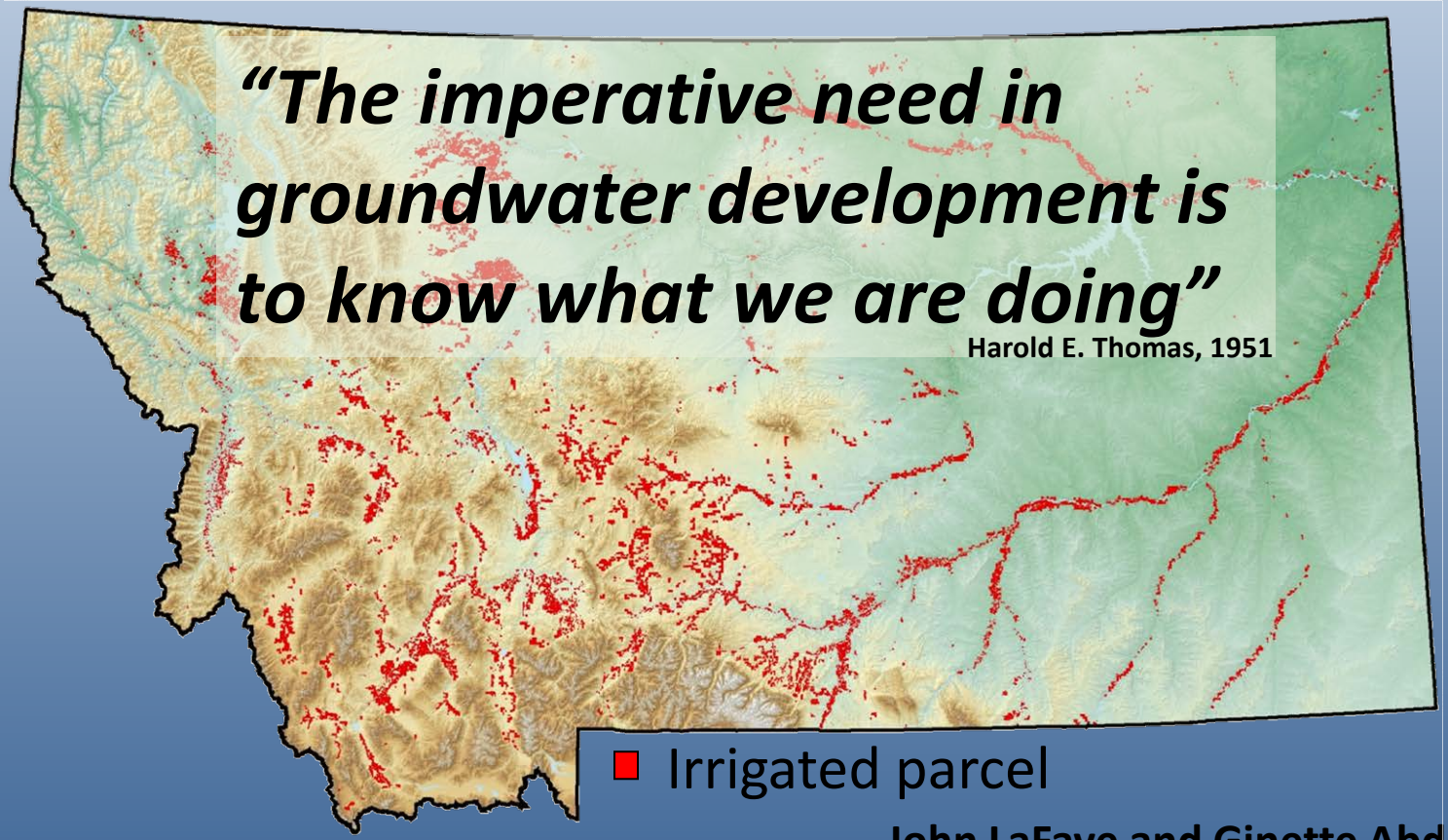
Irrigation and "Incidental Recharge" in Montana



John LaFave and Ginette Abdo
Montana Bureau of Mines and Geology
Presented to:
Shallow Recharge Technical Meeting
Helena, MT Oct. 21, 2015

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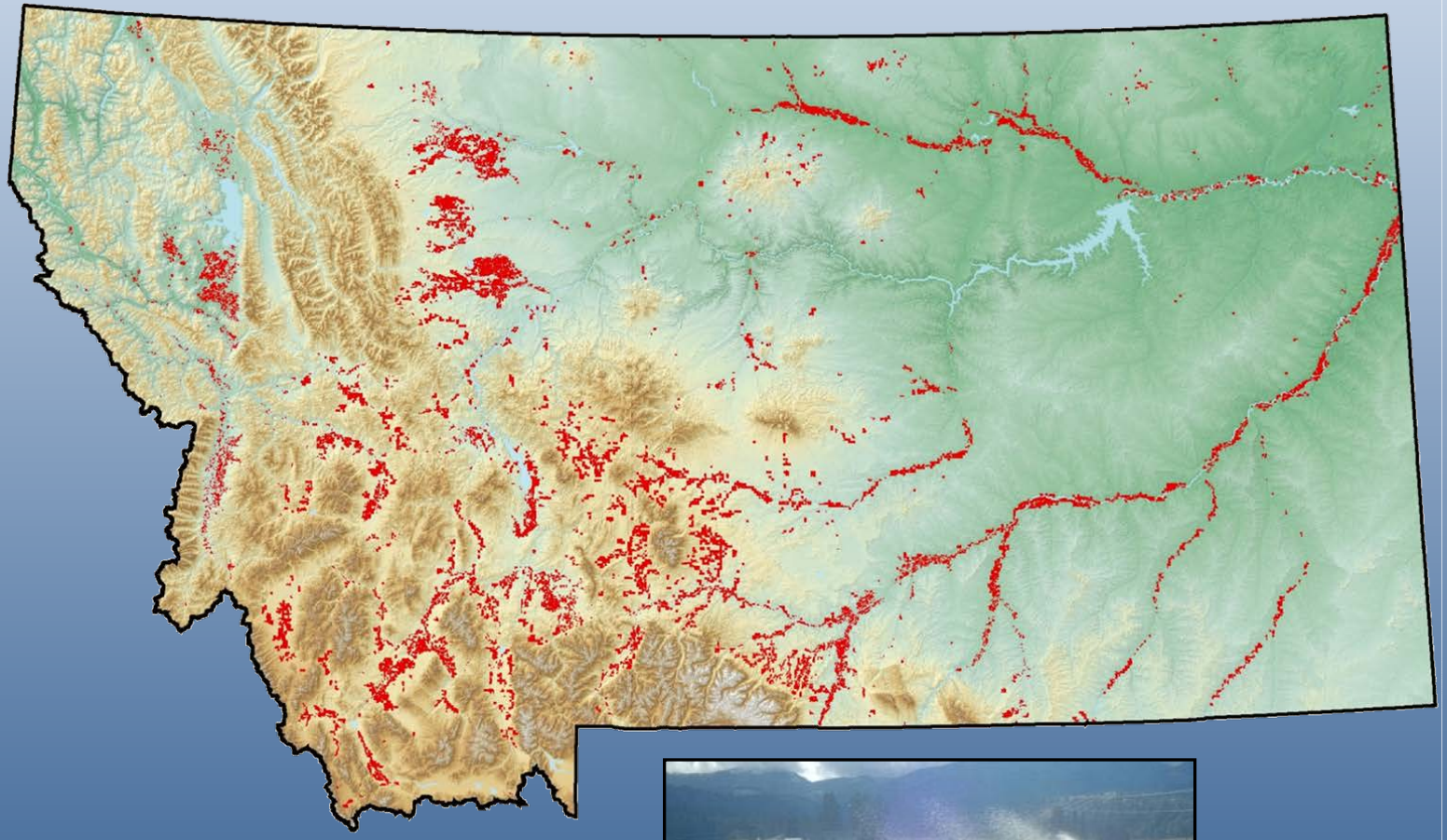
Incidental Recharge

- Recharge that occurs related to irrigation use
- Unintended consequence of the use
- Unmanaged
- Prevalent in MT alluvial valleys
  - Irrigated areas
- Volumetrically Significant
  - Measurable impacts

In Montana we irrigate about 2 million acres…



- Irrigated parcel

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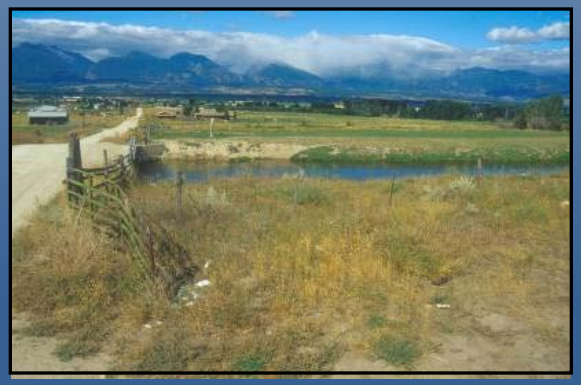
We divert about 11.6 million acre-ft per yr through more than 7,000 miles of canals



— Irrigation canal

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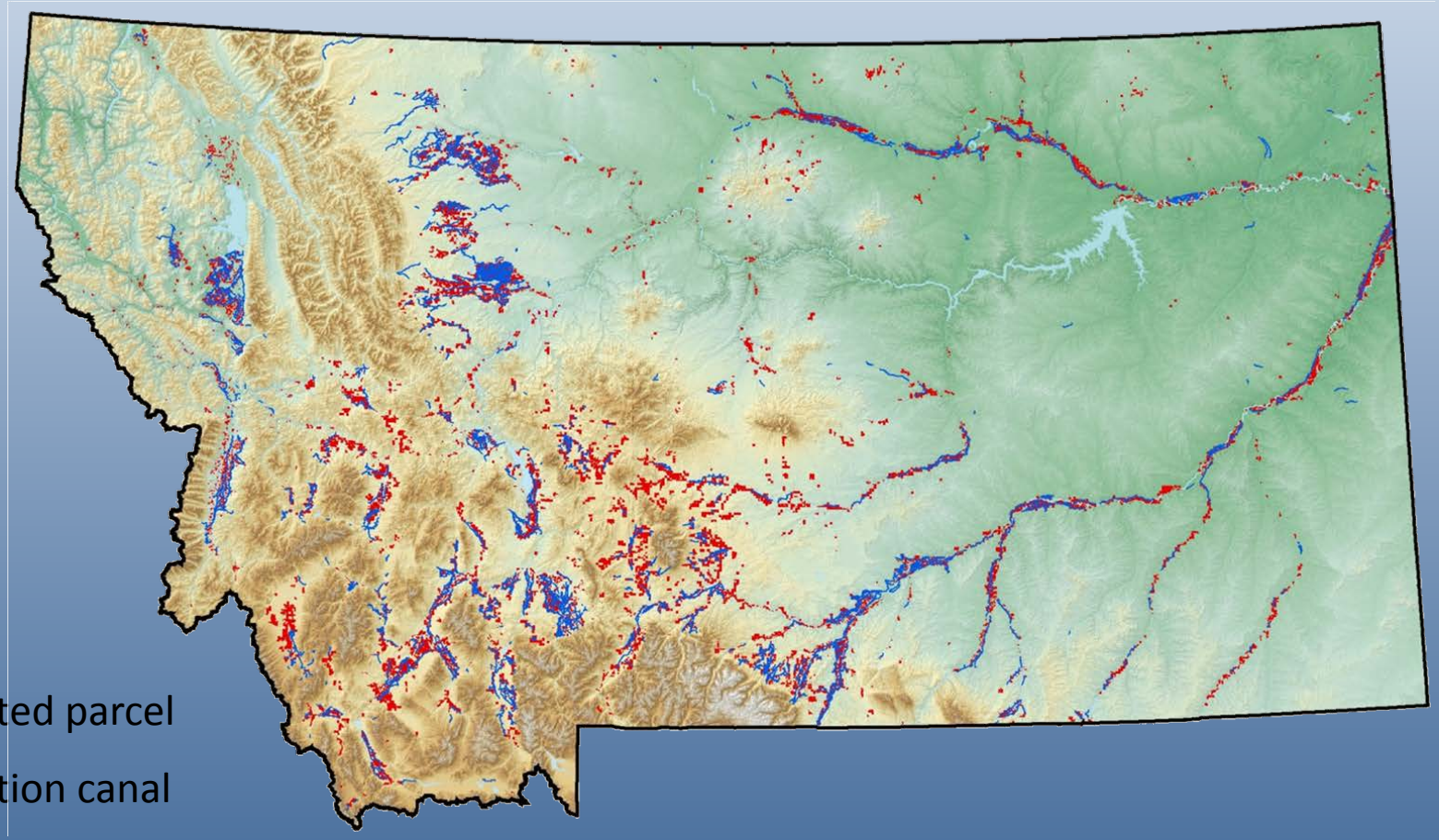
That's 5.5 ft of water per acre…



If it takes 2 ft of water to grow a crop, where does the rest of the water go?

