M. Riffey, 2007

Water Availability in the Clark Fork Basin

Water Supply and Growth Conference

March 10 - 11, 2008

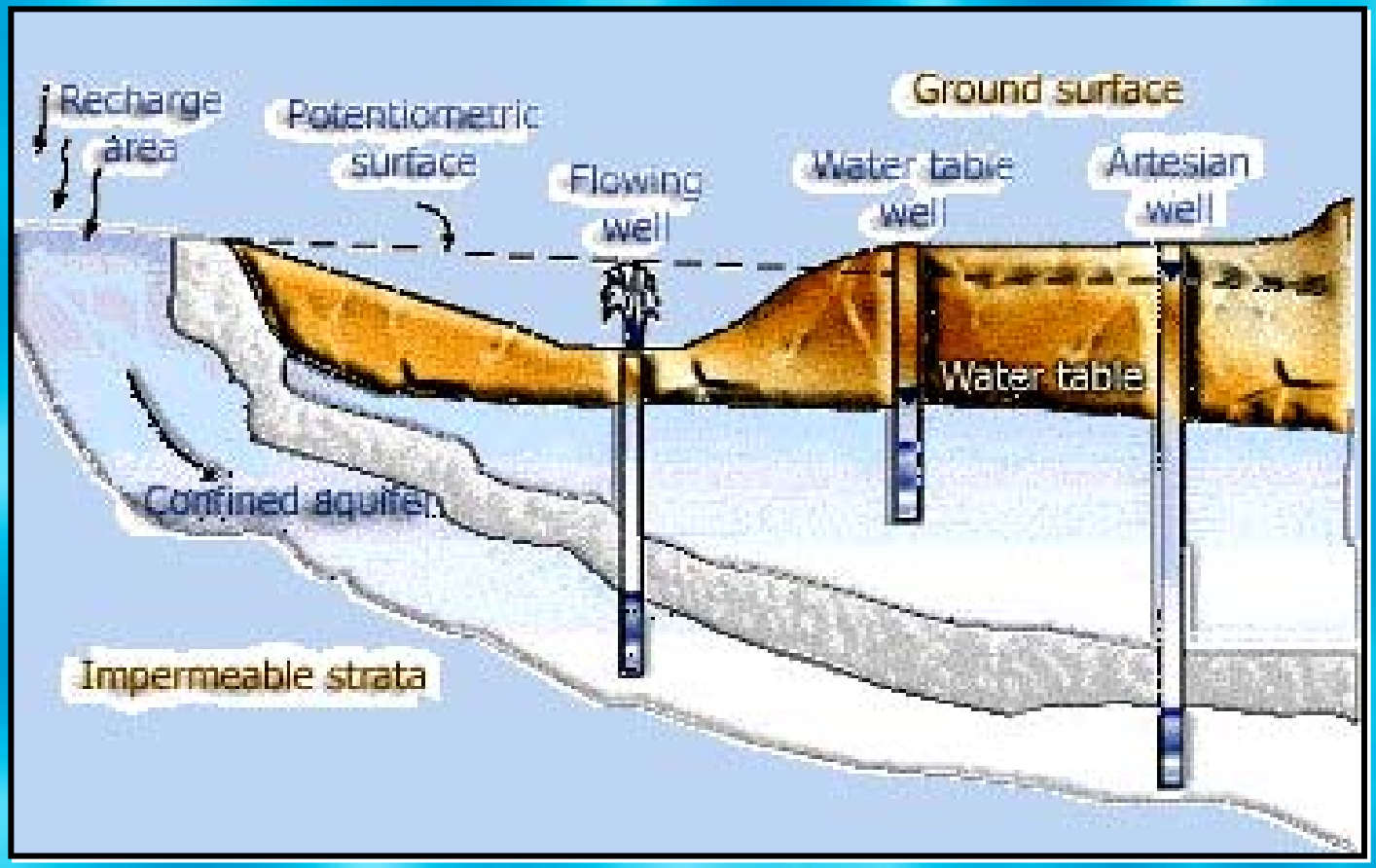
University of Montana

Clark Fork Basin Task Force

Missoula, Montana

Marc M. Spratt CPG, PH, CGWP
Sr. Hydrogeologist
RLK Hydro, Inc.
Kalispell, Montana

