Conversion of irrigated agricultural land in eastern Idaho to non-agricultural uses: *consequences for water management and hydrology*

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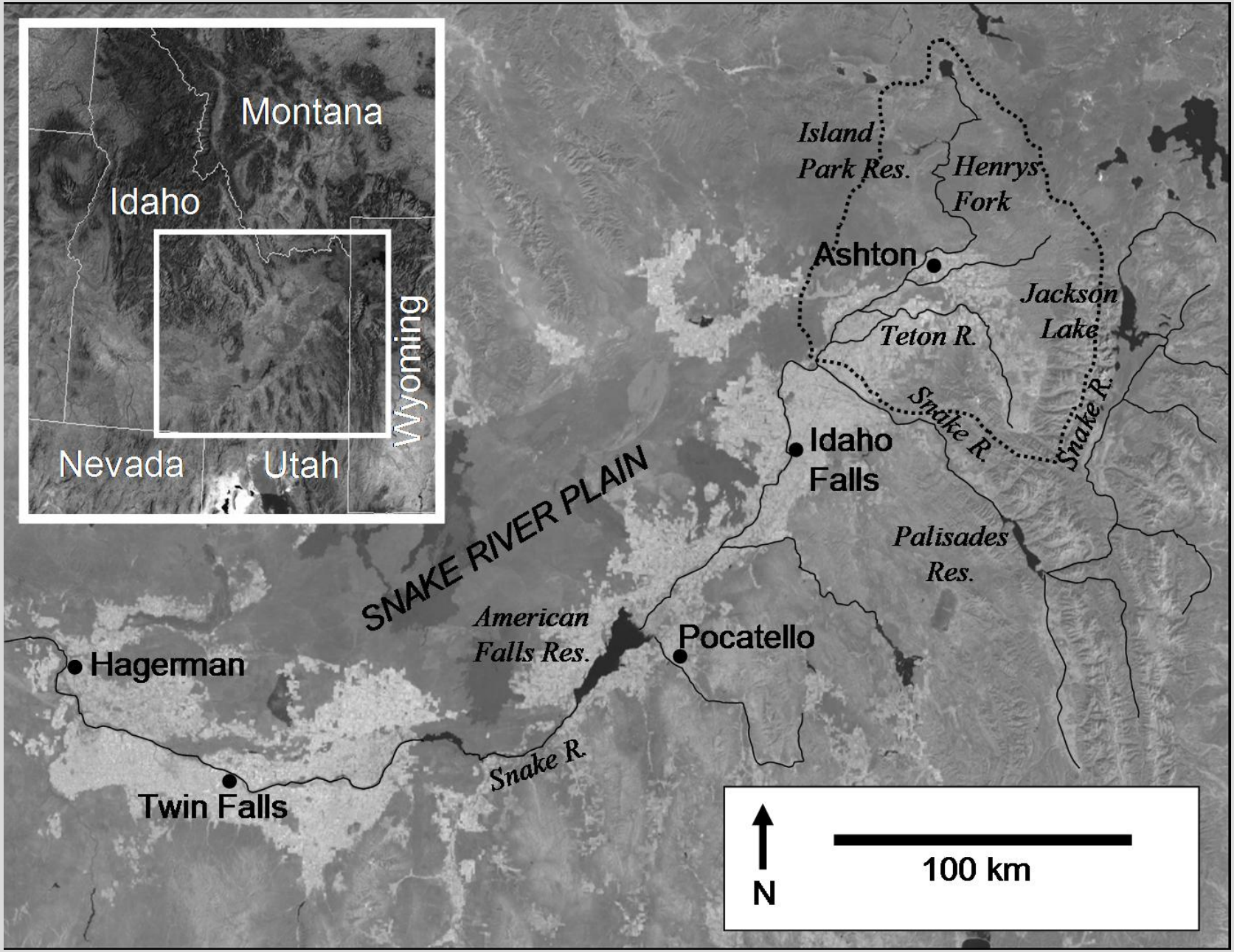
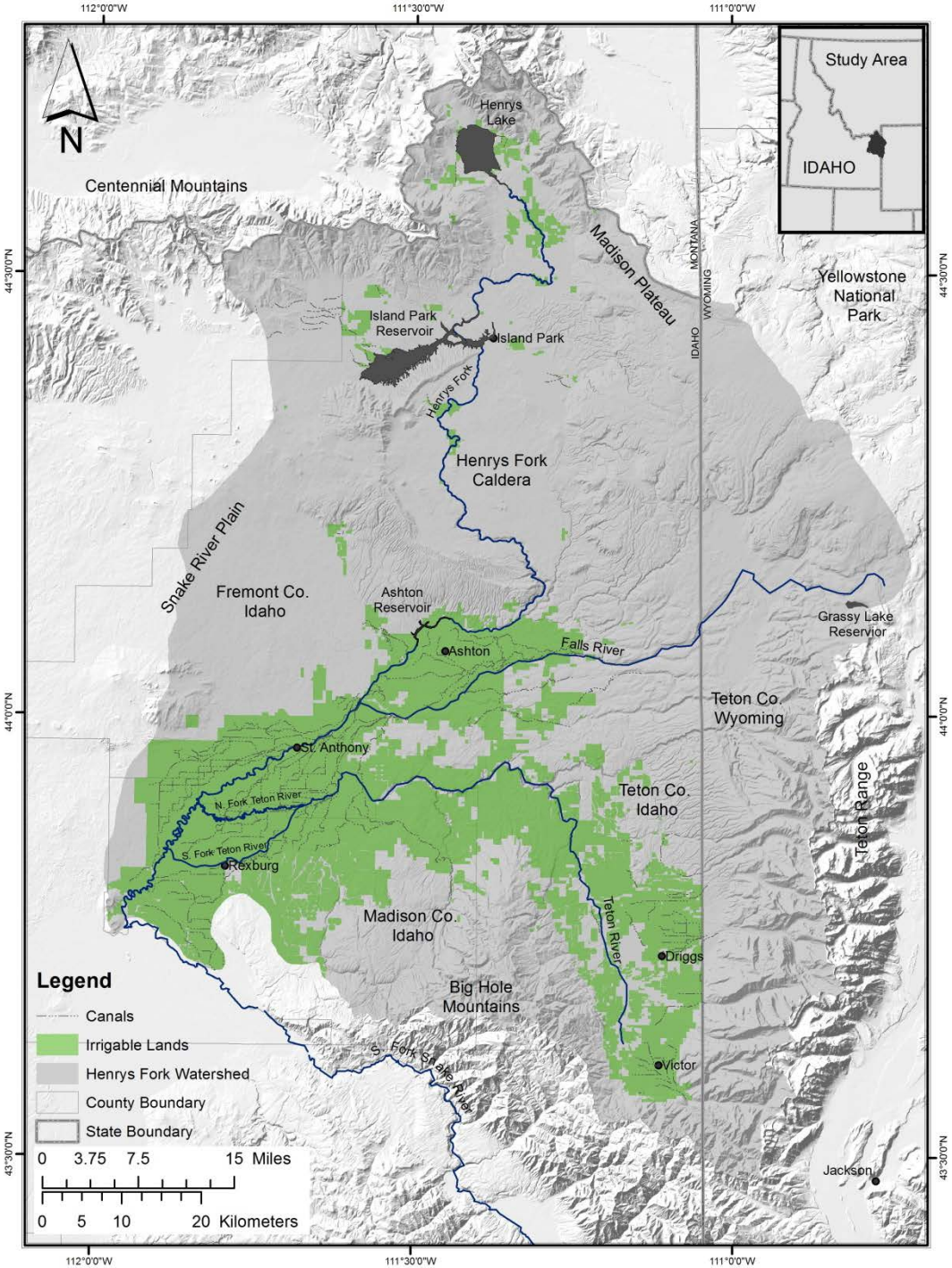
Outline