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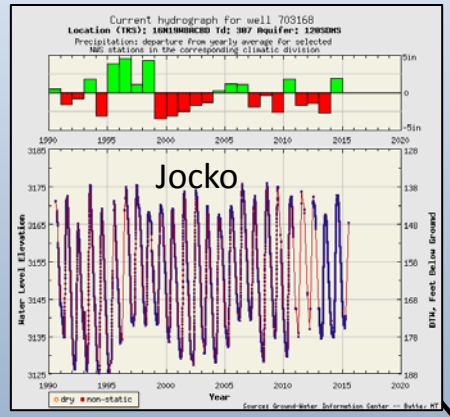

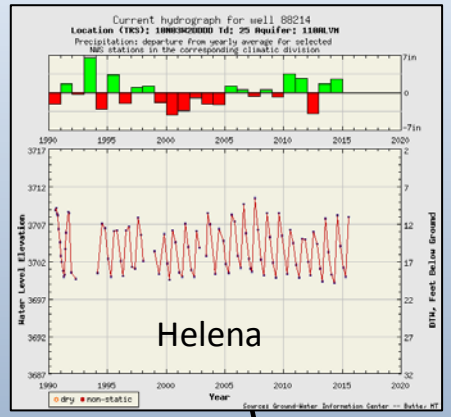

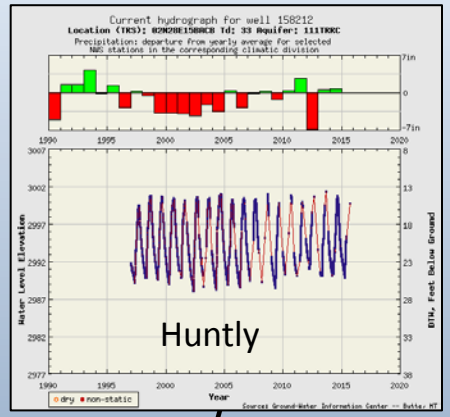

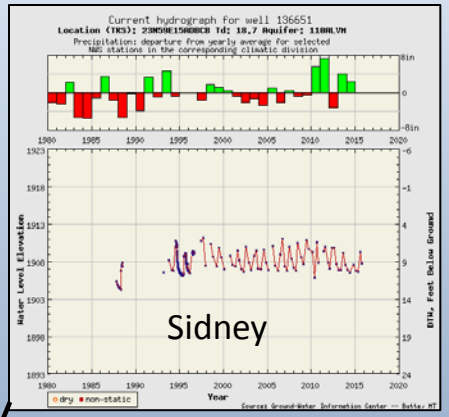

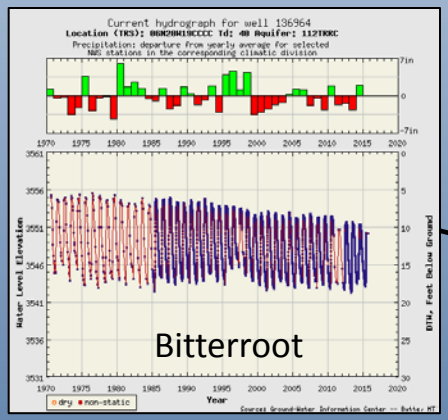

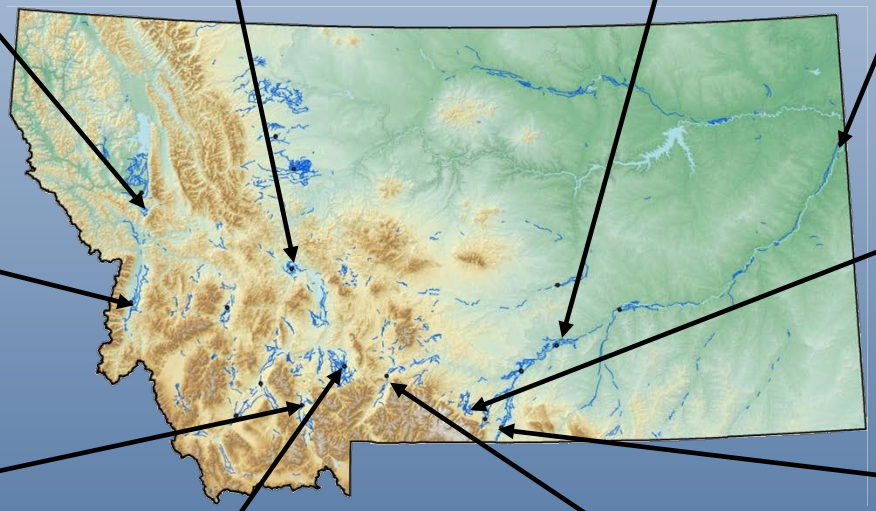

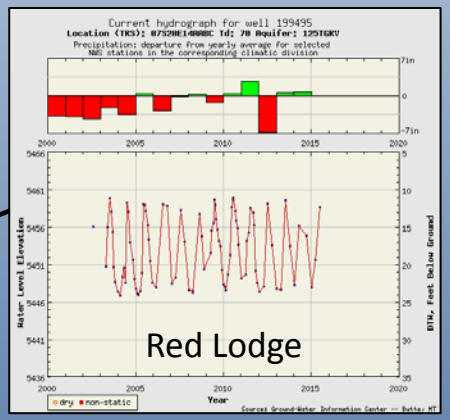

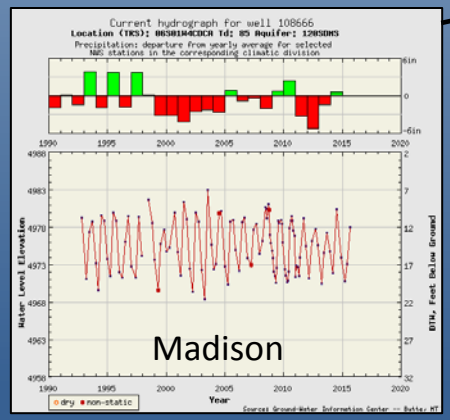

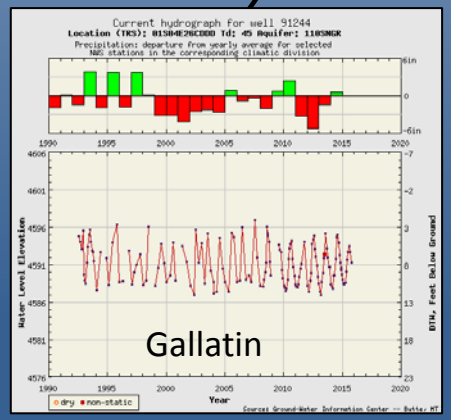

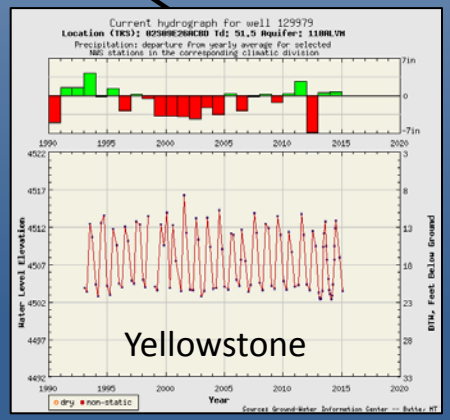

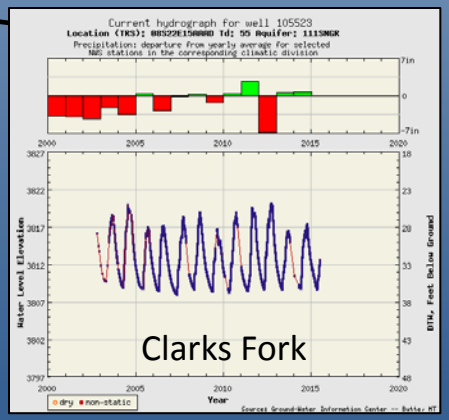

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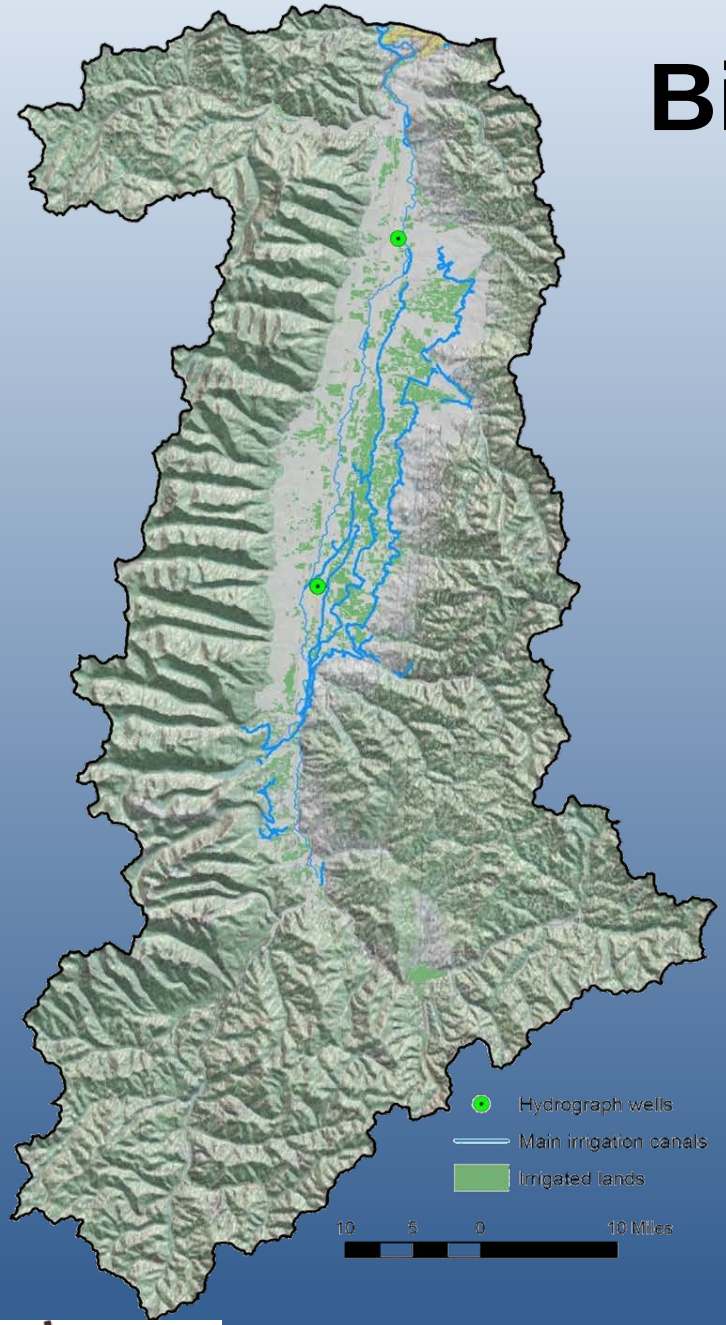
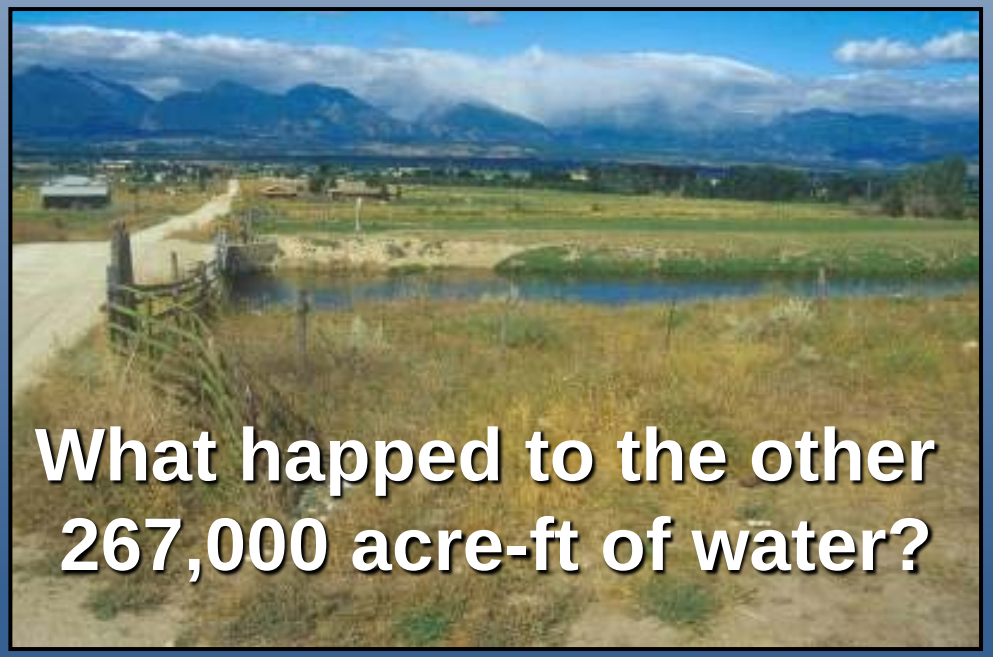


