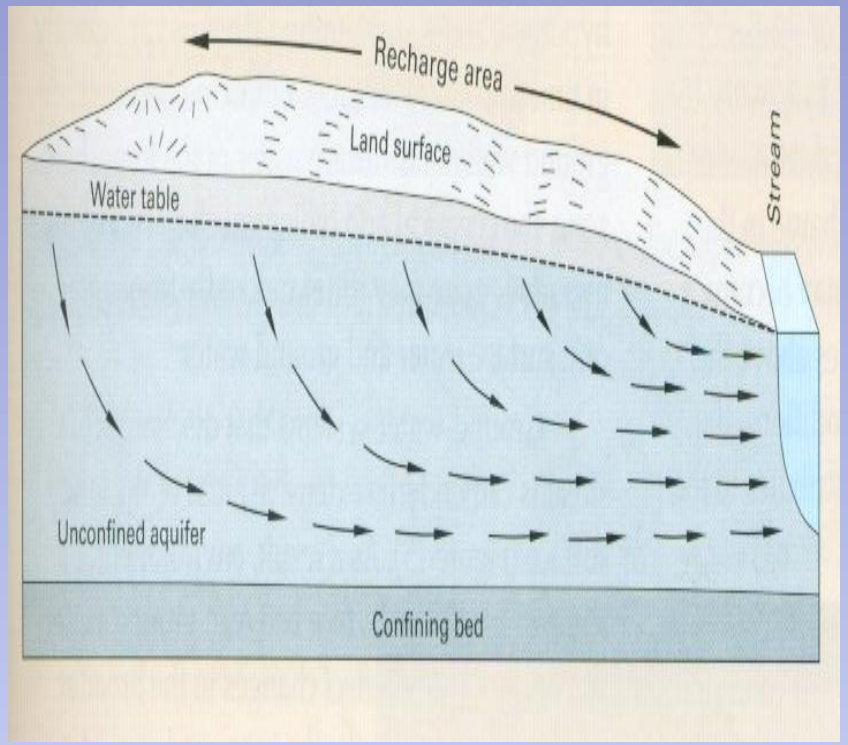
Evapotranspiration (ET)

↓

Irrecoverable losses (do not return to the source)

Surface and Groundwater are Connected





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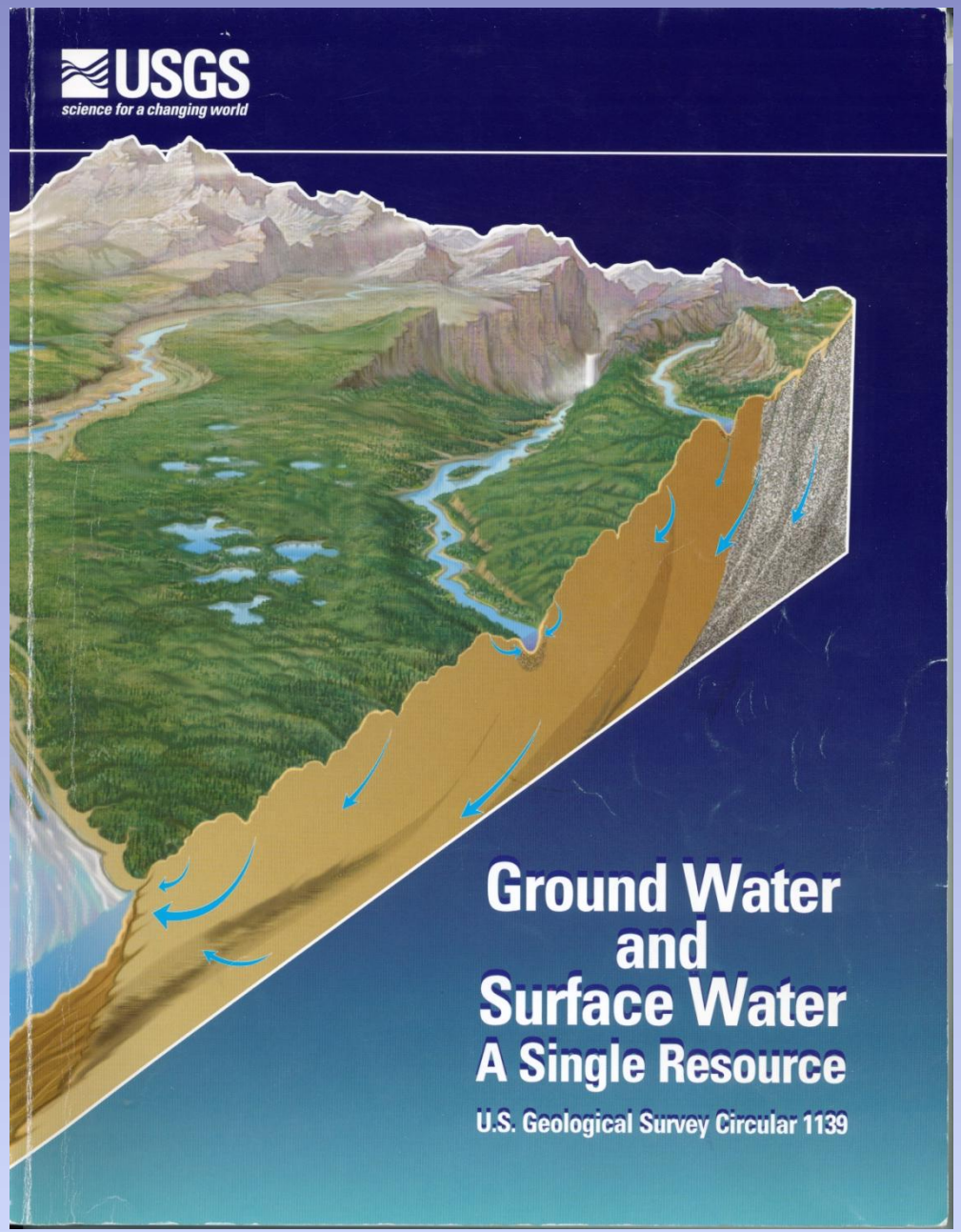
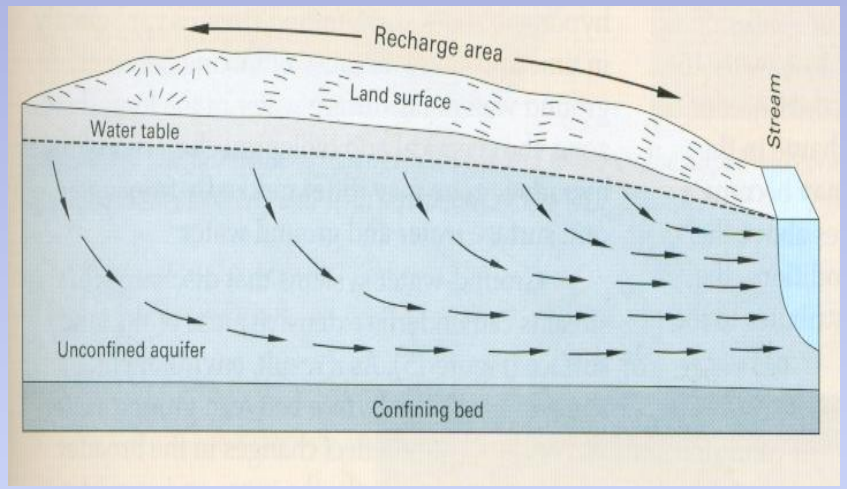