- Study area
- Objectives
- Methods
- Results
- Conclusions
- Outreach
- State policies

Study watershed: Henry's Fork Snake River, Idaho and Wyoming





- Area: 3,250 sq. mi
- Mean ann. precip.: 28.2 in.
- Min. elevation: 4,820 ft.
- Max. elevation: 11,400 ft.
- Forested area: 36.7%
- Agricultural land: 20.9%
- Urban land cover: 1.5%

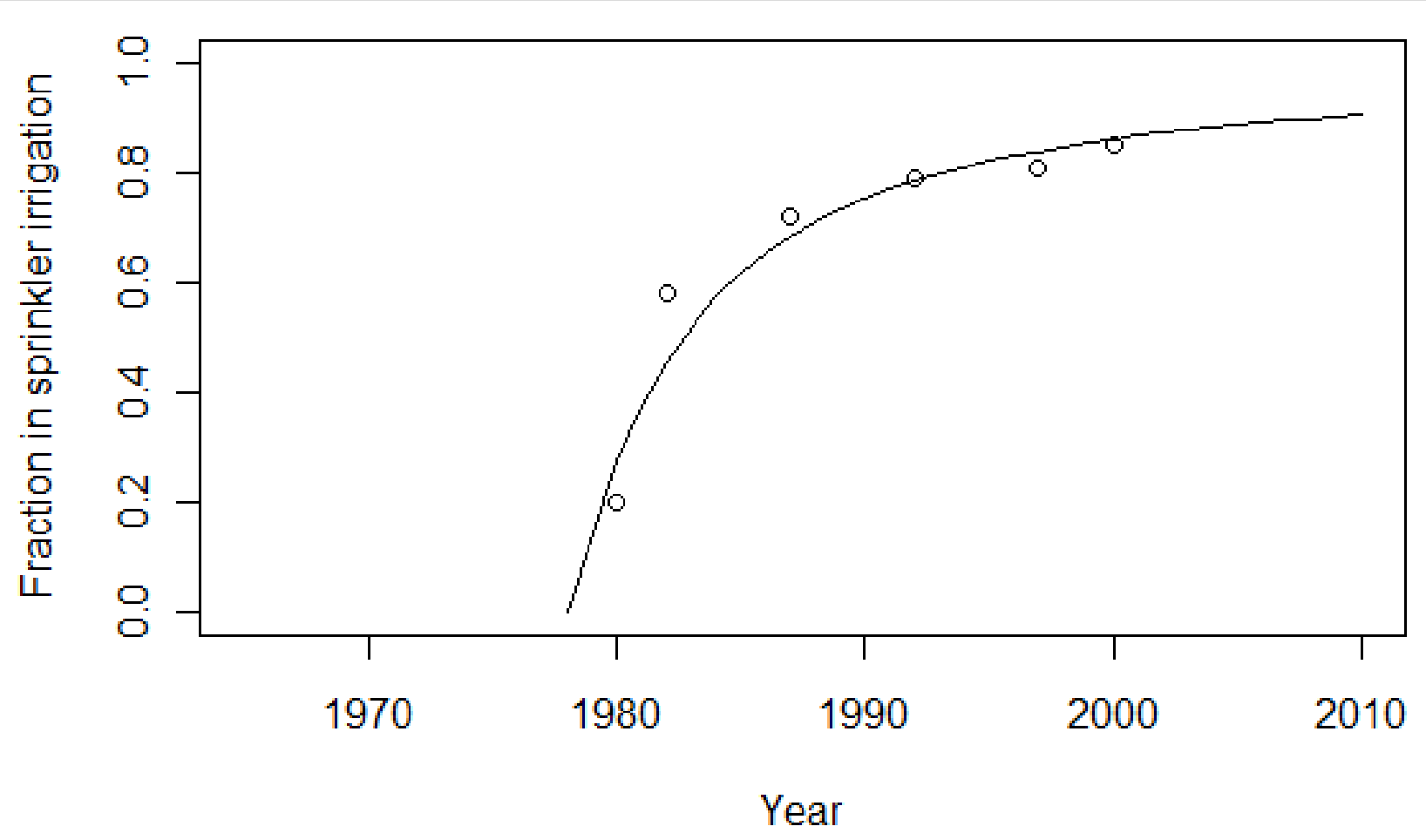
- 450,000 acres with irrigation water rights
- 250,000 acres in Fremont-Madison Irrigation District (irrigated with surface water)
- Primary crops: small grains, potatoes, hay, pasture, oilseeds
- 40 major canal systems with 450 miles of canals

<u>Storage Reservoirs</u>

- Henrys Lake: 90,000 a-f
- Island Park Res.: 135,000 a-f
- Grassy Lake: 15,000 a-f