Bitterroot Valley Example

85,000 acres of irrigated land

374,000 acre-ft of water diverted
(~4.5 ft of water per acre)

107,000 acre-ft consumed
(~1.3 ft of water per irrigated acre)



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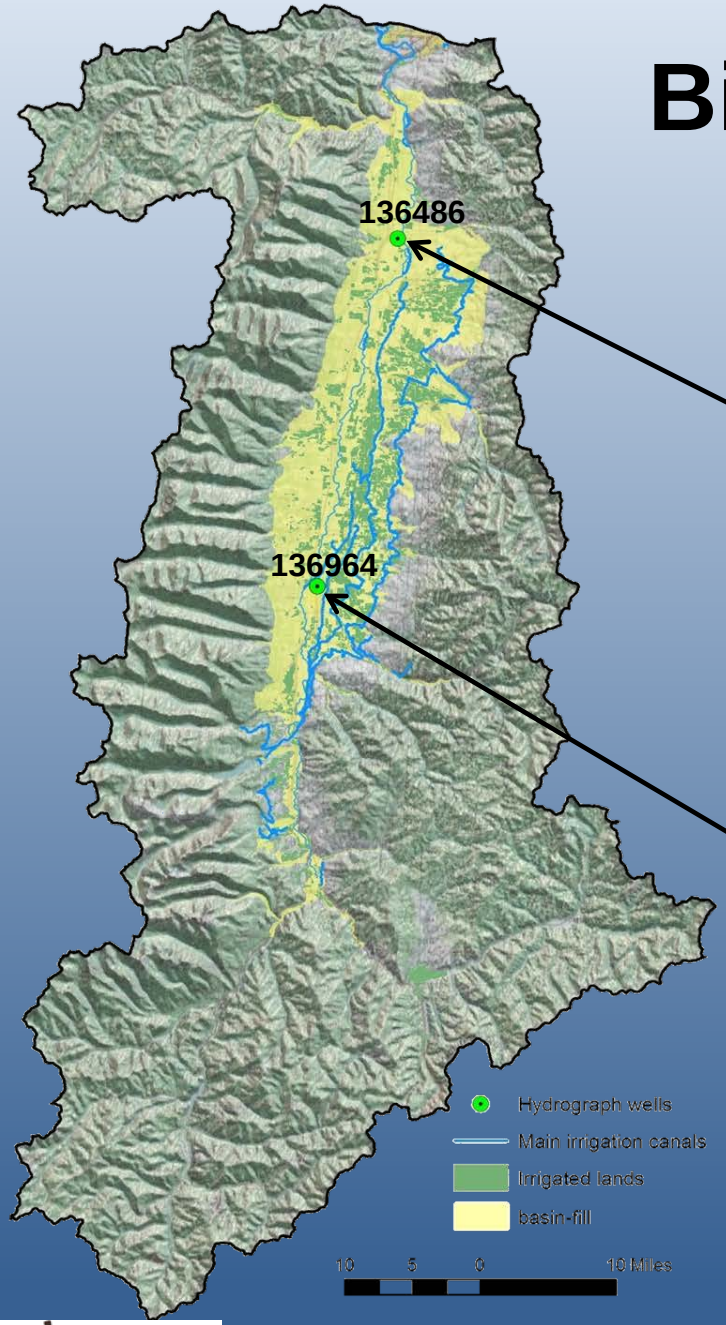
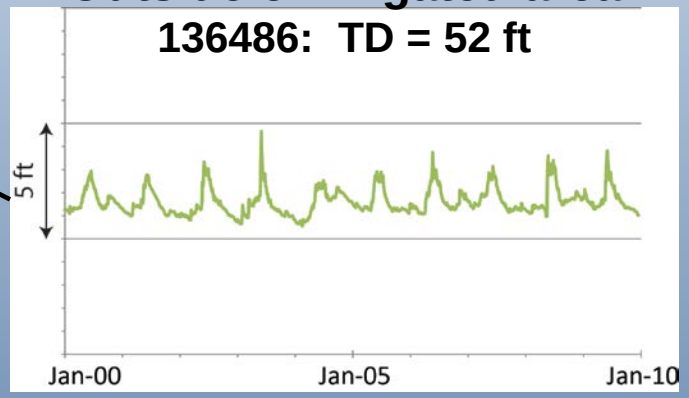
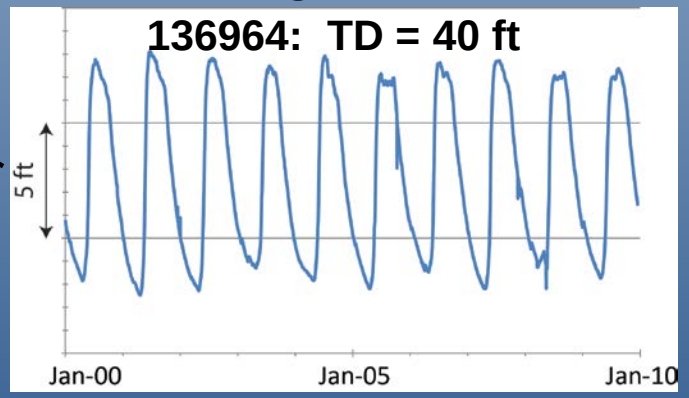
Bitterroot Valley Example



Outside of irrigated area



In irrigated area



Same Aquifer

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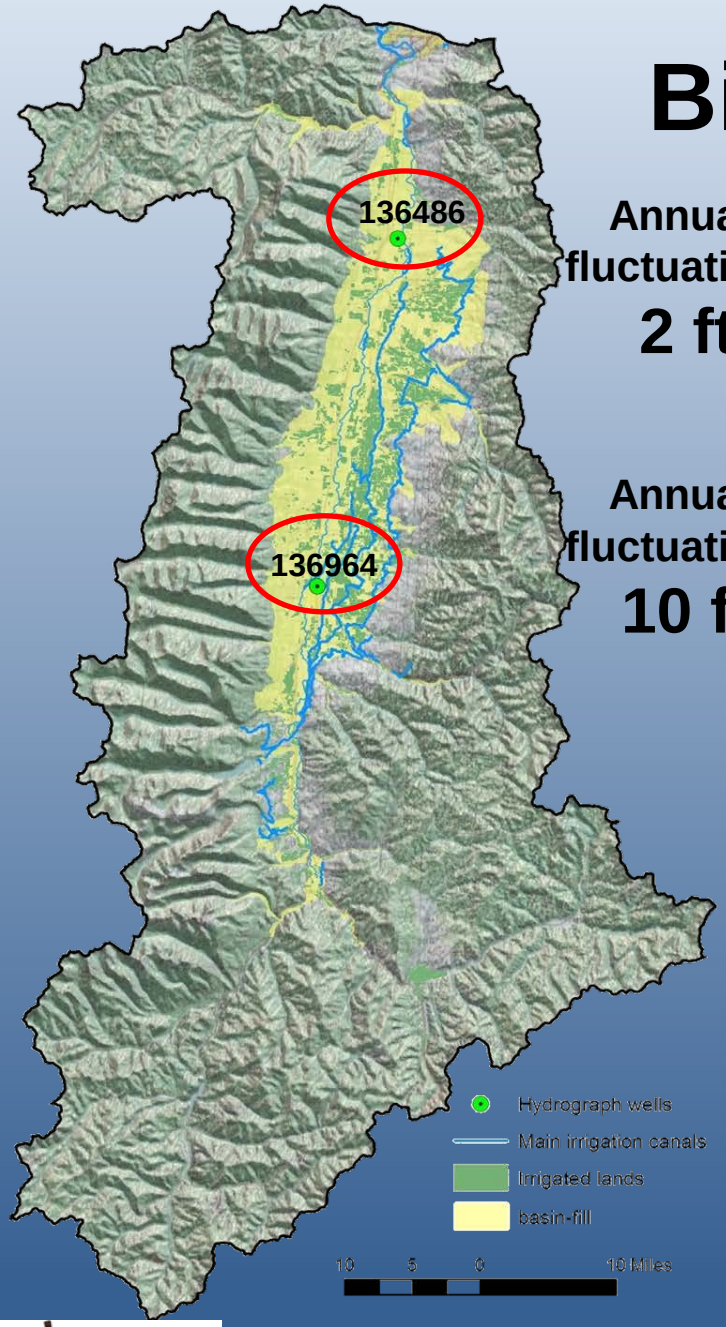
Bitterroot Valley Example



Annual fluctuation:

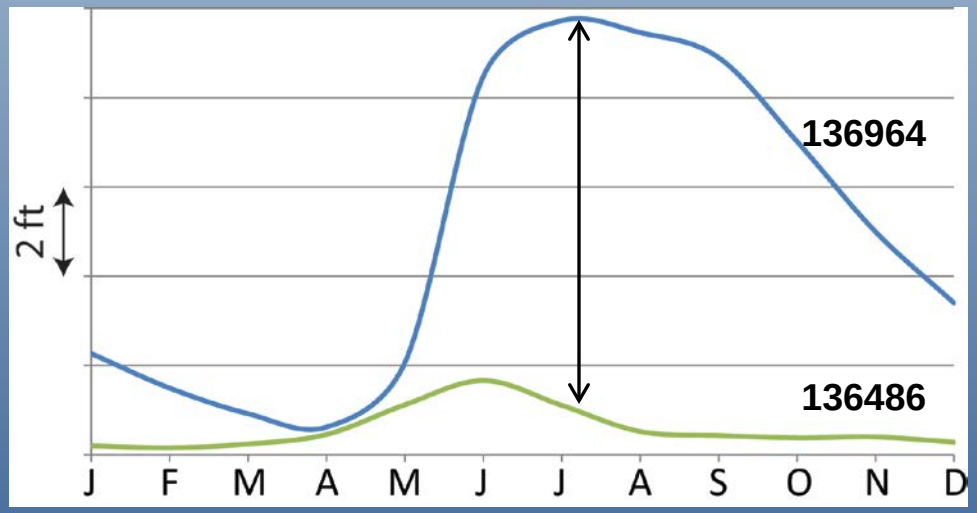
2 ft

Annual fluctuation:

10 ft

Irrigation returns provide significant groundwater recharge

Average monthly water levels



Same Aquifer

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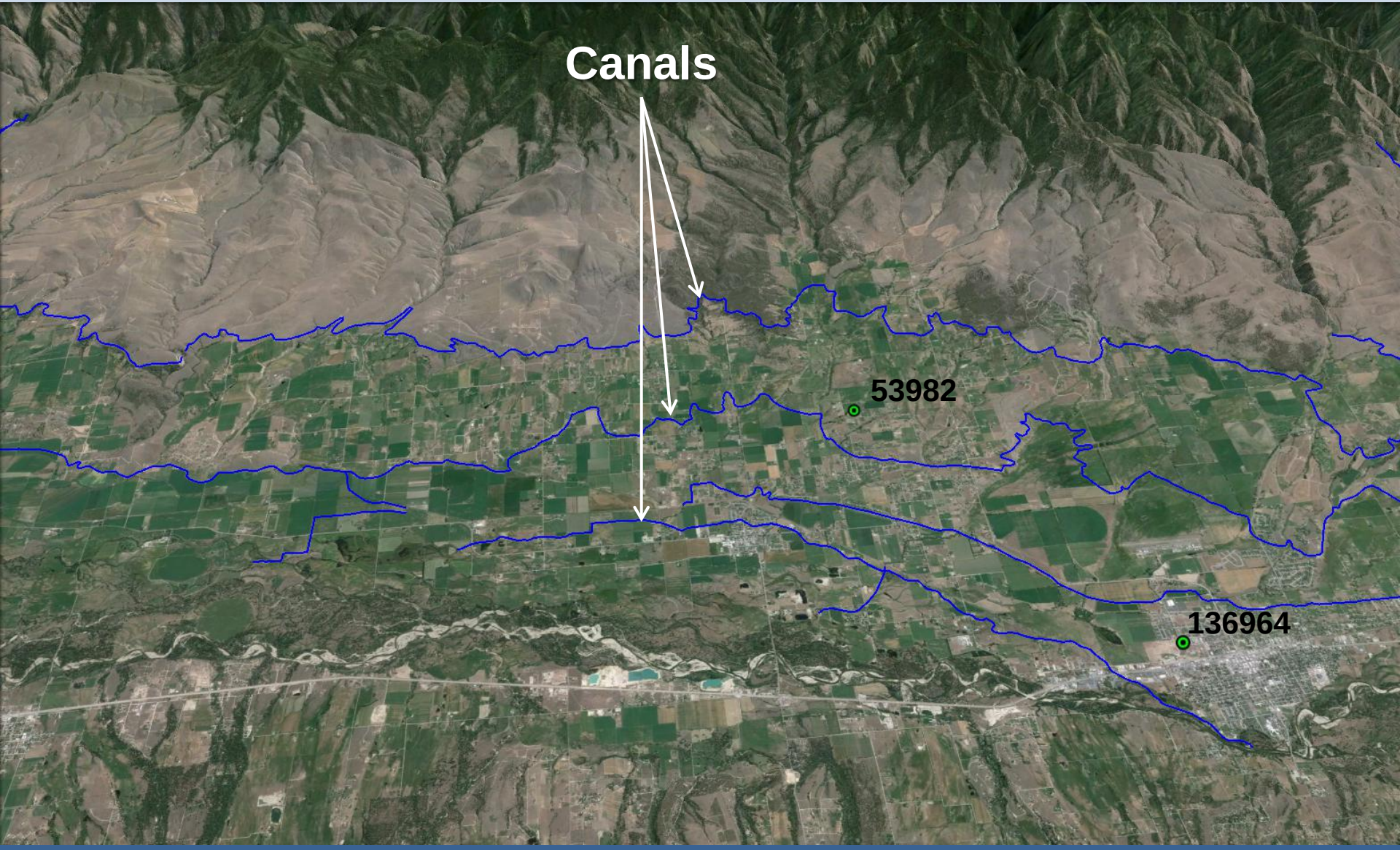
Irrigation leakage: Dependent systems



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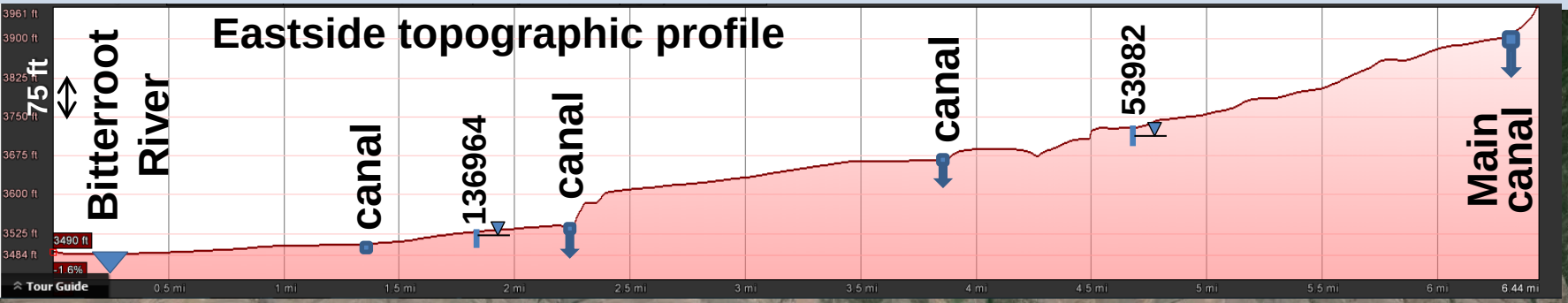