- Flint Creek Return Flow Study *(DNRC 1997)*
- NF Blackfoot River Hydrologic Study *(DNRC 2001)*
- Stream and Fluvial Plain Ground Water Interactions *(Woessner 2000)*



Increase in yield = increase in Consumptive Use (ET)

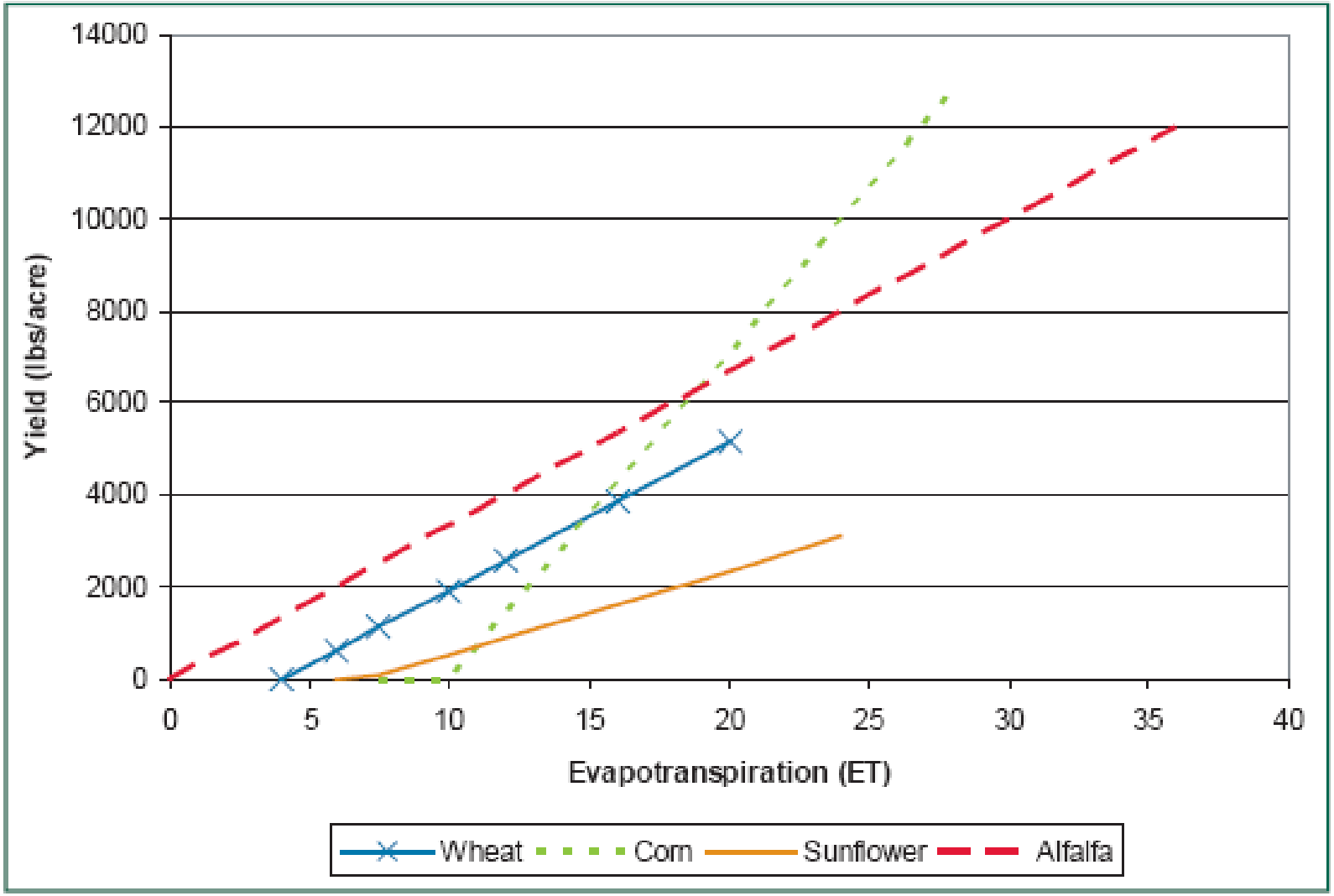
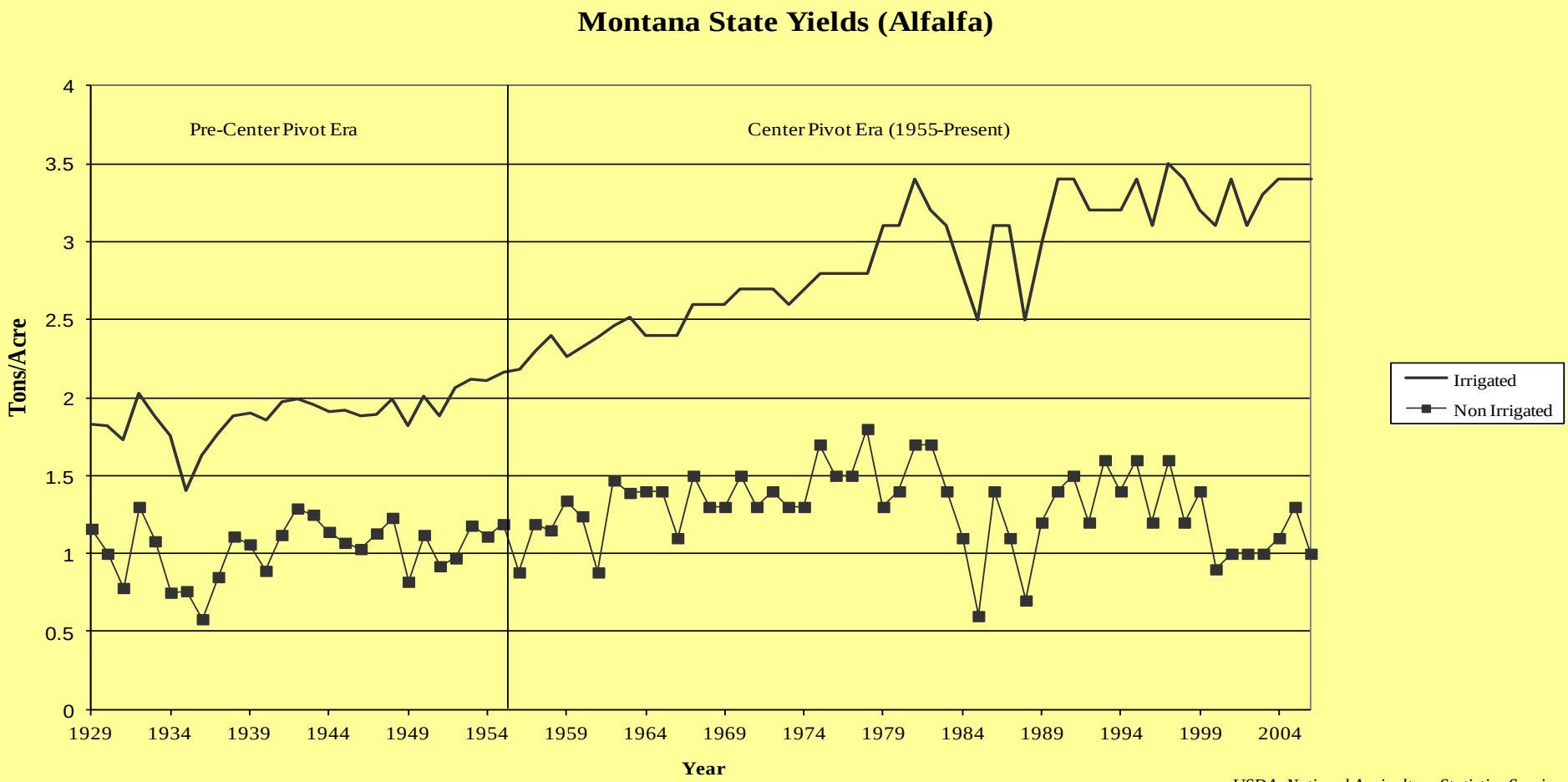