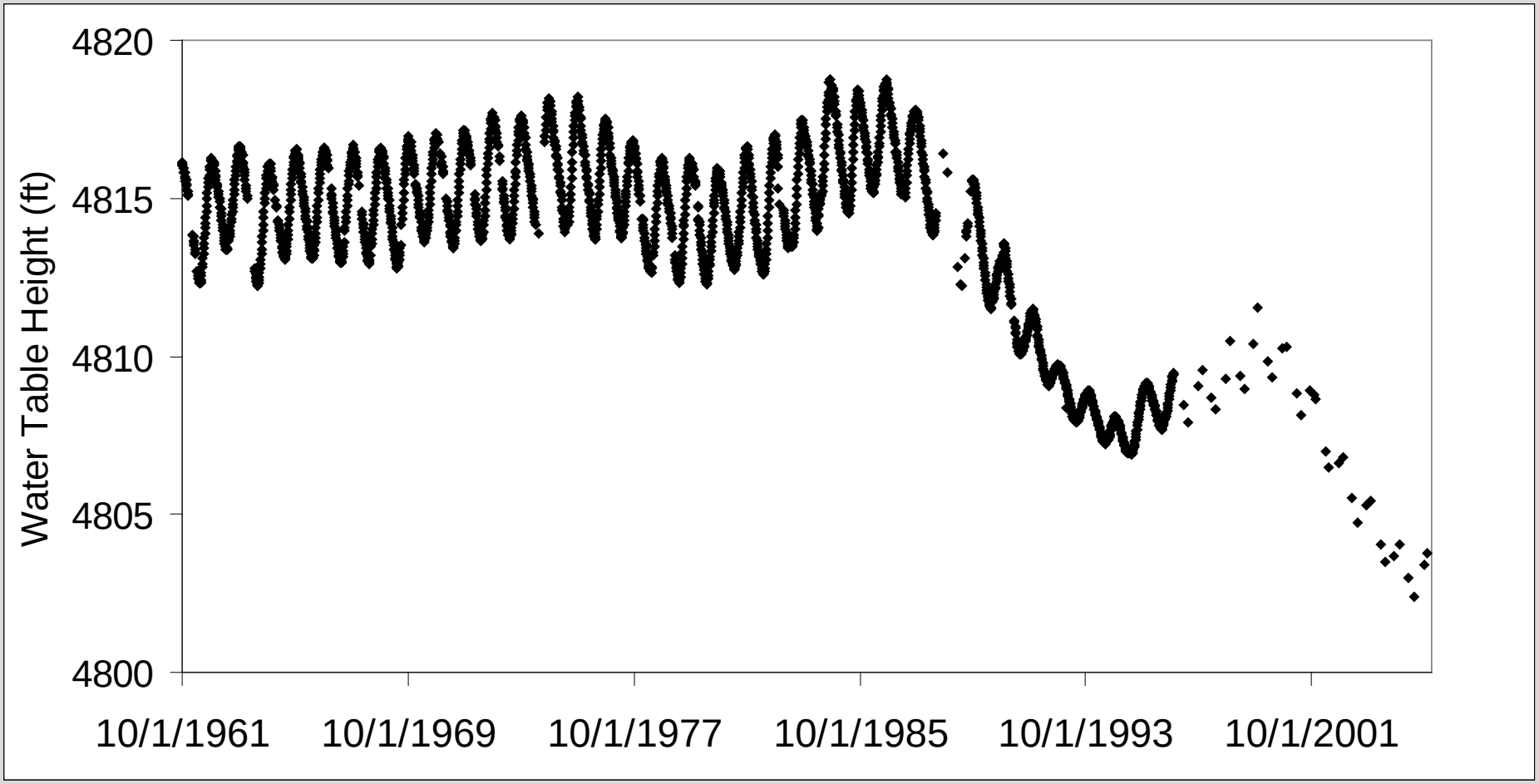
Irrigation water management

Conversion from flood to sprinkler irrigation

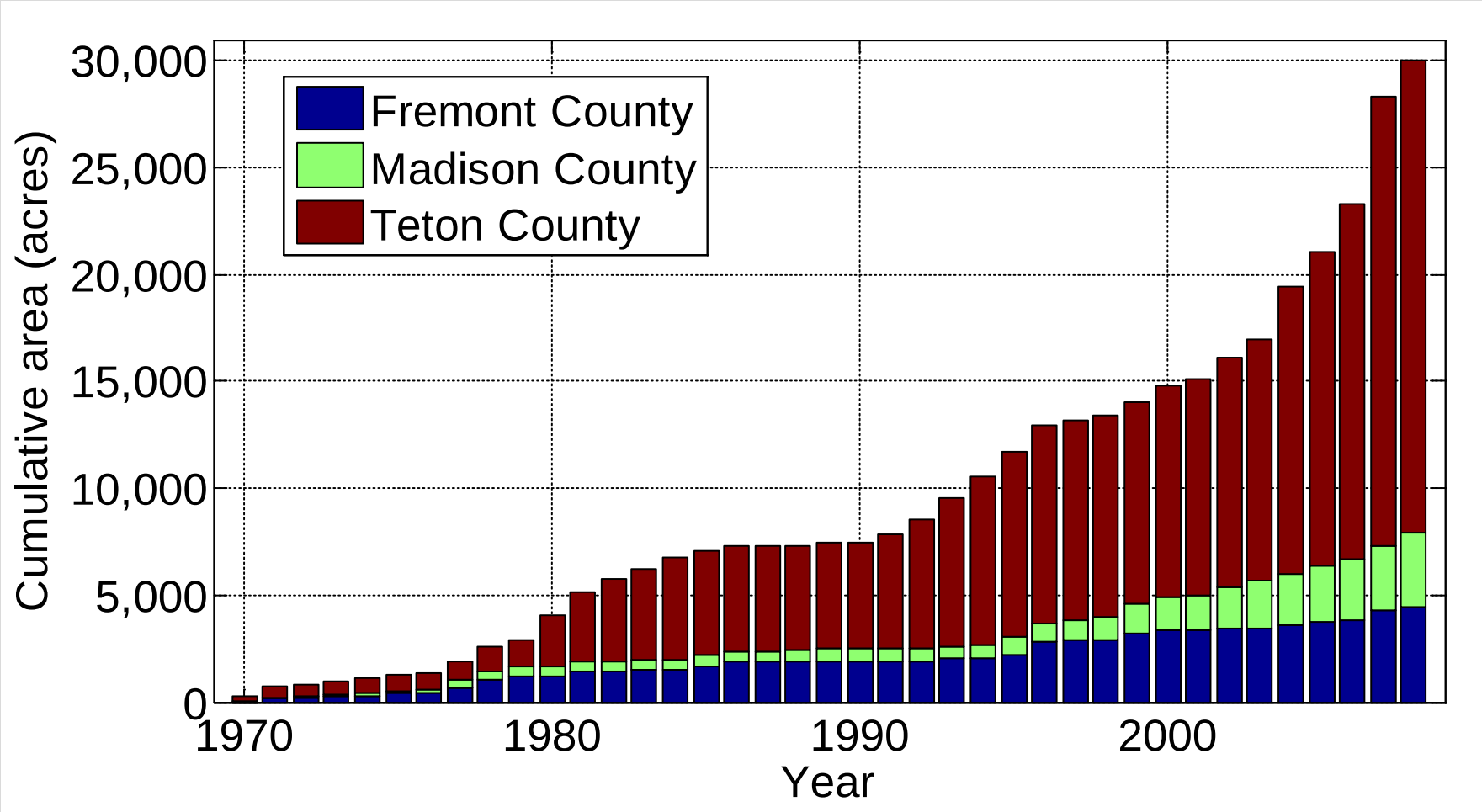


But, almost all conveyance still occurs in unlined canals. Groundwater pumping provides small fraction of irrigation in Henry's Fork watershed.

Observed well level in irrigated area



Conversion of land use from agriculture to non-agriculture



Cumulative area of subdivisions platted in agricultural areas

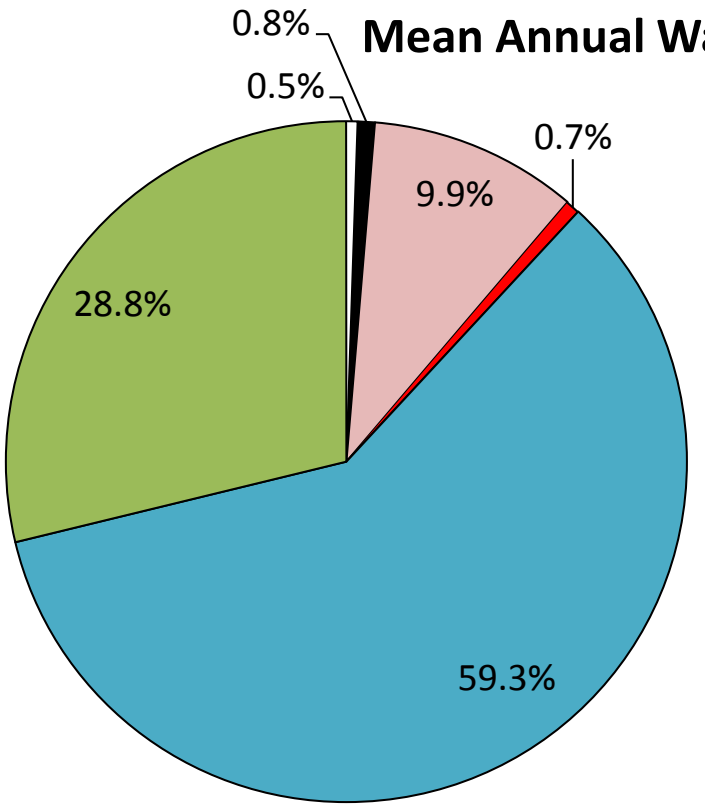
Objectives

1. Model ground- and surface-water flow under historic, current and future land/water use scenarios.
2. Identify factors that determine water use on formerly irrigated land.
3. Develop strategies to increase water availability for agriculture while enhancing ecological benefits.
4. Provide information on hydrology and water use to decision-makers and stakeholders.