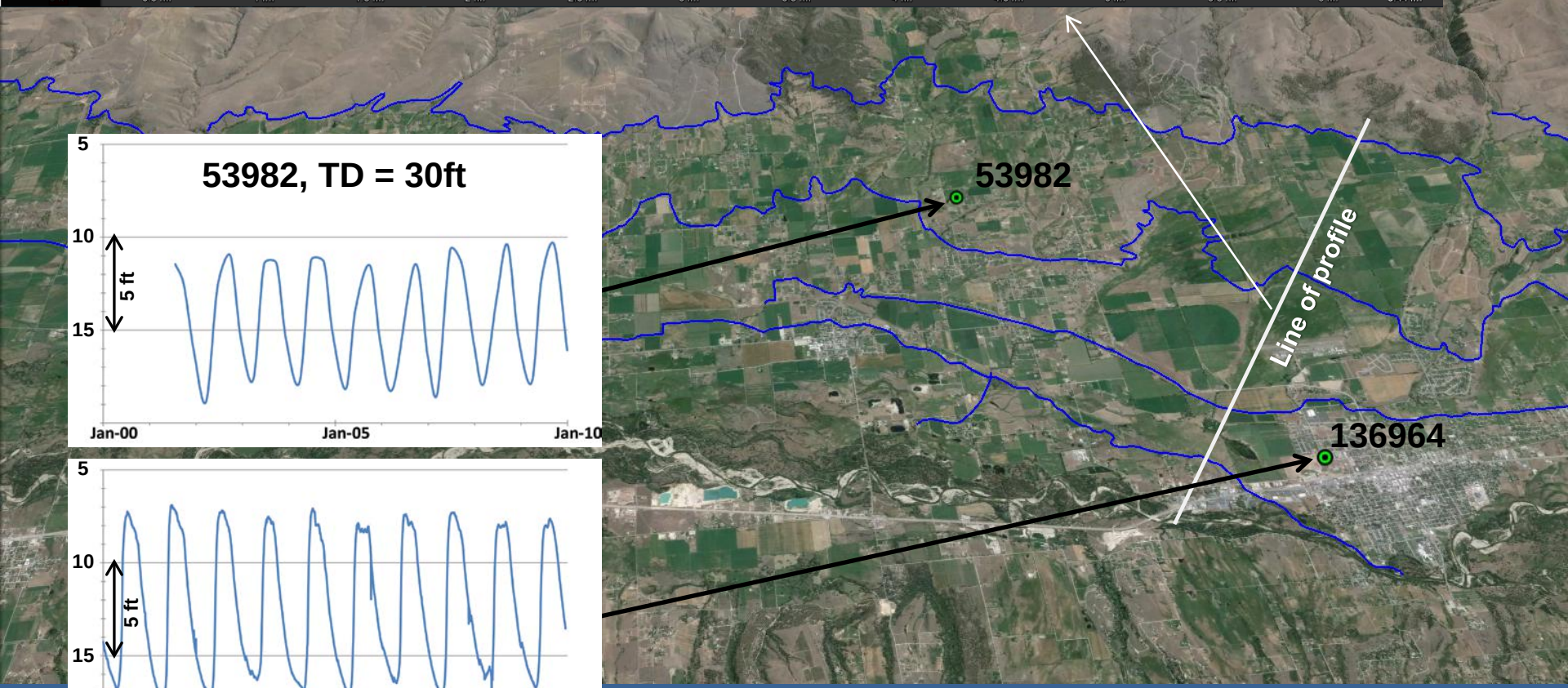

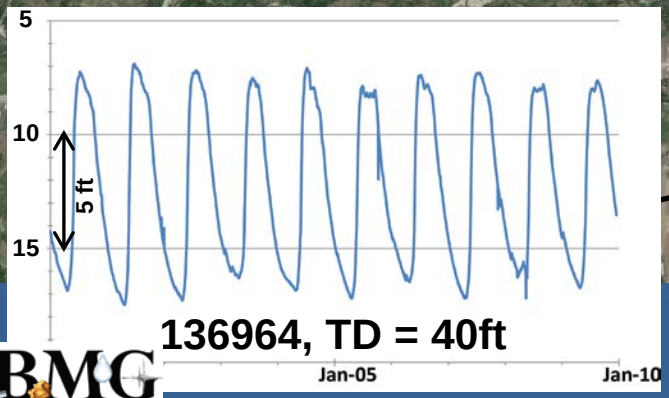

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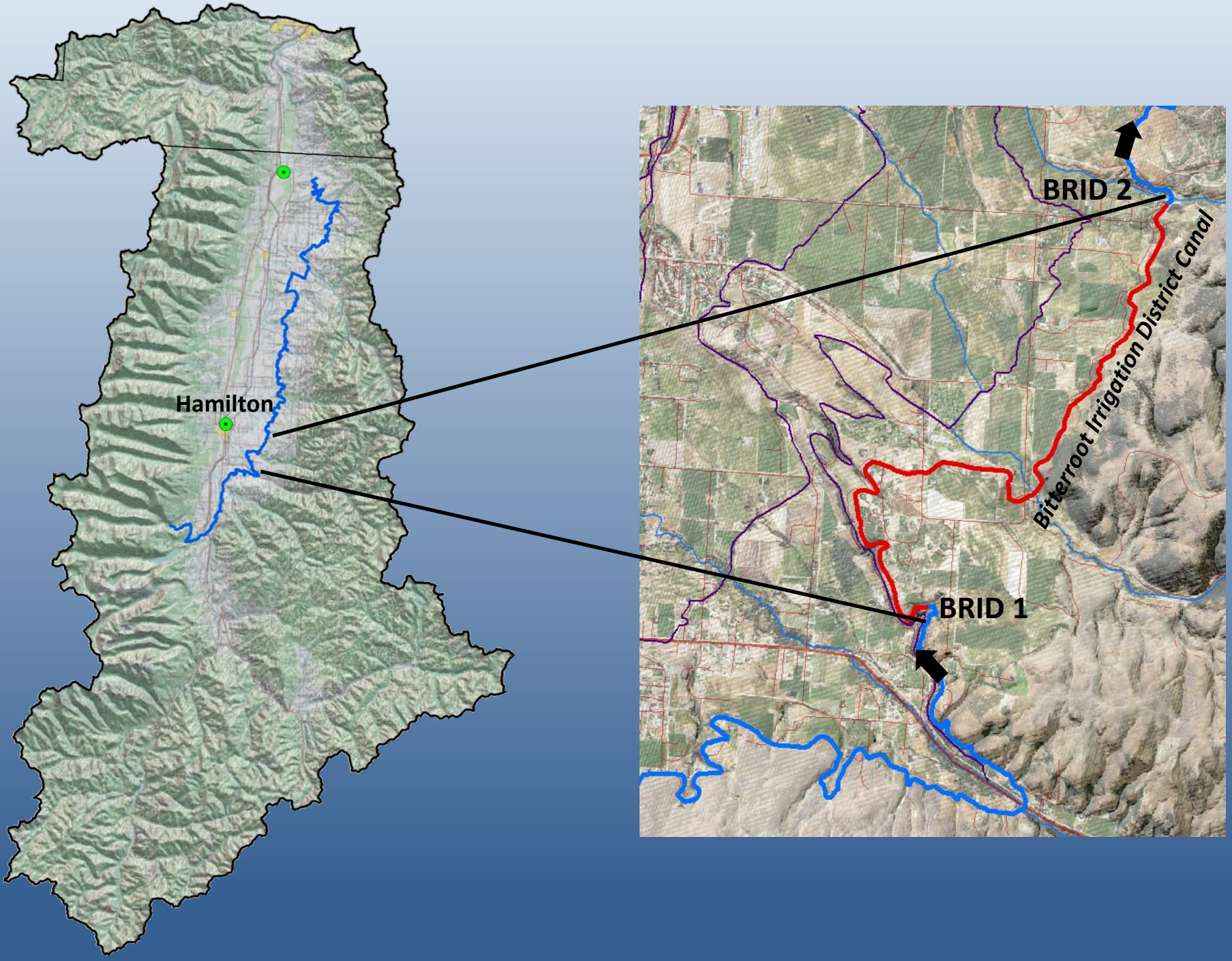
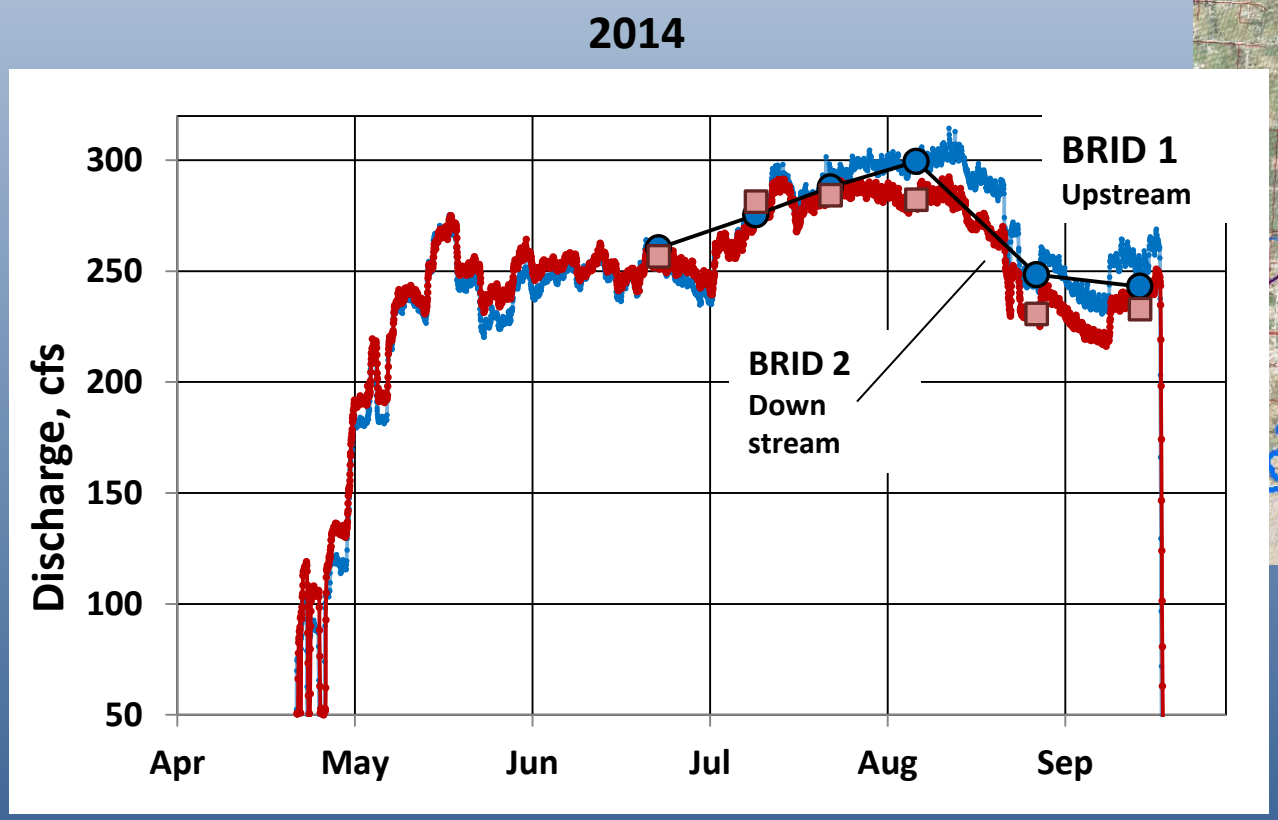
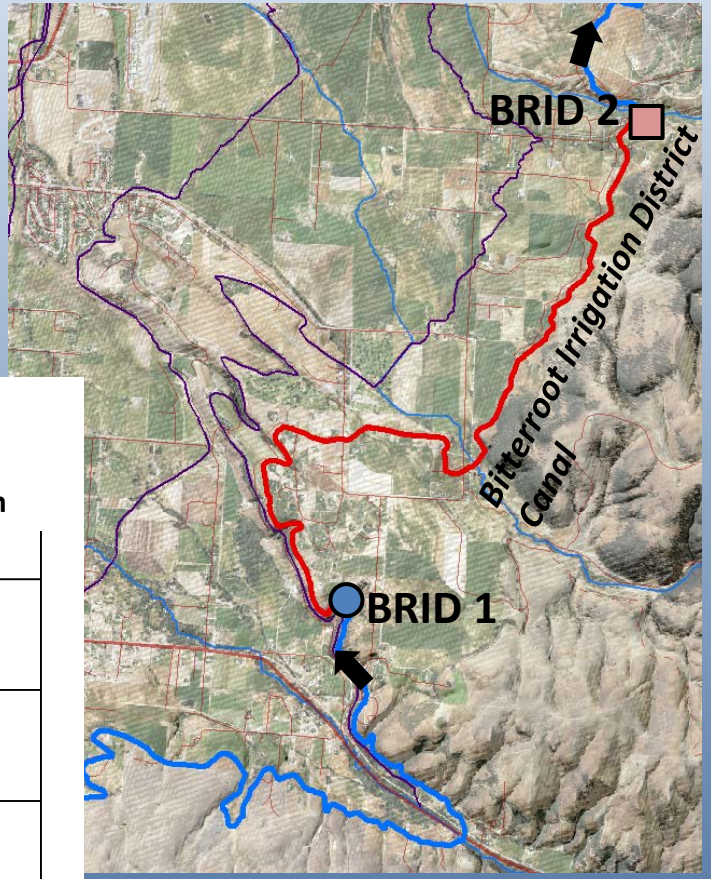

Hamilton
BRID 2
Bitterroot Irrigation District Canal
BRID 1

Bitterroot Irrigation District Canal

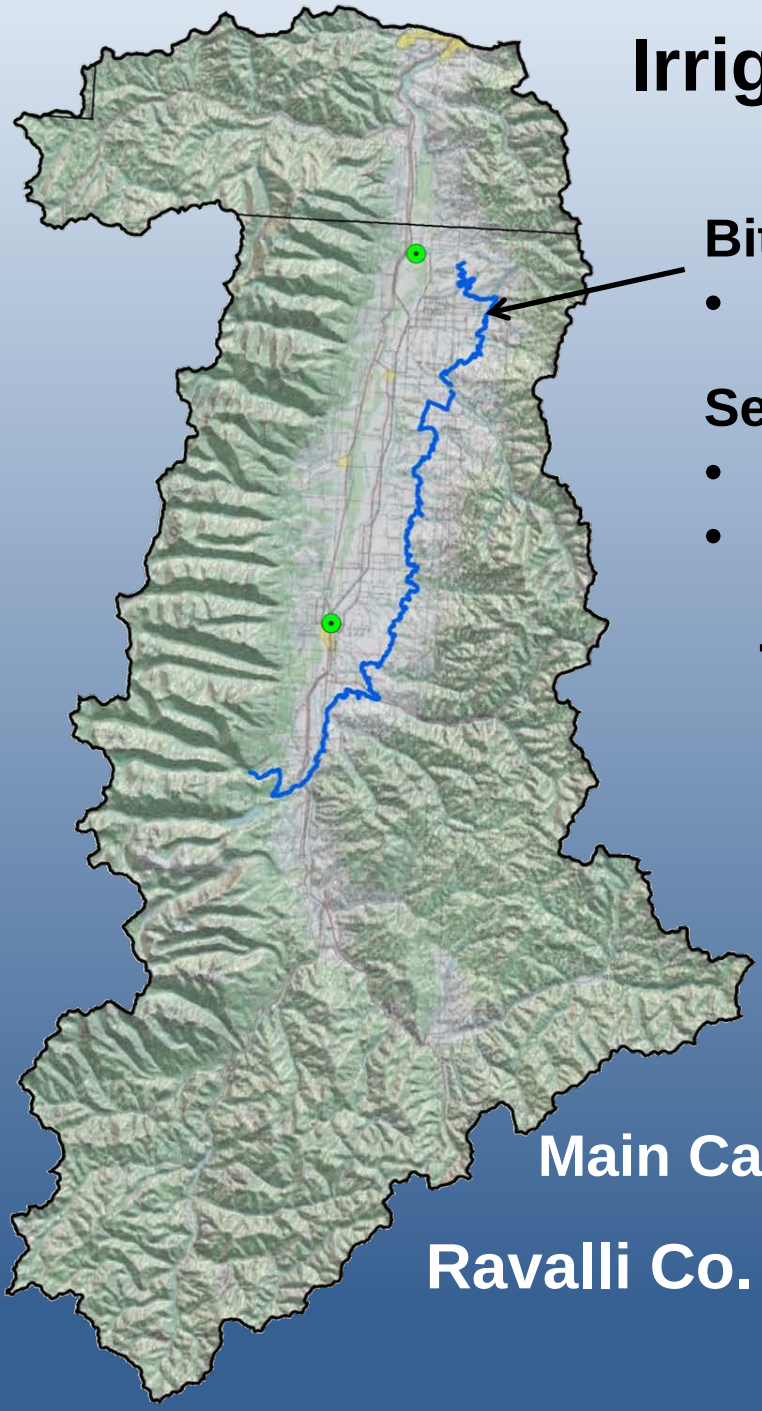
5.8 miles





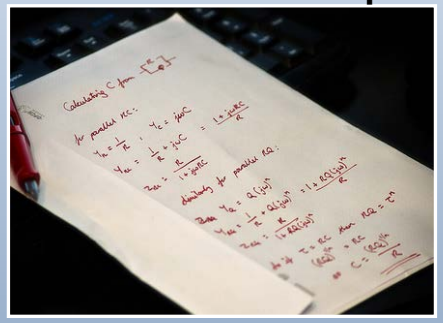
3.1 cfs/mile loss

Provisional data



Irrigation leakage: How much?

Back of the envelope



Bitterroot Main Canal

- 77 miles mostly unlined

Seepage loss

- ~ 3 cfs/mile (GWIP)
- (1 cfs/mile)

77 cfs = ~150 ac-ft/day = 50 MGD

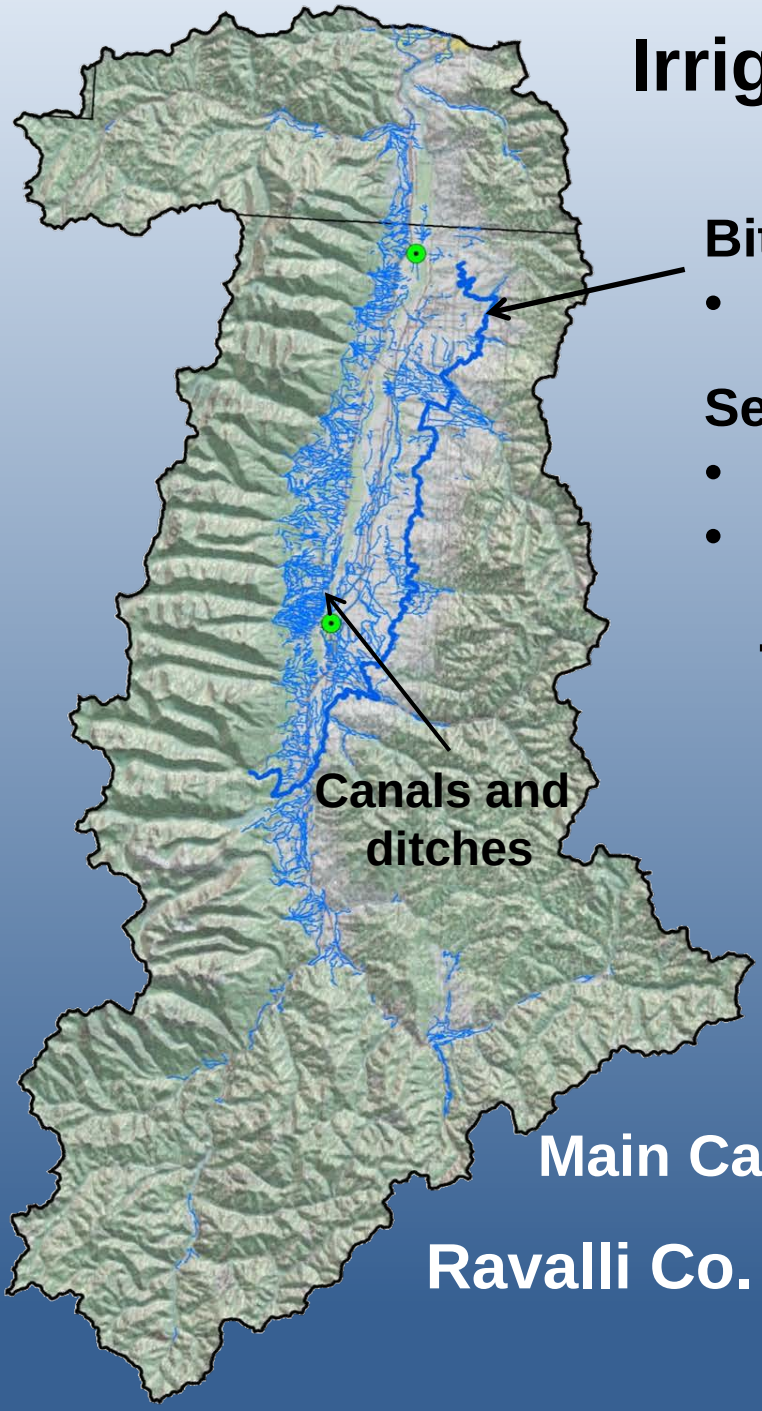
Irrigation season

- April 15 – Sept 15 (150 days)

Main Canal seepage loss = 7.5 Billion gal/season

Ravalli Co. GW withdrawals = 3.4 Billion gal/year

Irrigation leakage: How much?