Figure 1. Crop yield and seasonal evapotranspiration relationships.

From: Agronomy News, Colorado State University Extension, April 2007, Volume 26

Production in Montana



USDA, National Agriculture Statistics Service
Montana Field Office

Note: Better management practices
Fertilizers

What typically happens when a flooded field is converted to sprinkler?

1997

Photos courtesy of Scott Irvin

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2005

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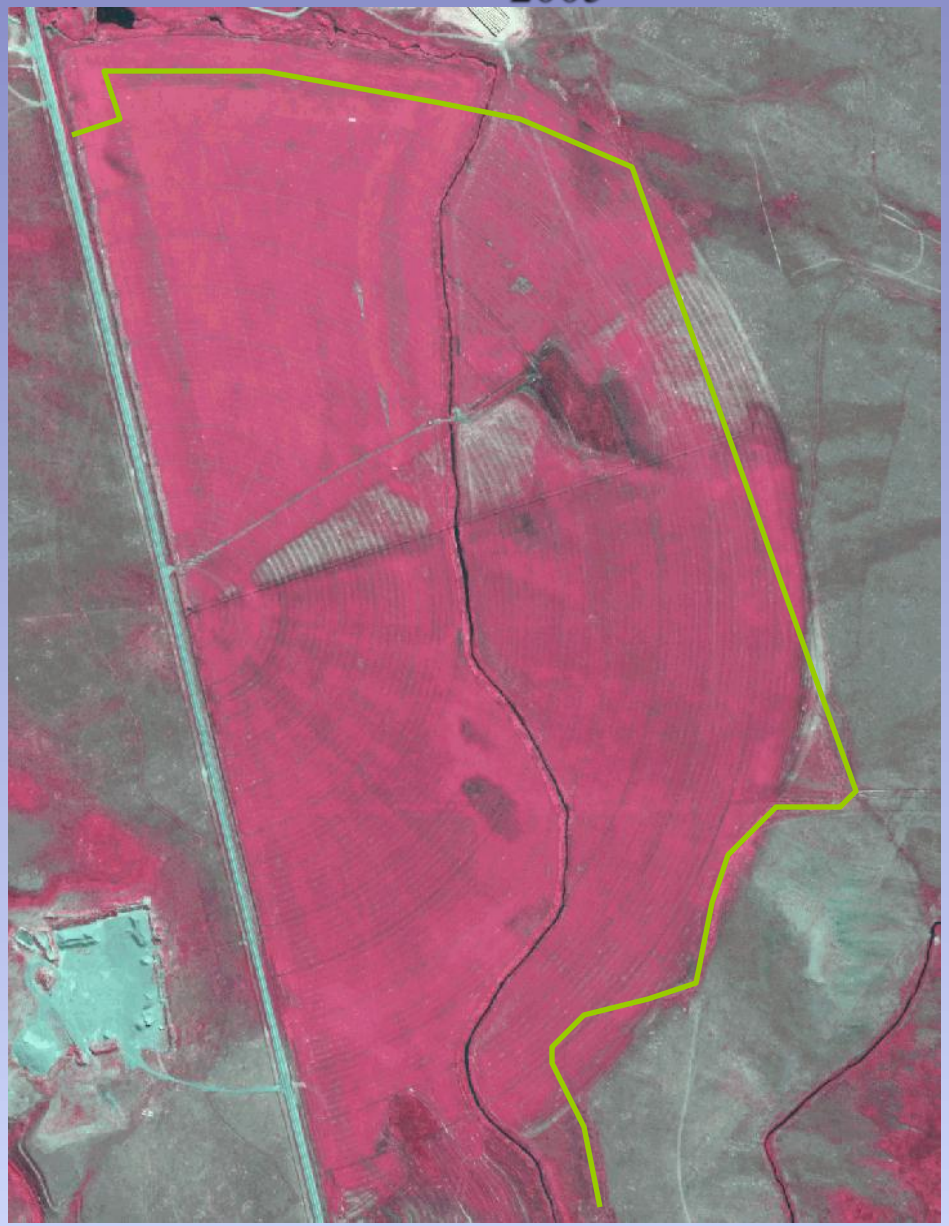
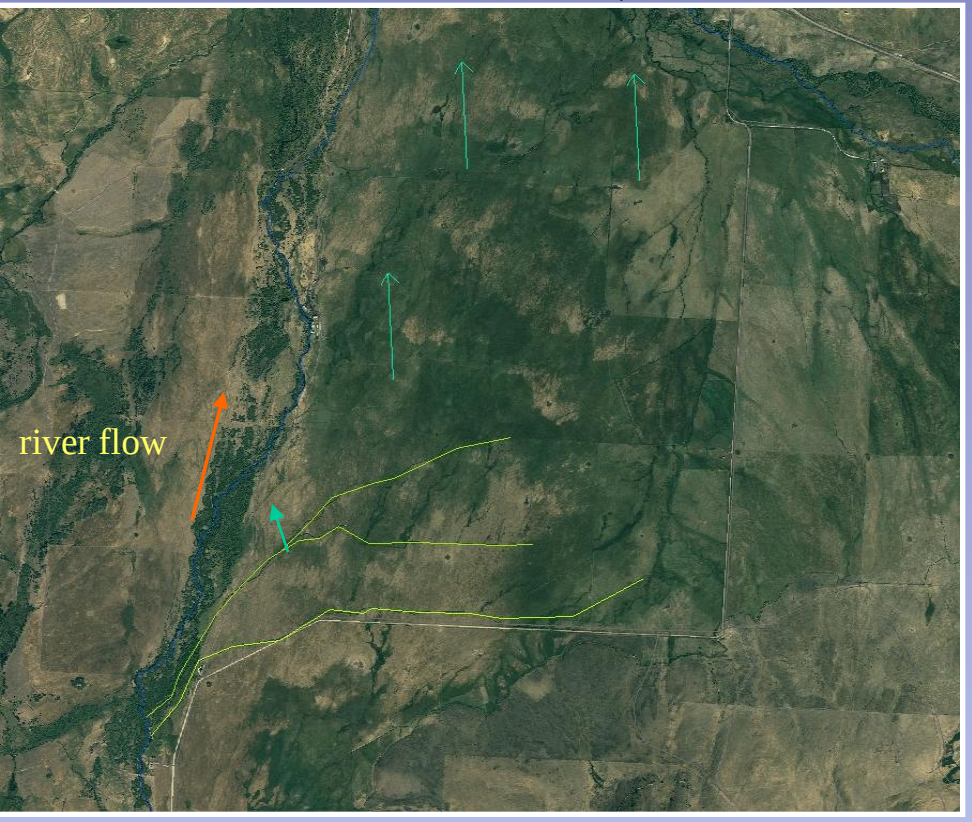


Photos courtesy of Scott Irvin

System Efficiencies

(% diverted that is used by the crop)



Flood irrigation = 15 to 60% efficient

↓

Need to divert more water
Requires higher stream flows
Increases groundwater storage and
results in more return flow

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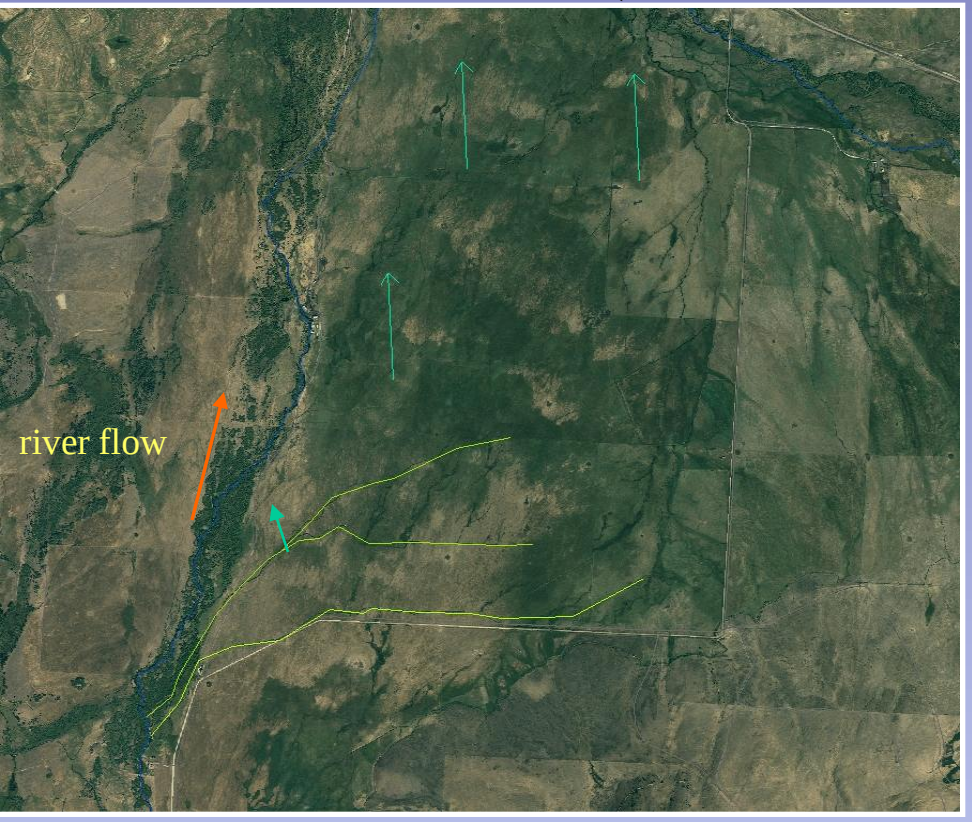