Methods

- Spatial analysis of land use, canal system, water rights
- Field measurements of canal and stream channel losses/gains
- Groundwater-surface water modeling
- Statistical analysis of water use
- Interviews with water users/stakeholders and managers/planners
- Review, guidance, and endorsement from Henry's Fork Watershed Council from proposal through outreach stages (4 years)

Results: Water budget for HF Watershed

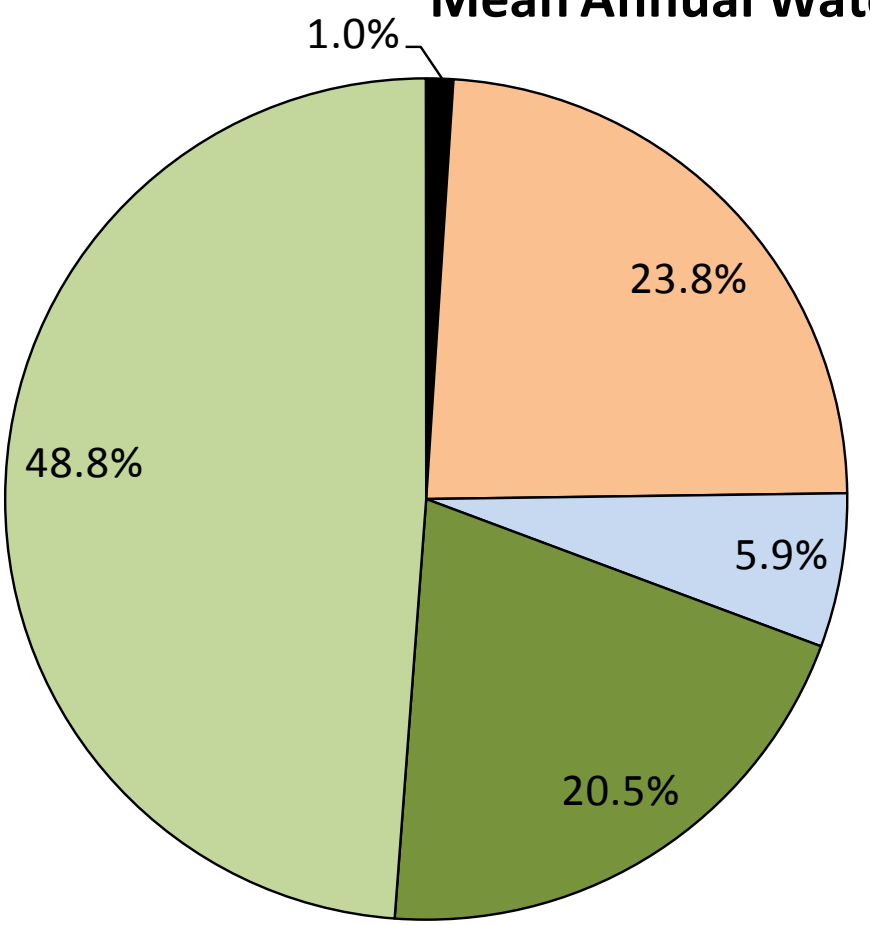


Mean Annual Water Budget for Surface and Shallow GW System

- Domestic, commercial, industrial use: 14,766 a-f
- Reservoir, canal, sprinkler evaporation: 22,929 a-f
- Crop ET supplied by surface irrigation: 278,076 a-f
- Crop ET supplied by shallow GW irrig.: 18,680 a-f
- Surface outflow from basin: 1,666,326 a-f
- GW outflow from basin: 809,135 a-f

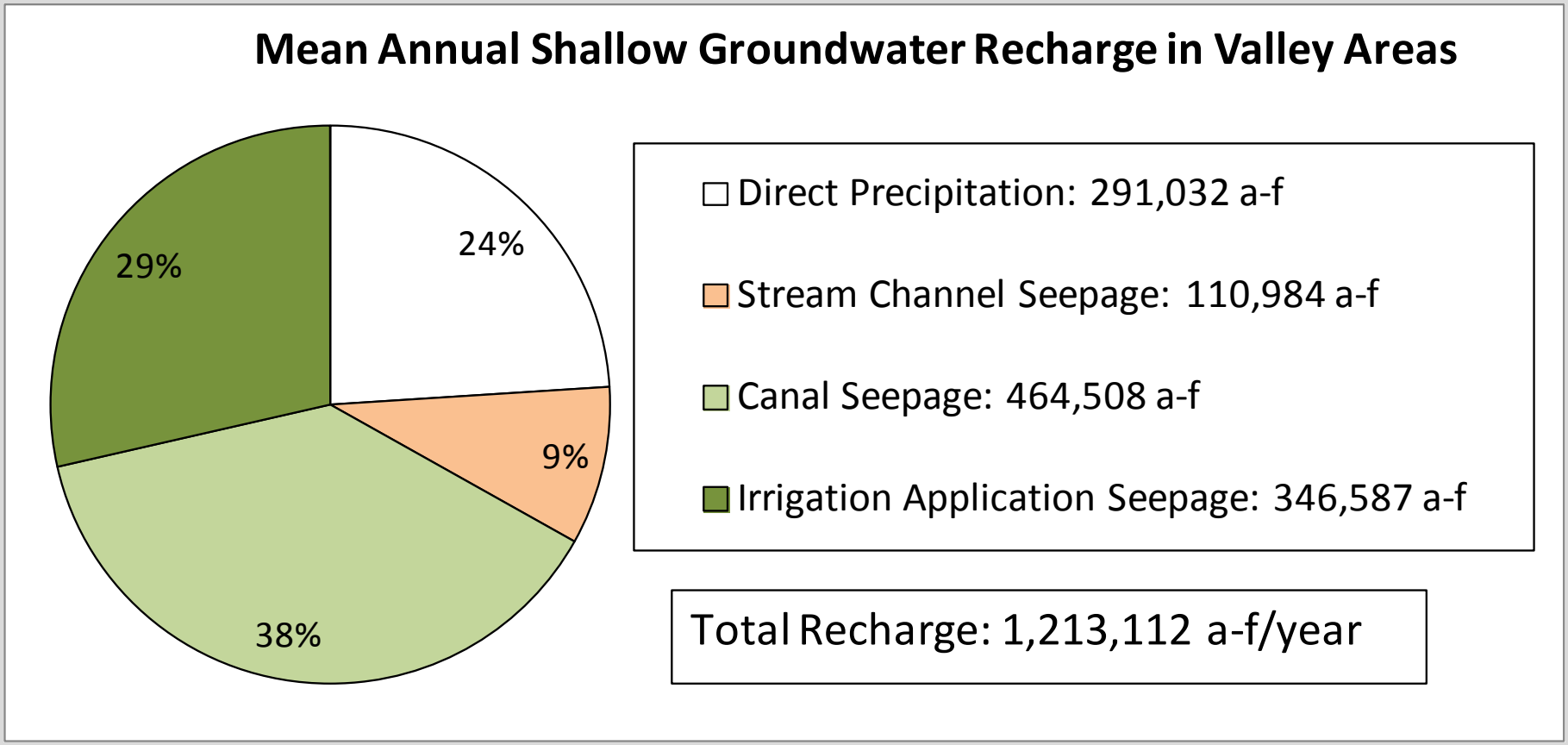
Total Surface/Shallow GW Supply: 2,809,912 a-f/year