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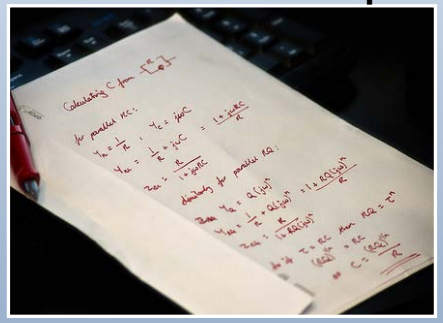

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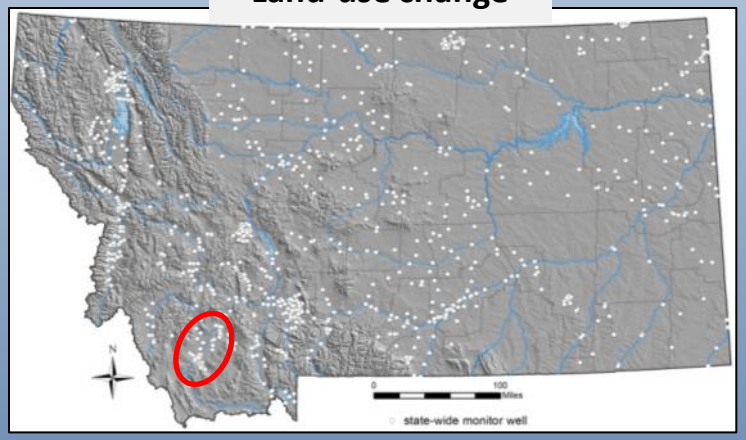
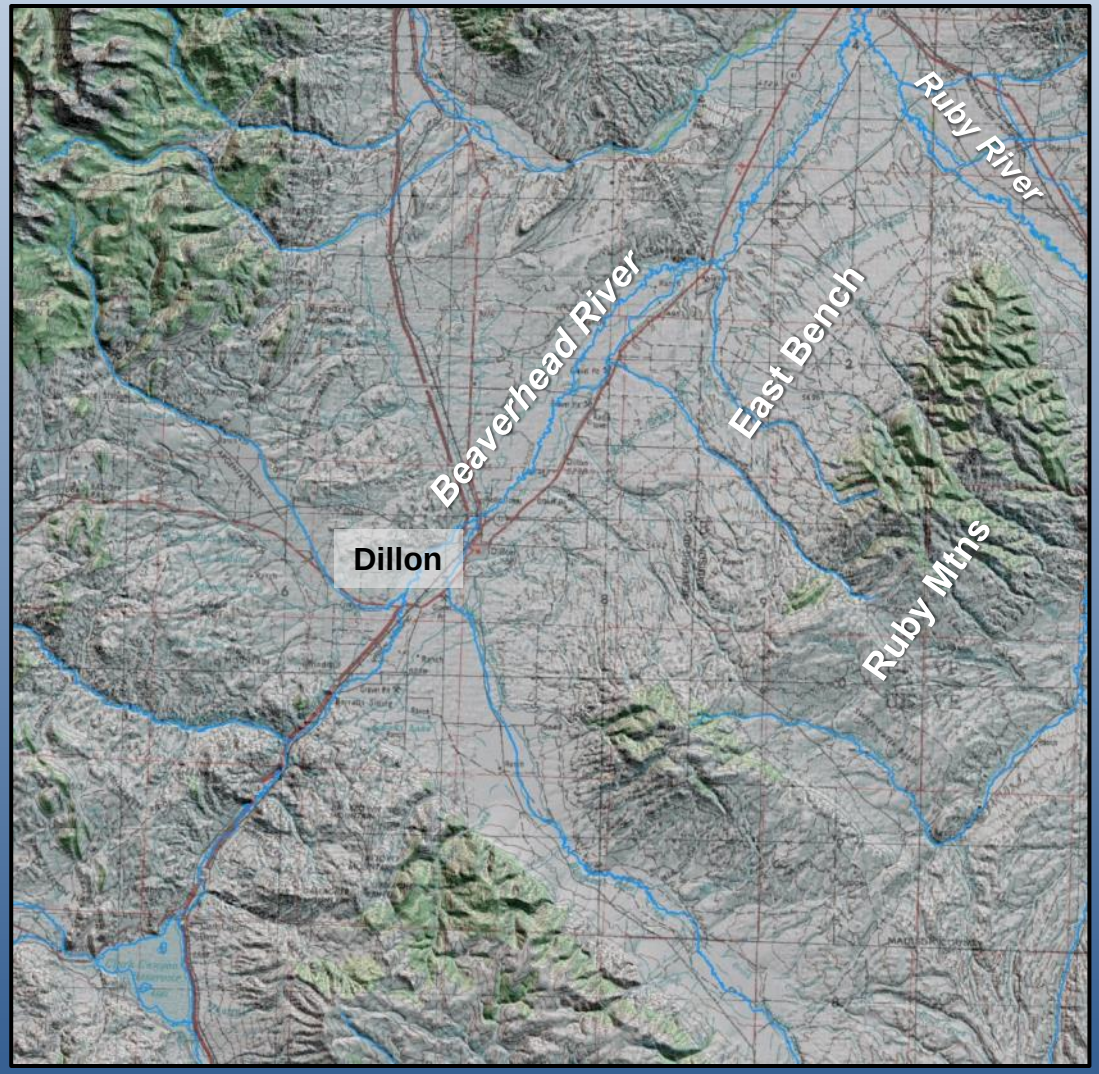
East Bench Canal Example

4) East Bench Canal Land-use change





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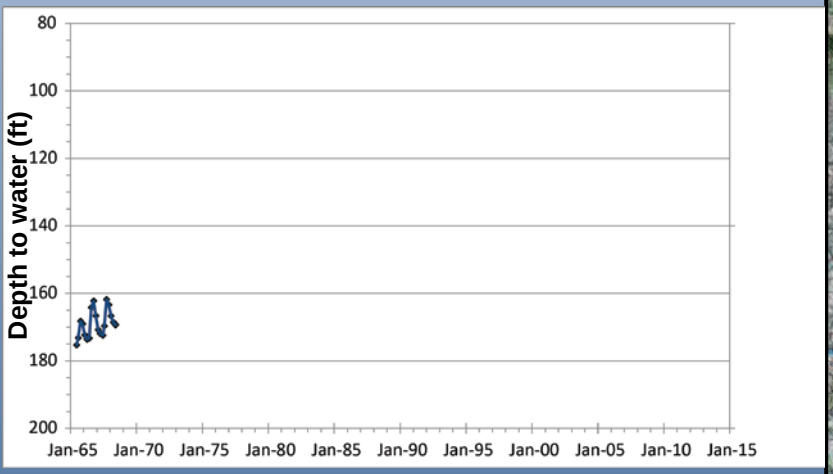
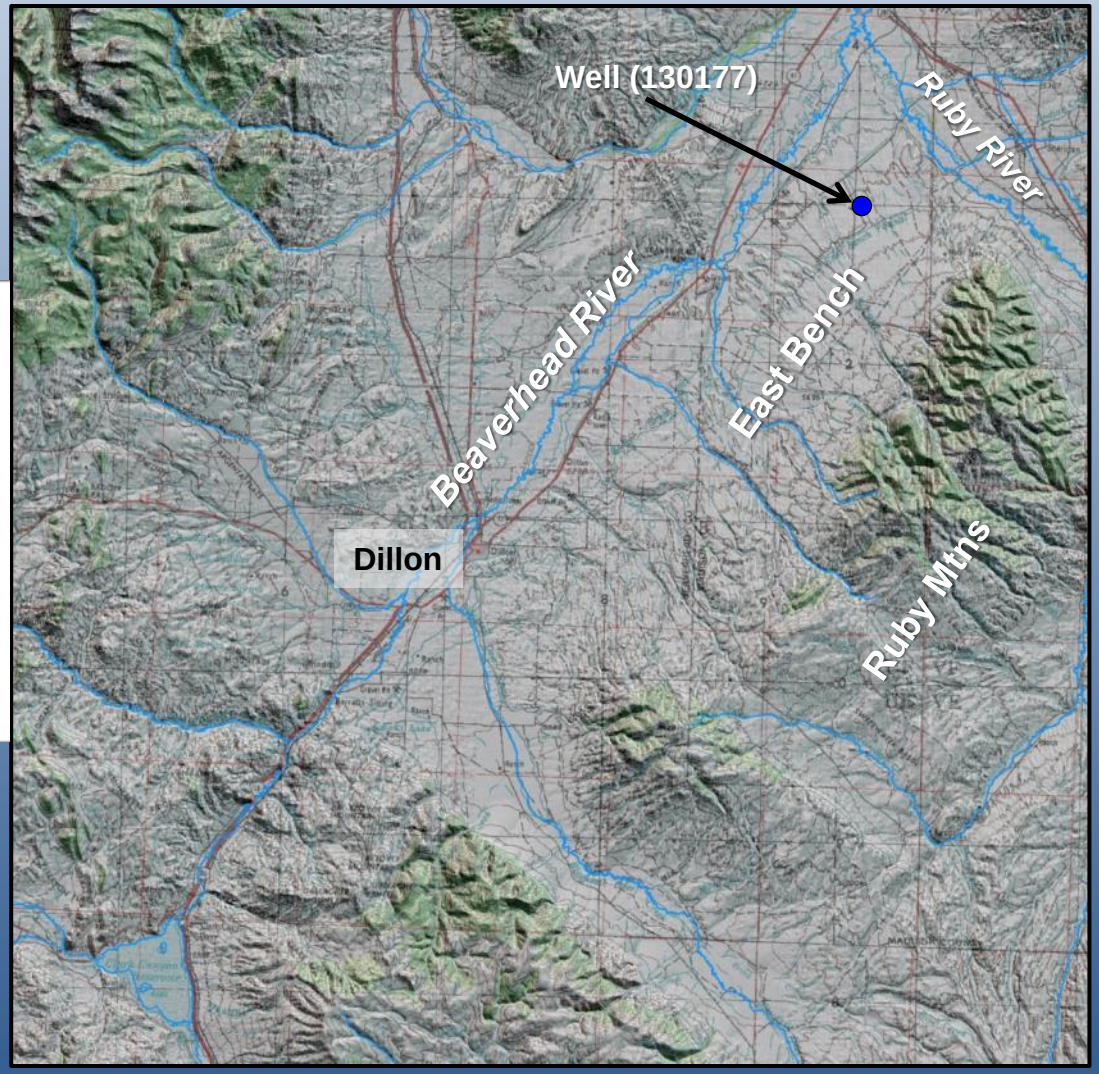
East Bench Canal Example