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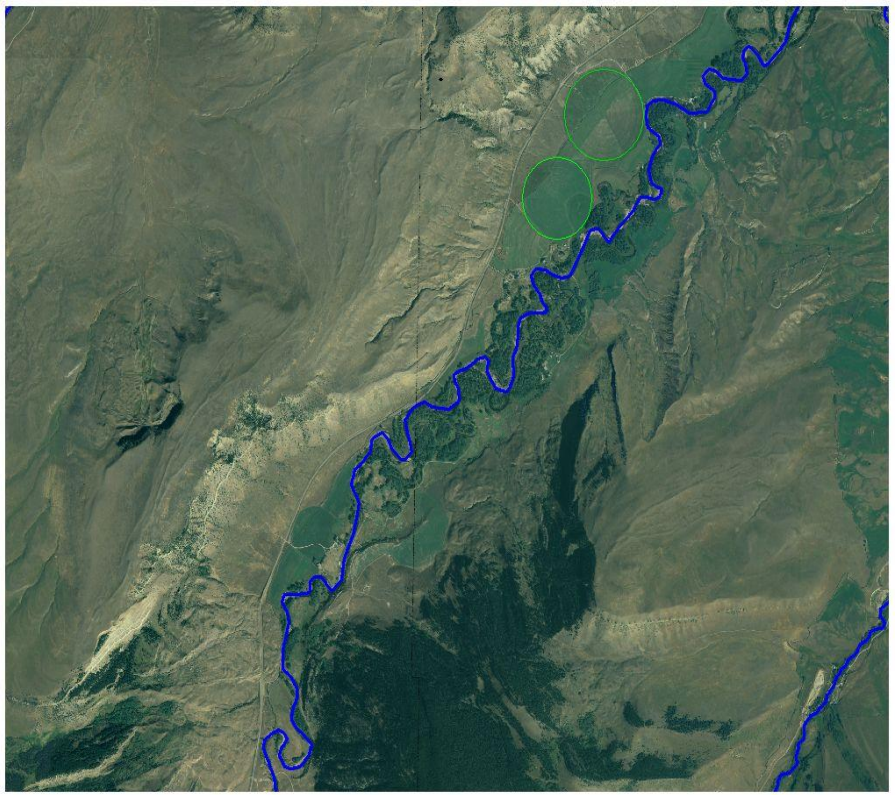
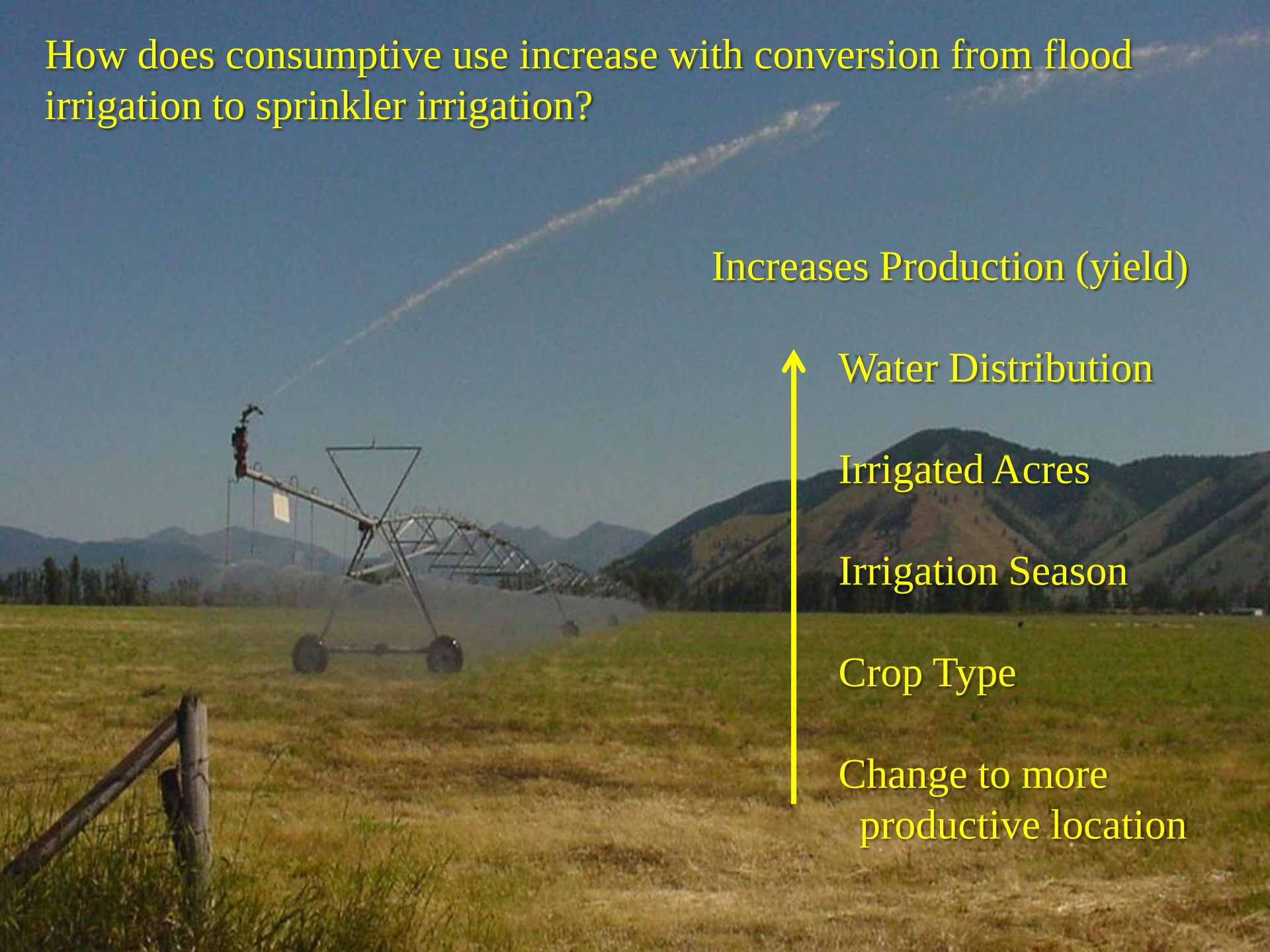