Results: Surface irrigation budget

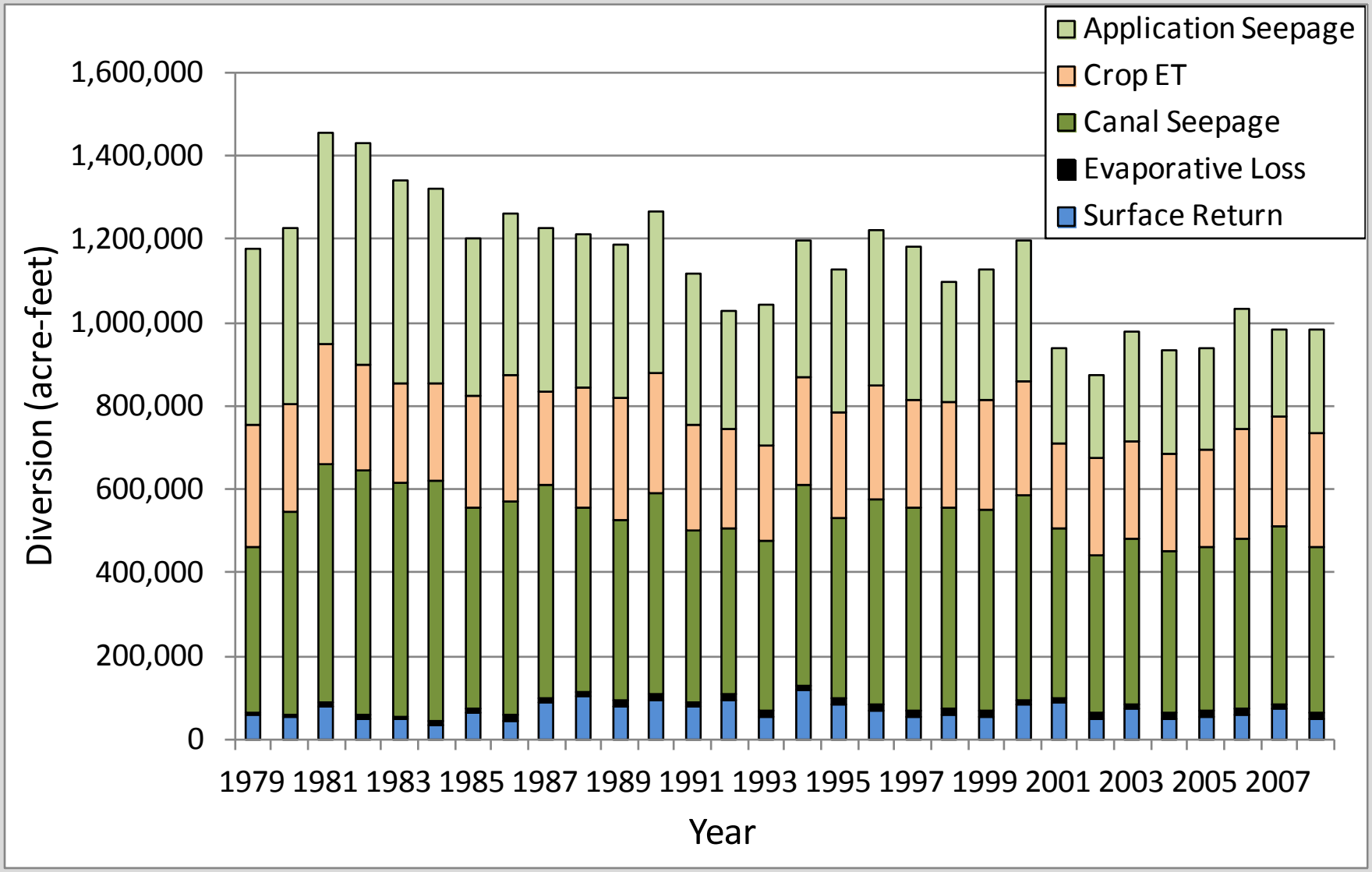


Total diversion: 1,170,045 a-f/year

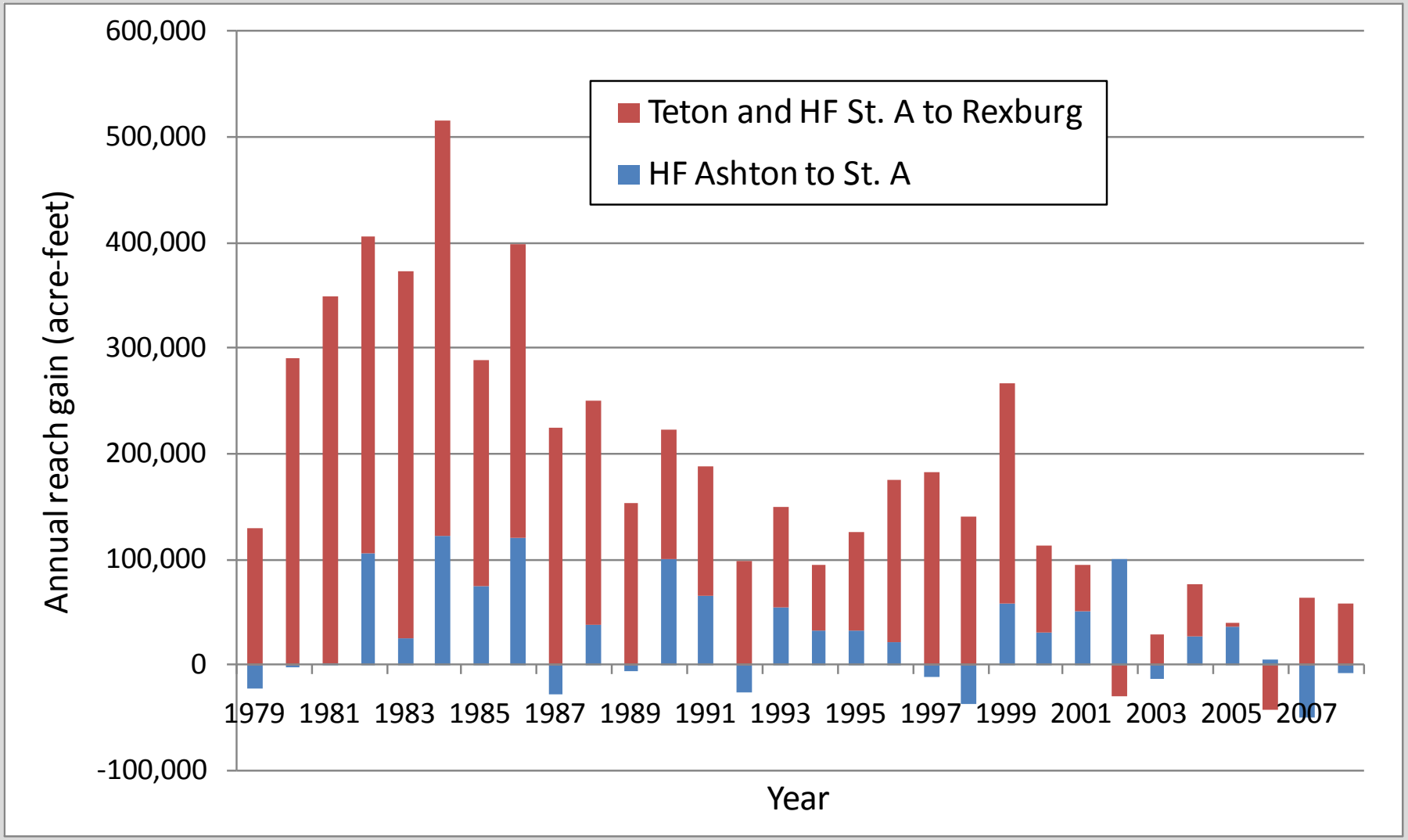
Results: Recharge to shallow aquifers