Hydrograph 130177, TD = 200 ft





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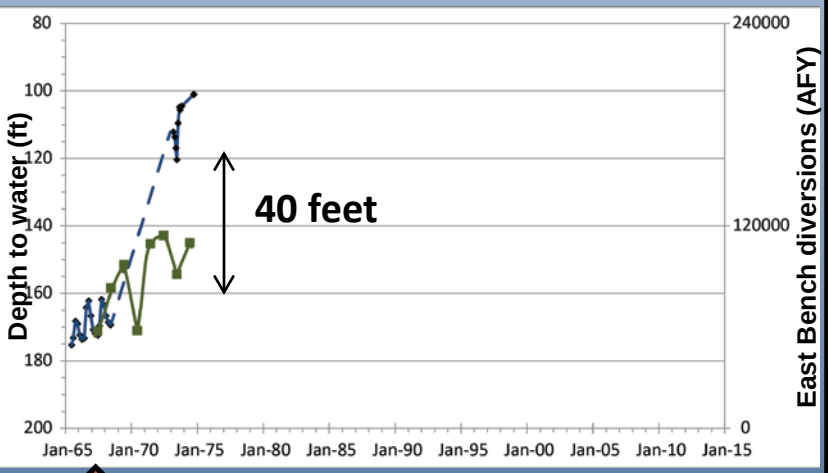
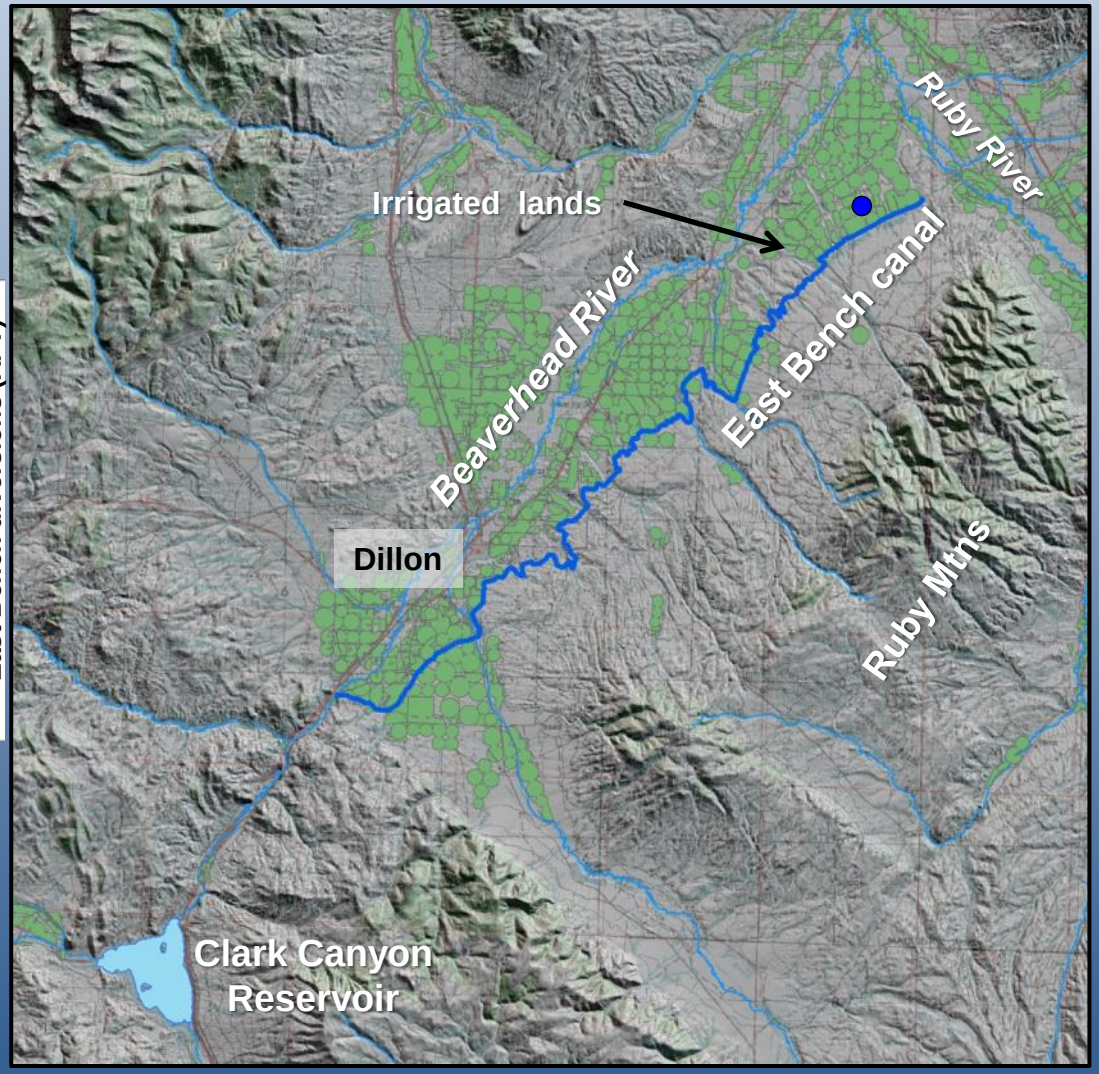


Canal installed



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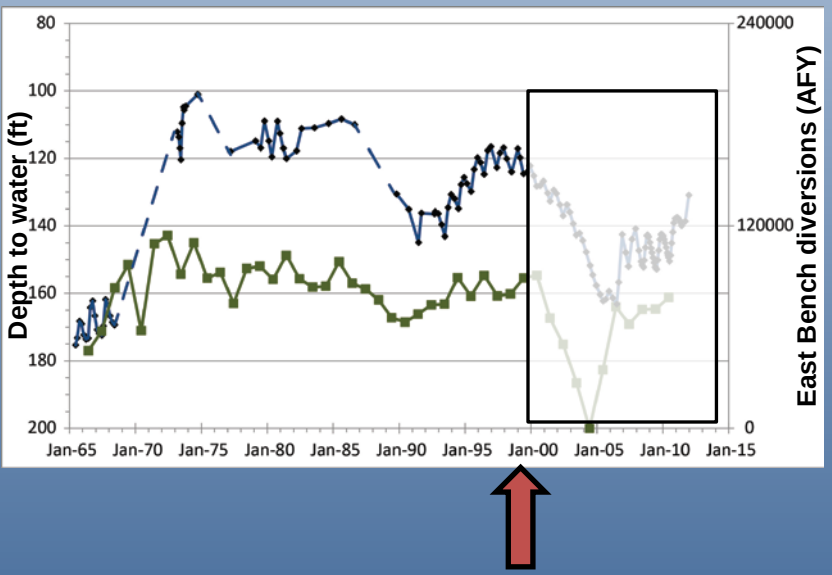

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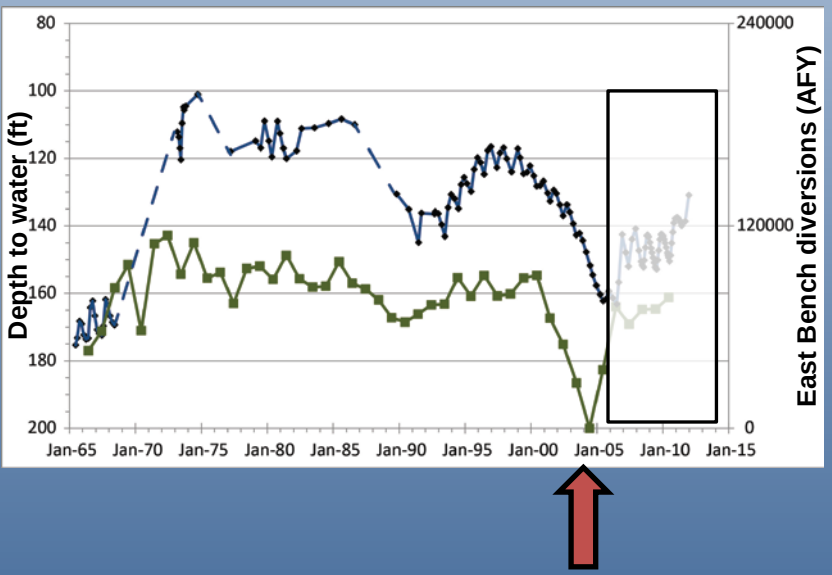

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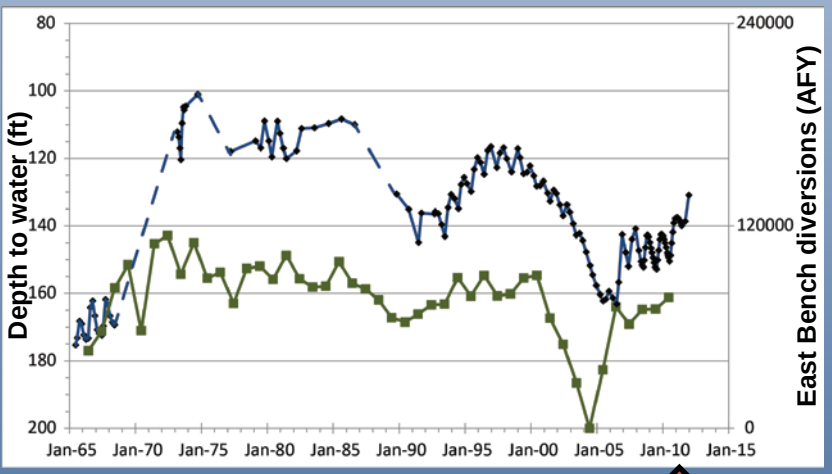

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East Bench Canal

Seepage Rate….

2.2 cfs/mile

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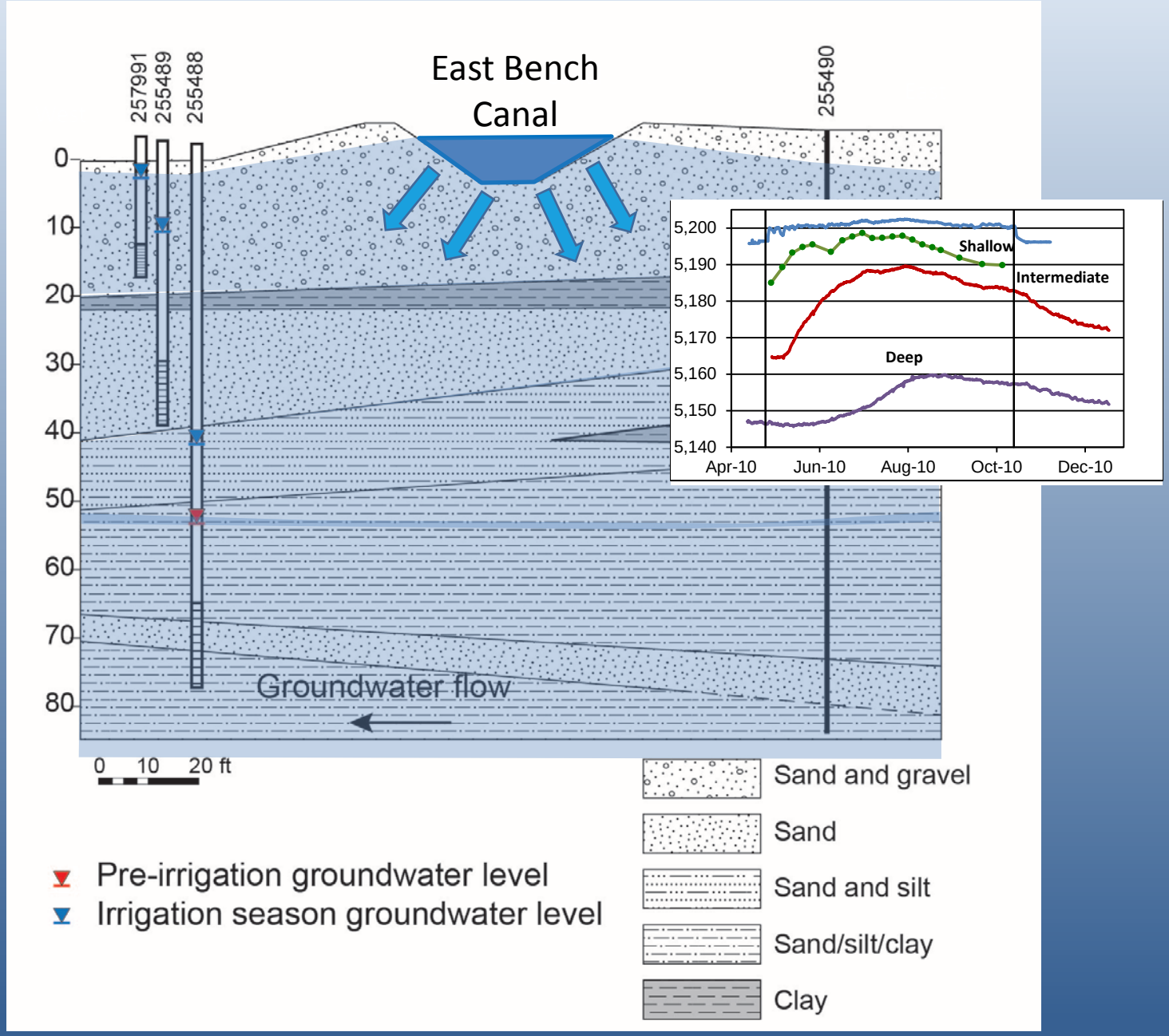