Sprinkler irrigation = 60 to 85% efficient

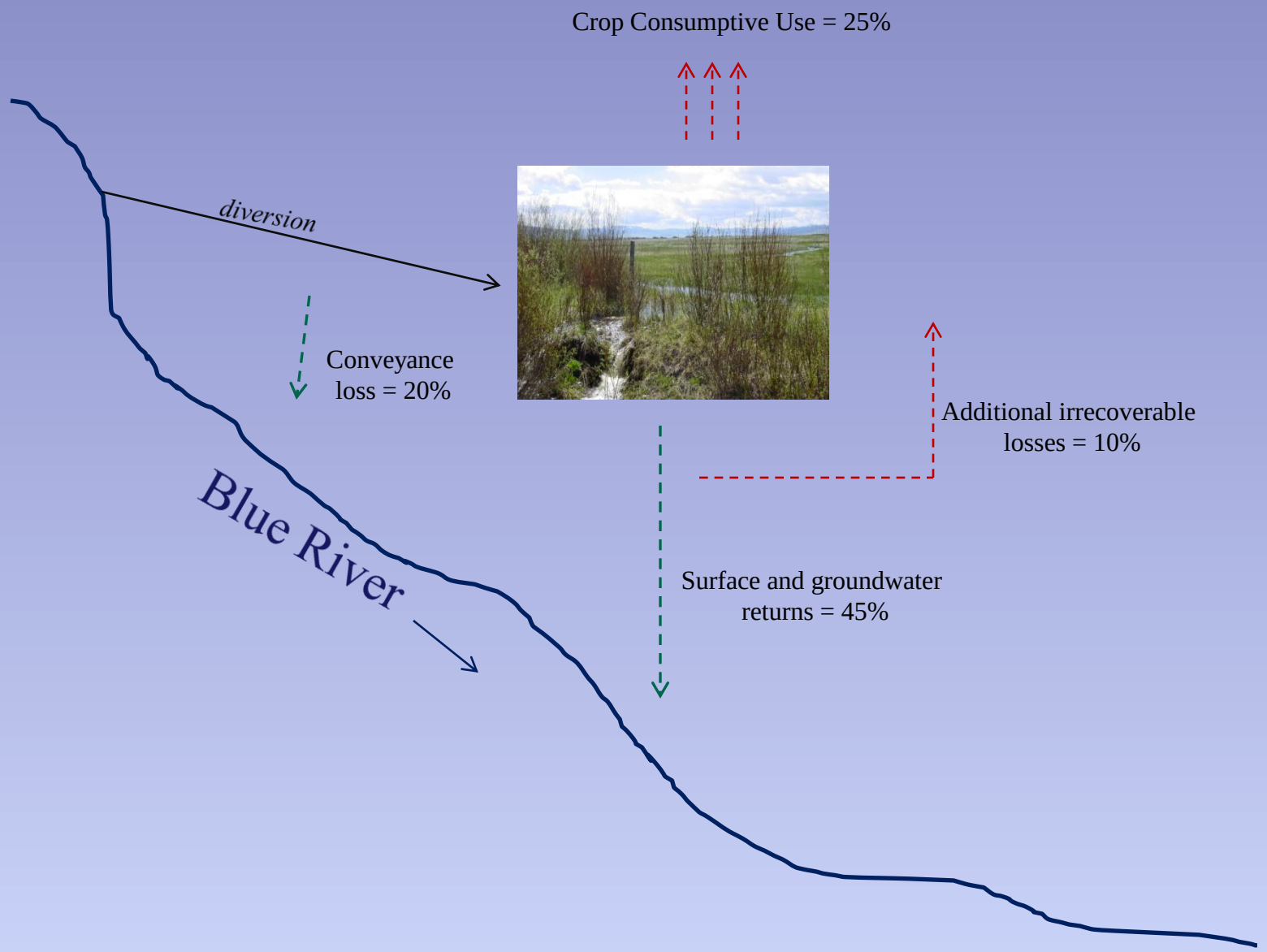
↓

Need to divert less water
Less instream flow needed to divert
Less groundwater storage and return flow


How does consumptive use increase with conversion from flood irrigation to sprinkler irrigation?
Increases Production (yield)
Water Distribution
Irrigated Acres
Irrigation Season
Crop Type
Change to more productive location