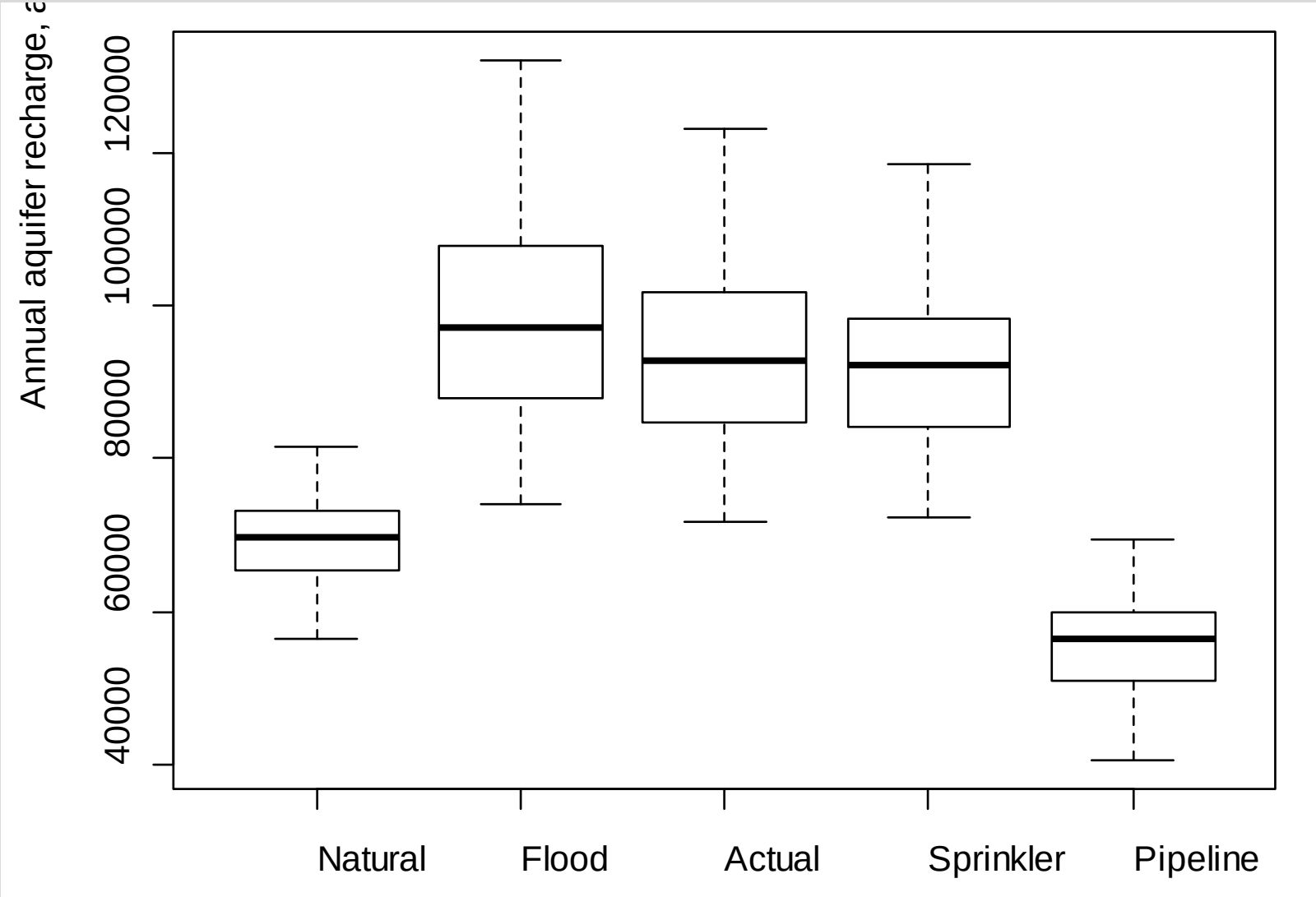
Results: Total Diversion 1979-2008



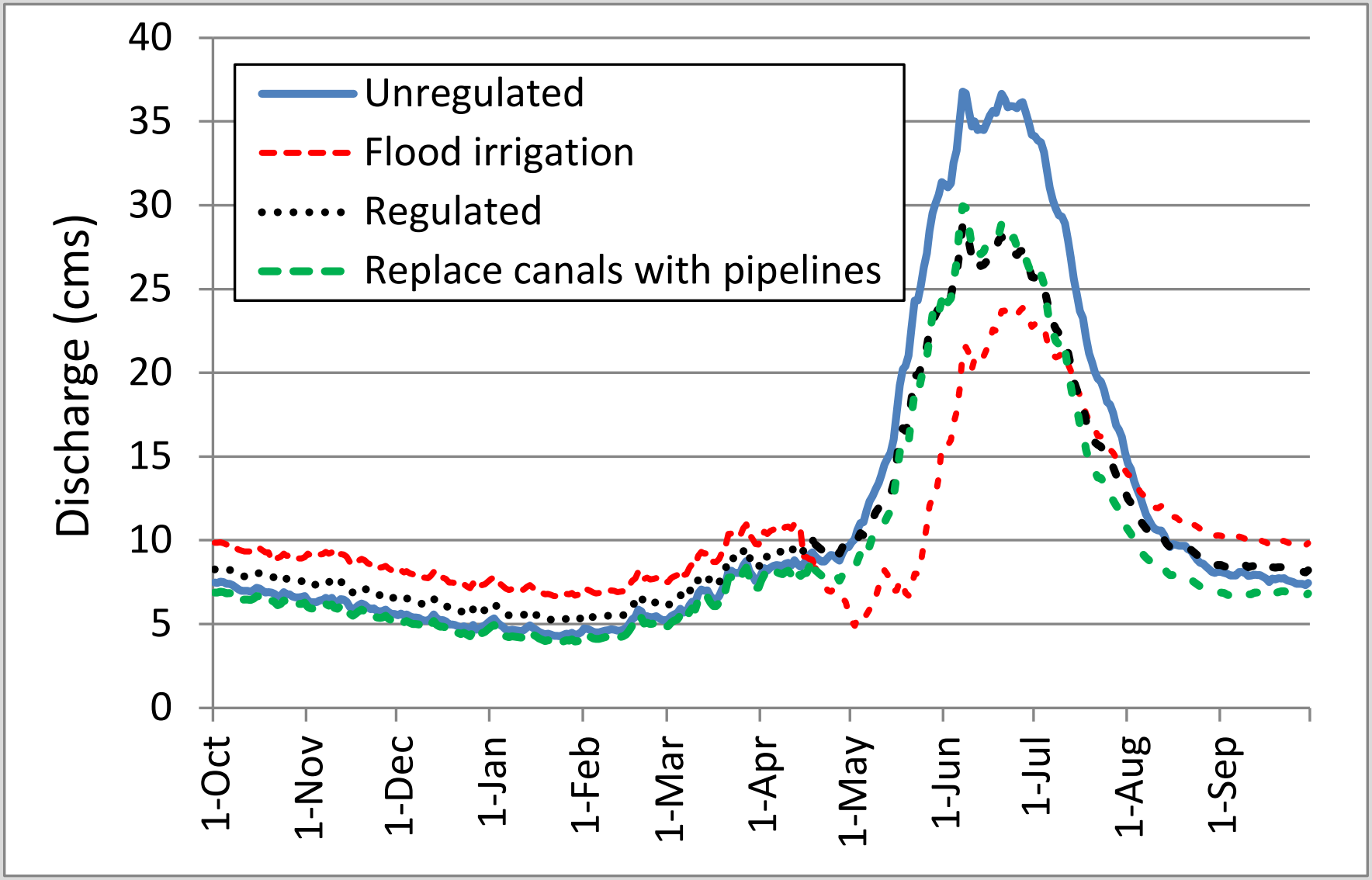
Results: River Reach Gains 1979-2008



GW recharge under modeled scenarios, Teton Valley.