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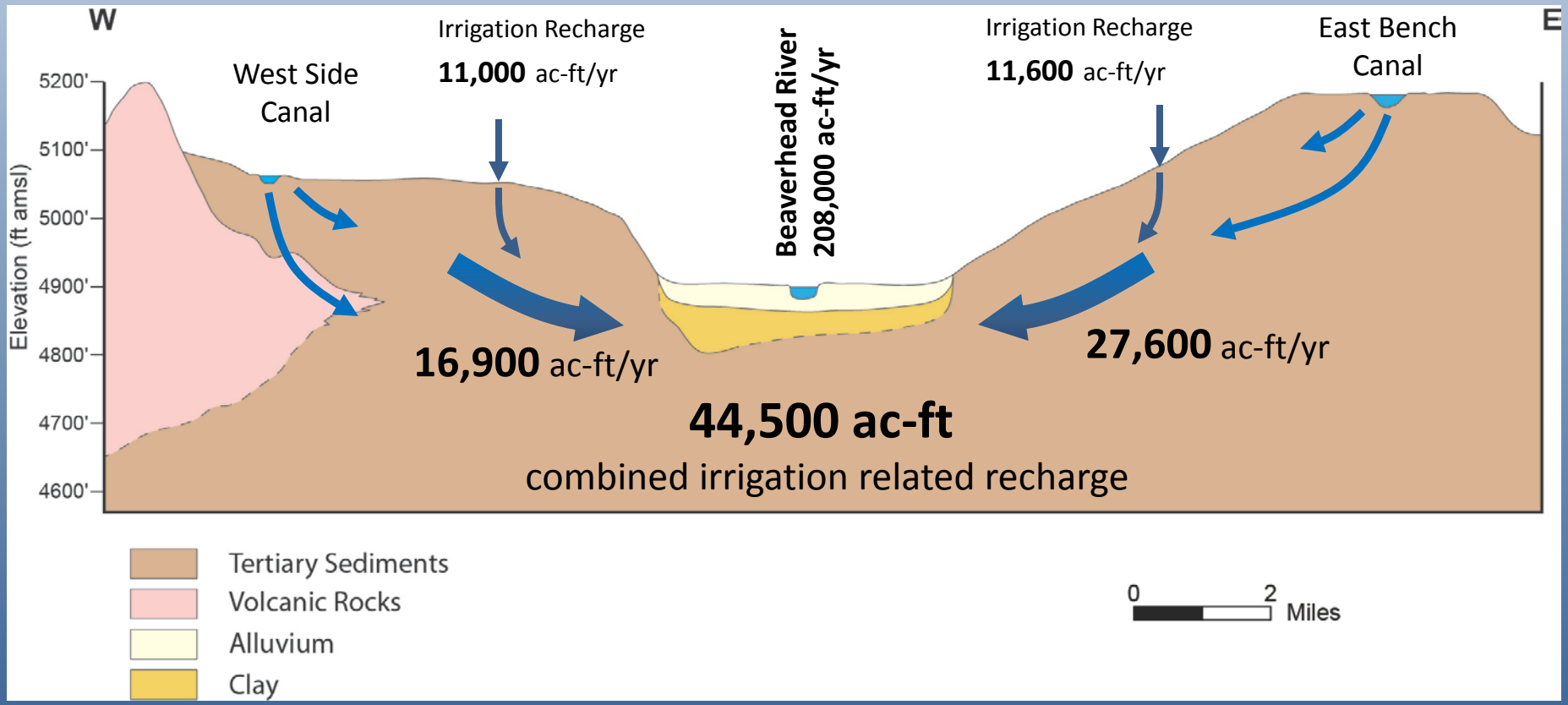
Groundwater Recharge from Irrigation and Canal Seepage

2010

Seepage Loss
5,900 ac-ft/yr

Seepage Loss
17,000 ac-ft/yr



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Seepage Loses

• East Bench Canal	2.2 cfs/mile
• West Side Canal	1.2 cfs/mile
• Carey Canal (Boulder Rv drainage)	2.1 cfs/mile
• BRID (Hamilton area)	1.4 – 3.1 cfs/mile
• Bozeman area ditches	1.1 cfs/mile
• Upper Big Hole	0.15-1.5 cfs/mile
• Helena Valley	0.6 cfs/mile
• Billings area	0.05-0.5 cfs/mile
• Stillwater-Rosebud Watershed	1.1-1.8 cfs/mile
• Greenfields Bench	0.45-4.7 cfs/mile

1 cfs = 724 acre-feet/year

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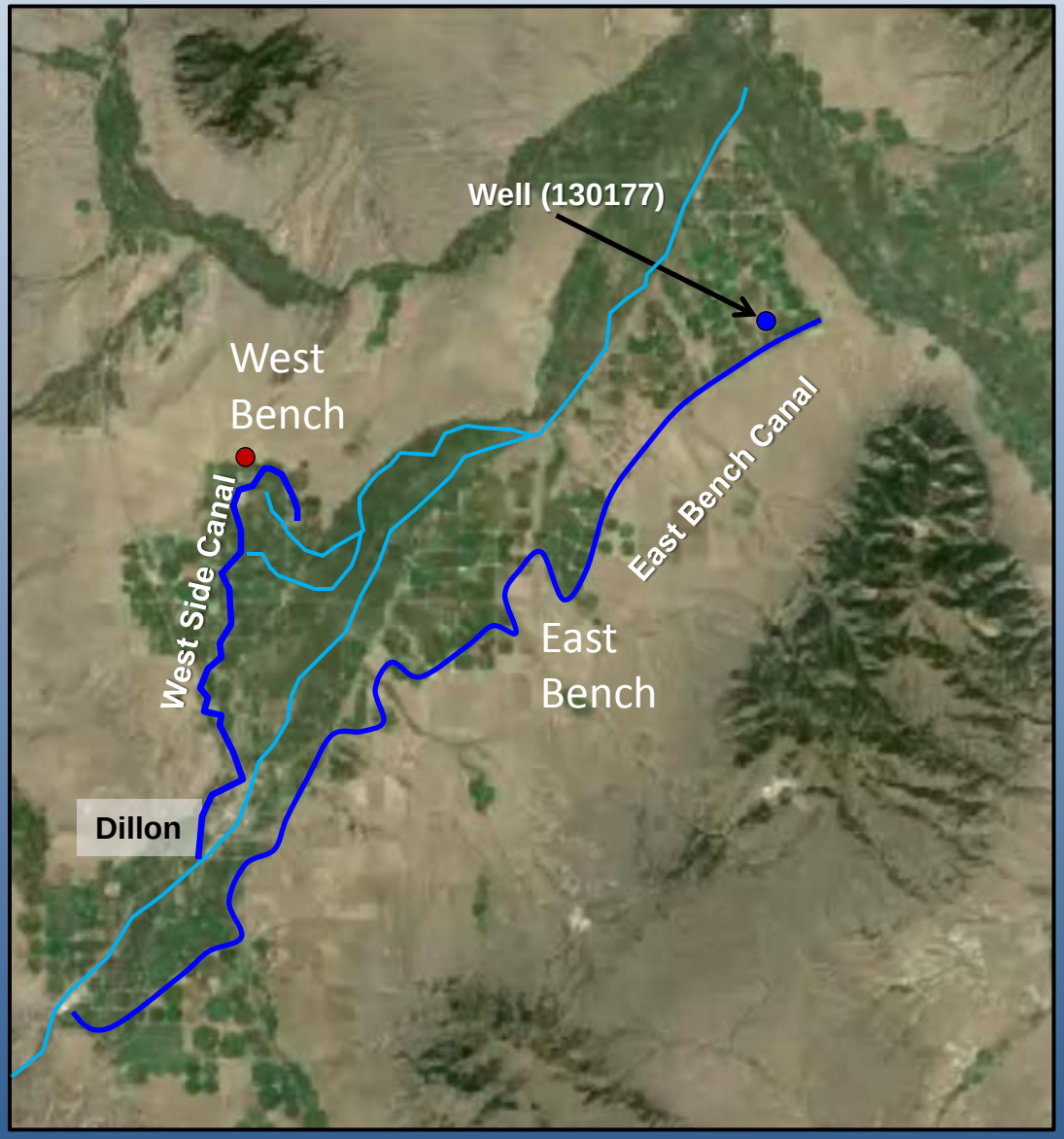
West Side Canal And Black Slough

Seepage Rate….

1.1 cfs/mile

Modeling Scenario

Additional groundwater recharge by increasing period of canal flow offset stream depletion



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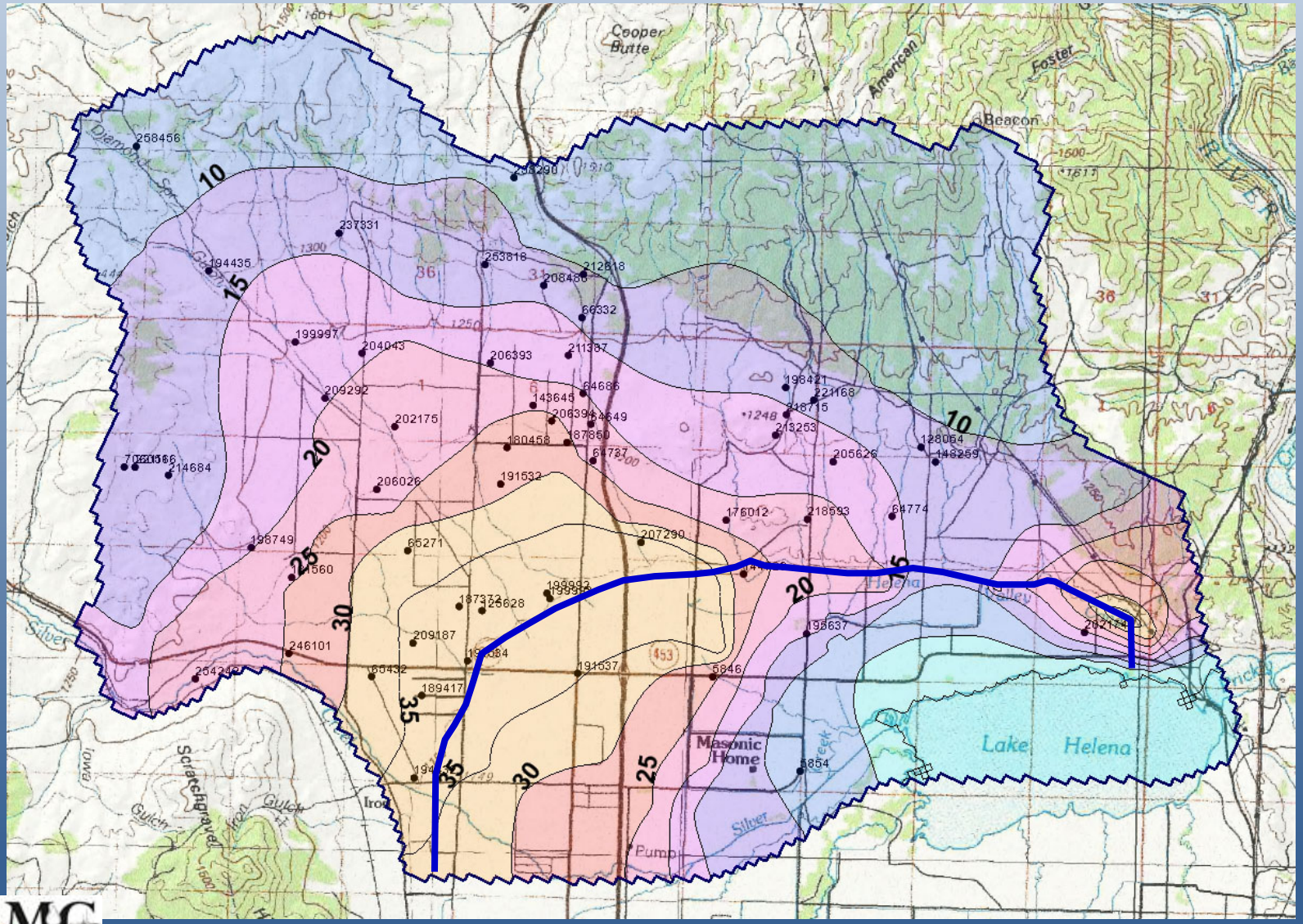
North Hills

Removing the influence of the HVID Canal and associated irrigated areas.



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