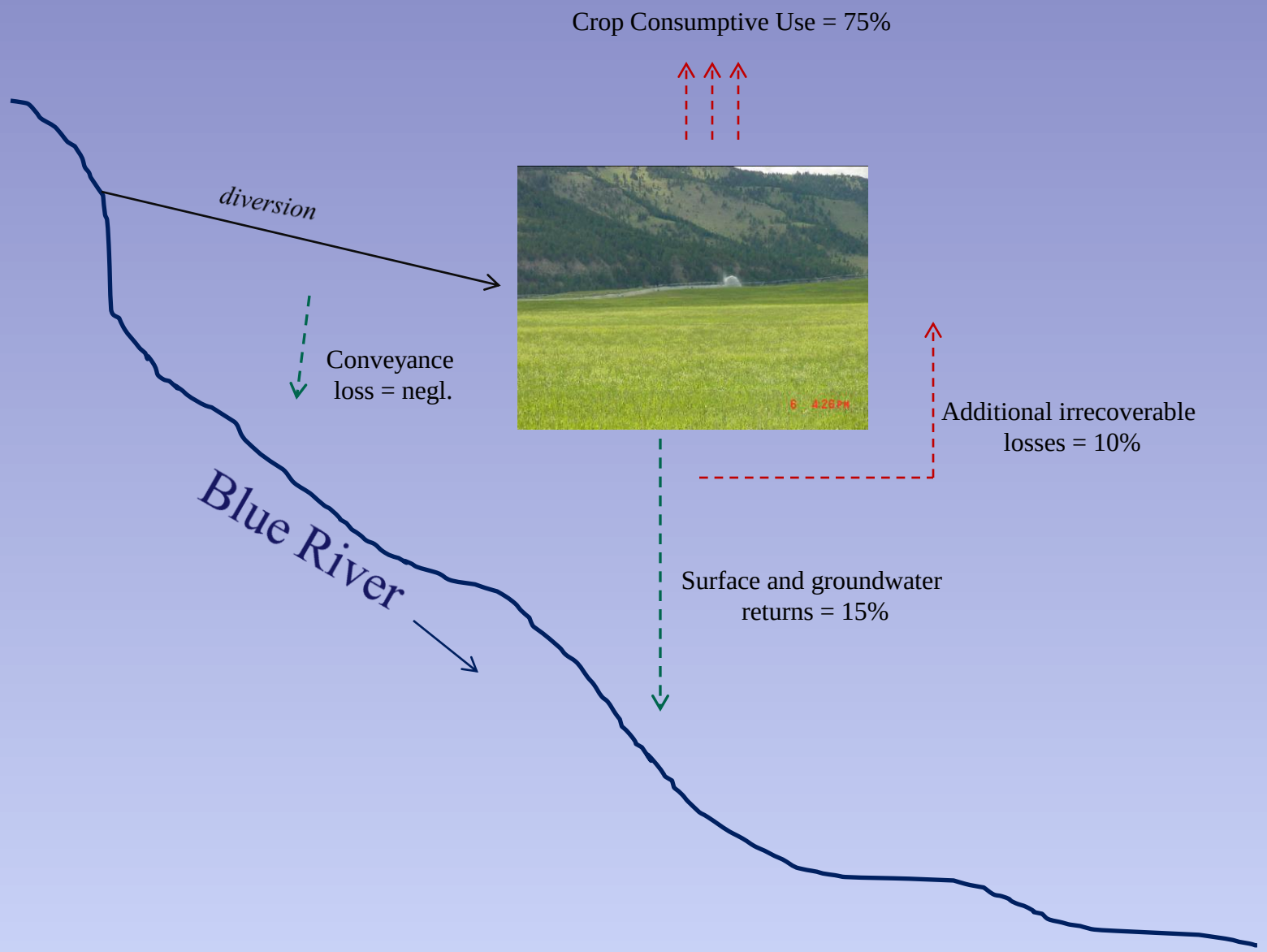
Typical Flood Irrigation

(percentages relative to diverted amount)