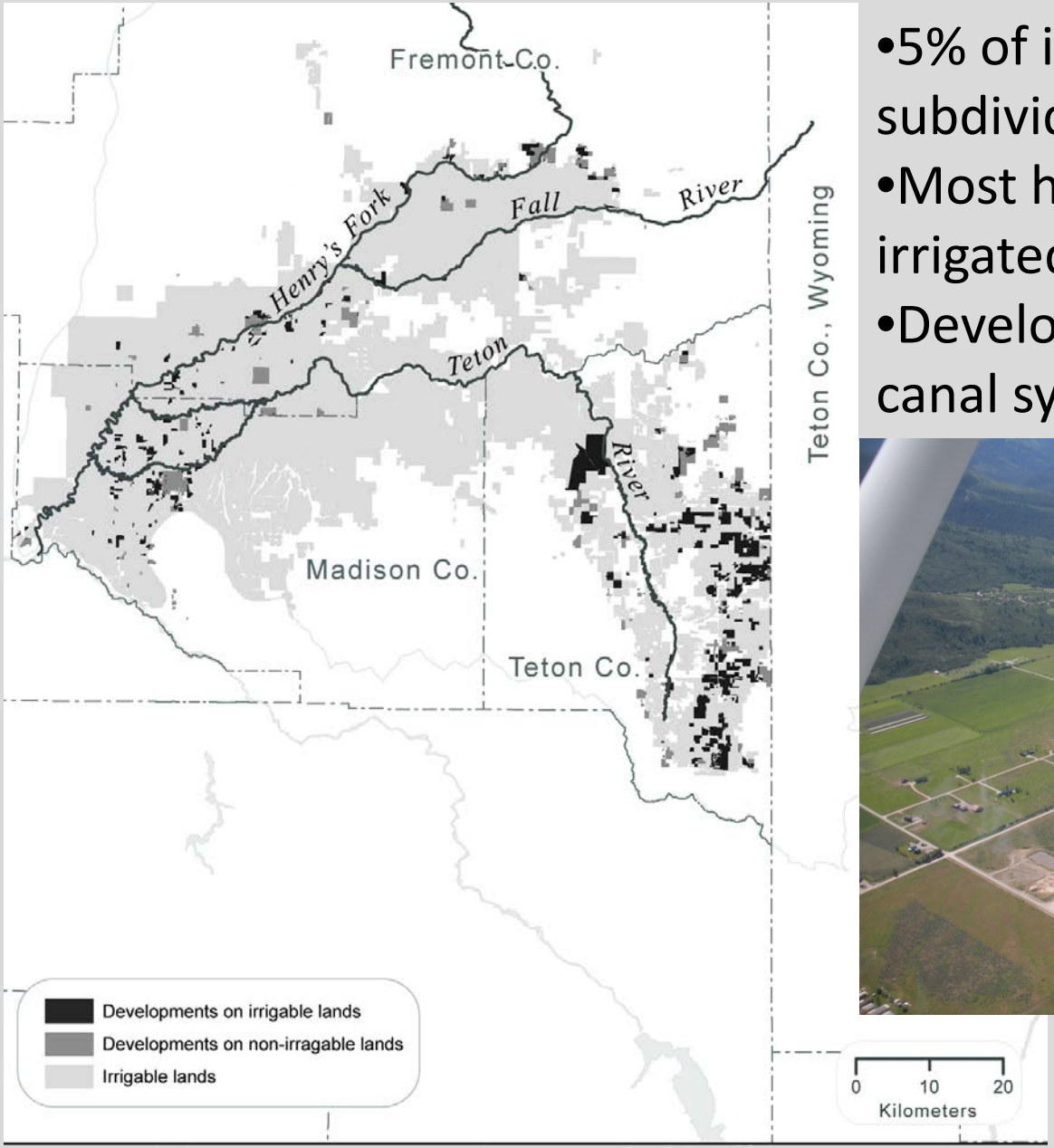


Results: Modeled stream hydrographs



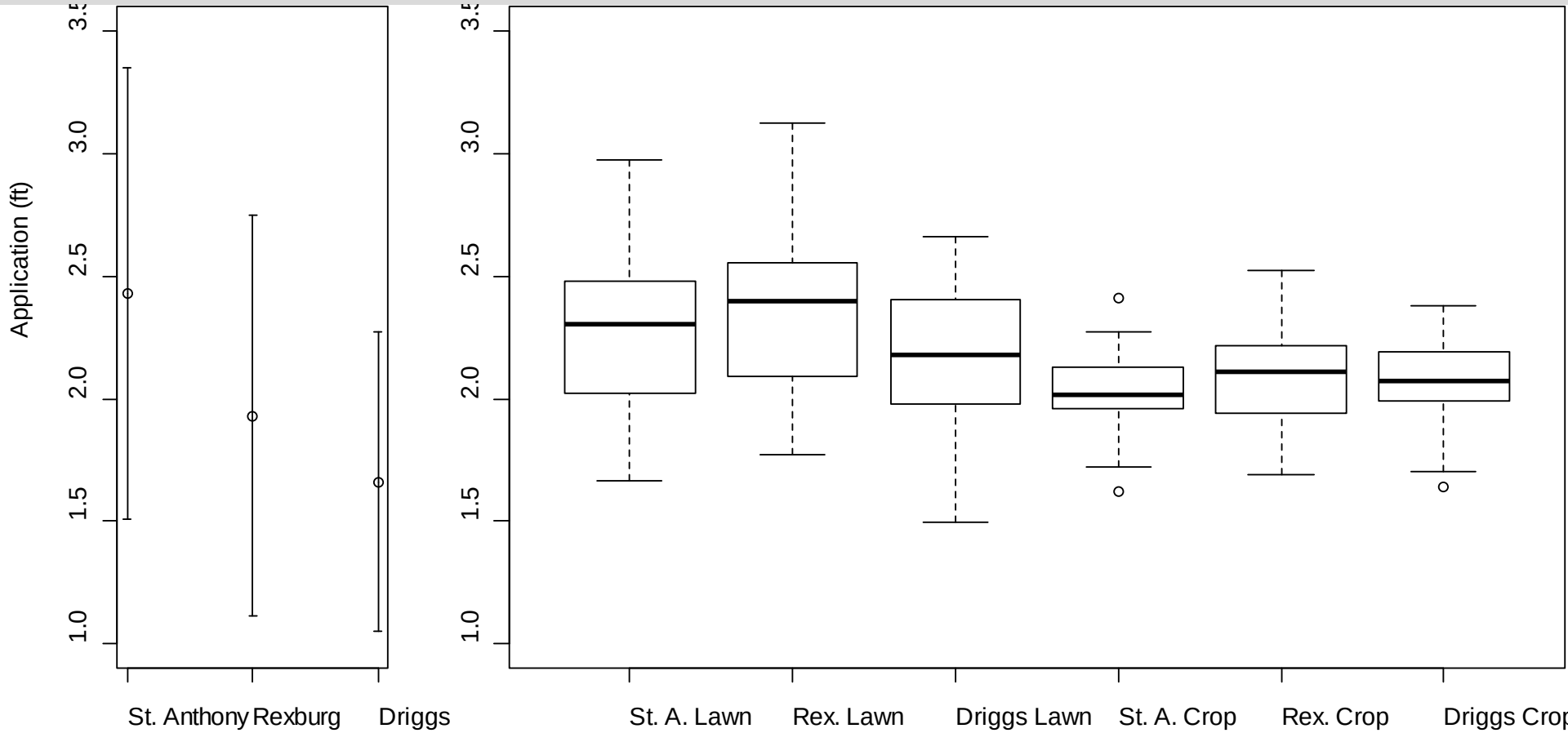
Modeled Teton River hydrographs under different irrigation scenarios

Results: Land Use Conversion



- 5% of irrigable land has been subdivided
- Most has occurred on canal-irrigated land
- Development has fragmented canal systems

Results: growing-season water use



Subdivision use: 95% CI

Growing season net ET, 1979-2008

Conclusion: per-acre consumption in new subdivisions not statistically different from agricultural use or from ET demand

Results: Water use on developed land

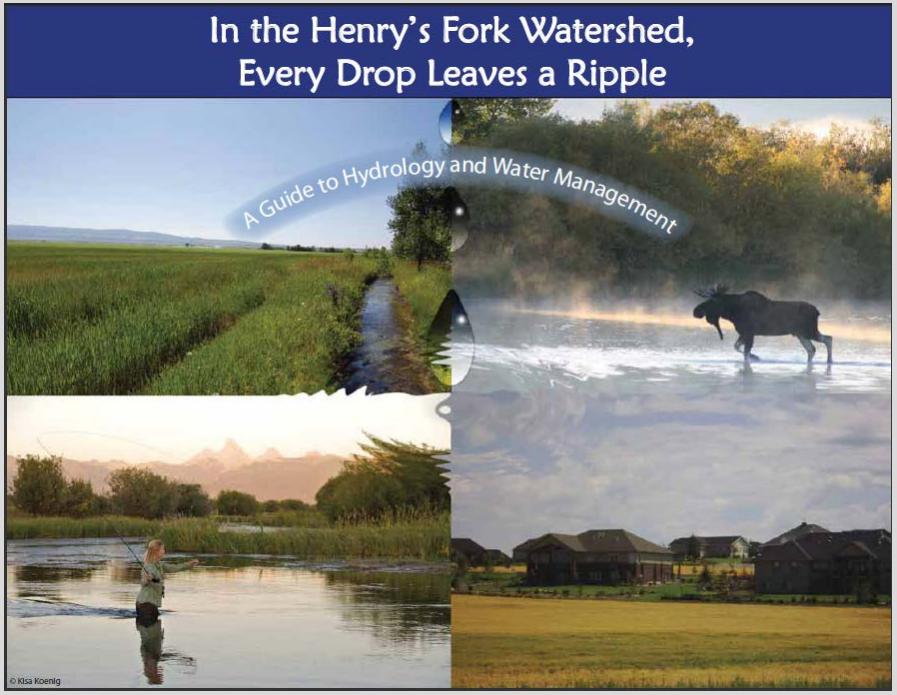
- Surface water rights are not always transferred with land.
- New residents may not know they have surface water shares.
- Developers do not build infrastructure to use existing canal system.
- All developments use groundwater for domestic supply.
- Small farmer-run canal companies not equipped to handle large numbers of new, small-acreage users.
- Developments use more groundwater but recharge less to aquifers than traditional irrigation.

Conclusions

- Traditional irrigation:
  - consumptively uses relatively little water
  - is largest source of aquifer recharge
  - has created/enhanced wetlands and baseflows
  - has contributed to high water tables (source of readily available water for domestic/commercial uses)
- Reduction in diversion and increase in irrigation efficiency has:
  - decreased groundwater levels
  - decreased return flow, particularly late in the summer
- Changes are good for some resources and users, bad for others