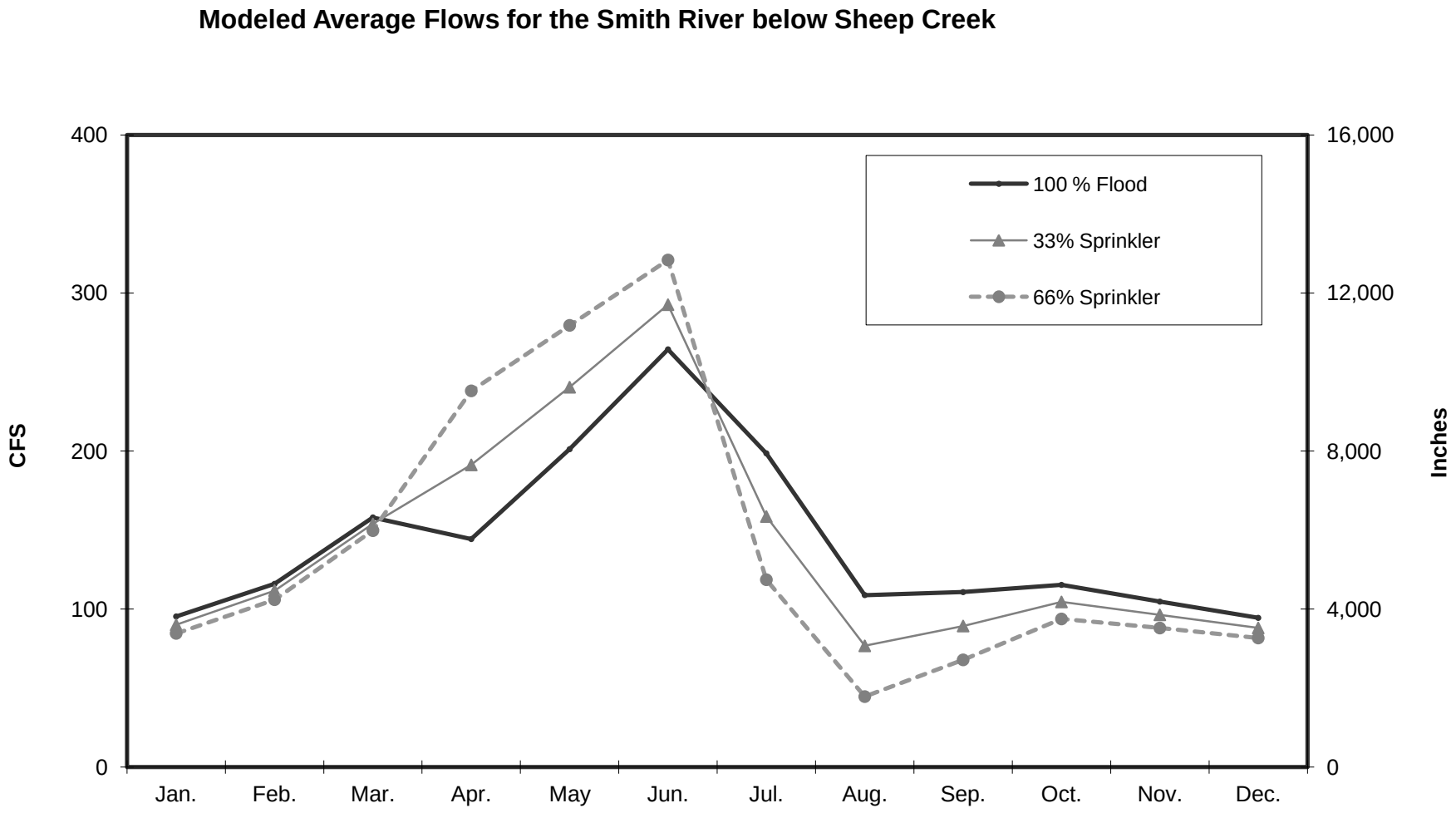


Typical Sprinkler Irrigation

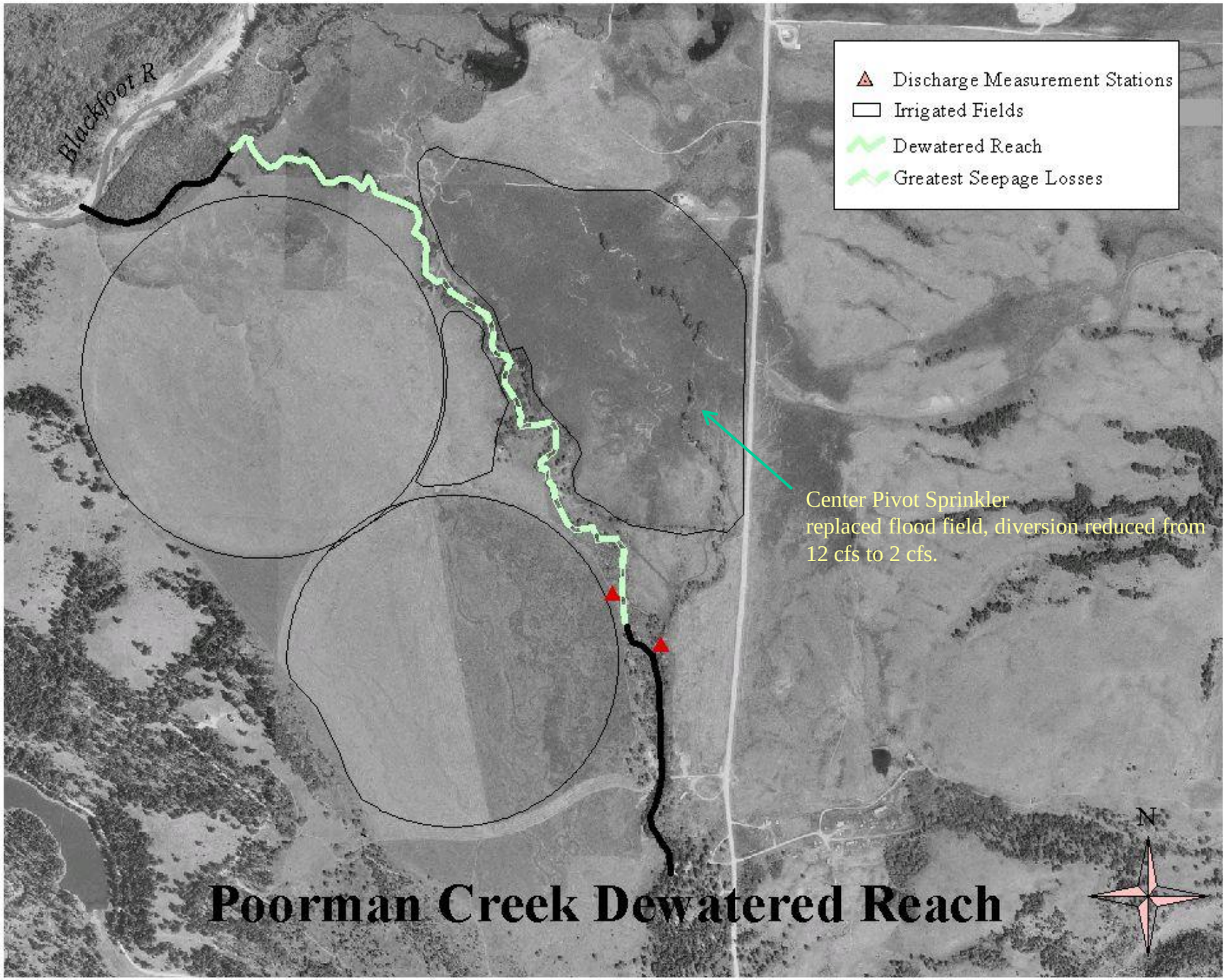
(percentages relative to diverted amount)



Case Studies



(*Source:* DNRC Smith River Basin Permit and Change Applications Supplemental Environmental Assessment, 2002)


Blackfoot R
Discharge Measurement Stations
Irrigated Fields
Dewatered Reach
Greatest Seepage Losses
Center Pivot Sprinkler
replaced flood field, diversion reduced from
12 cfs to 2 cfs.
N
Poorman Creek Dewatered Reach

Potential Advantages

Increases production (especially on non-level field)
Decrease labor costs
Decrease Ag chemical application
Water quality improvements (saline seep)
Fisheries (spring spawning)
Instream water quantity increases (early season)
- channel maintenance

Potential Disadvantages

Instream water quantity reductions
Downstream producers and well users water availability reduced or eliminated.
Fisheries (fall spawning, WQ, etc.)
Water Quality (increased temperatures)
Increase power costs

NF Blackfoot River

Management Objective

Potential Advantages

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Potential Disadvantages

Less Groundwater Storage
Decreased late season flows
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Water Quality (increased temperatures)
Increased power costs

NF Blackfoot River

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NF Blackfoot River

Depends on
Management Objective

Key Points on Water Supply

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- Can be site-specific, it’s not simple, lots of variables