- Changes in irrigation have largest effect, but development has:
  - decreased use of canal system
  - increased use of groundwater
- WE RECOMMEND:
  - increased coordination between land-use planning and water resources planning/management.

Outreach

- 9 Watershed Council meetings
- Presentations to county P&Z commissions and other groups
- Booklet (reviewed and endorsed by Watershed Council)
- Peer-reviewed publication: Baker et al. 2014, Society and Natural Resources 27:1145-1160.
- Humboldt State University Master's theses:
  (available online at http://humboldt-dspace.calstate.edu/)
    - Liegel, L. 2011
    - Peterson, K. 2011
    - Apple, B. 2013



State of Idaho Groundwater Management

- 1951, 1953: Idaho Groundwater Act affirmed extension of prior appropriation doctrine to groundwater
- 1984: Swan Falls Agreement
- 1987-2014: Snake River Basin Adjudication
- 1992-1994: Moratorium on new groundwater irrigation rights on Eastern Snake Plain Aquifer
- 1994: Conjunctive management rules adopted
- 2009: Comprehensive Aquifer Management Planning (CAMP). Priorities:
  - Eastern Snake Plain (change water budget by 600K a-f), Spokane River/Rathdrum Prairie, Treasure Valley (Boise), Wood River Valley
- Current policies to achieve ESPA CAMP goals
  - Find alternatives to administrative curtailment
  - Reduce consumptive use of groundwater on ESPA
  - Encourage municipalities to use surface water for outdoor use and install dual conveyance (some cities do this for new development)
  - Promote continuation of flood irrigation and other incidental recharge
  - Implement large-scale managed recharge, with goal of 250K a-f/year