Hydrogeology



Surface water

Groundwater - Unconfined & Confined Aquifers

Typical Hydrogeological aquifer Characterization After MBMG,2008

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Upper Flathead Cross-Section

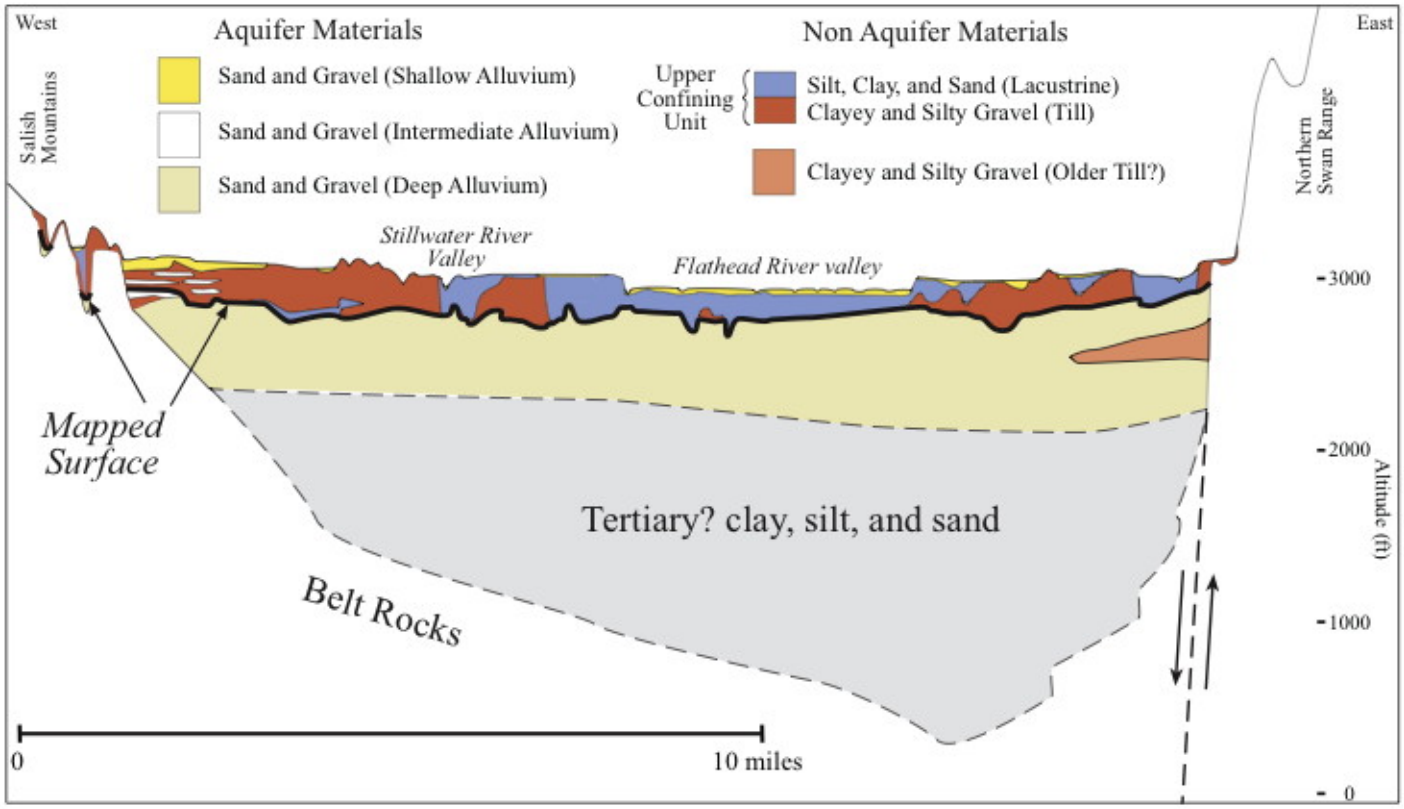

Figure 1. Diagrammatic cross section showing the stratigraphy of basin-fill units in the Kalispell valley.

After LaFave et al., 2004

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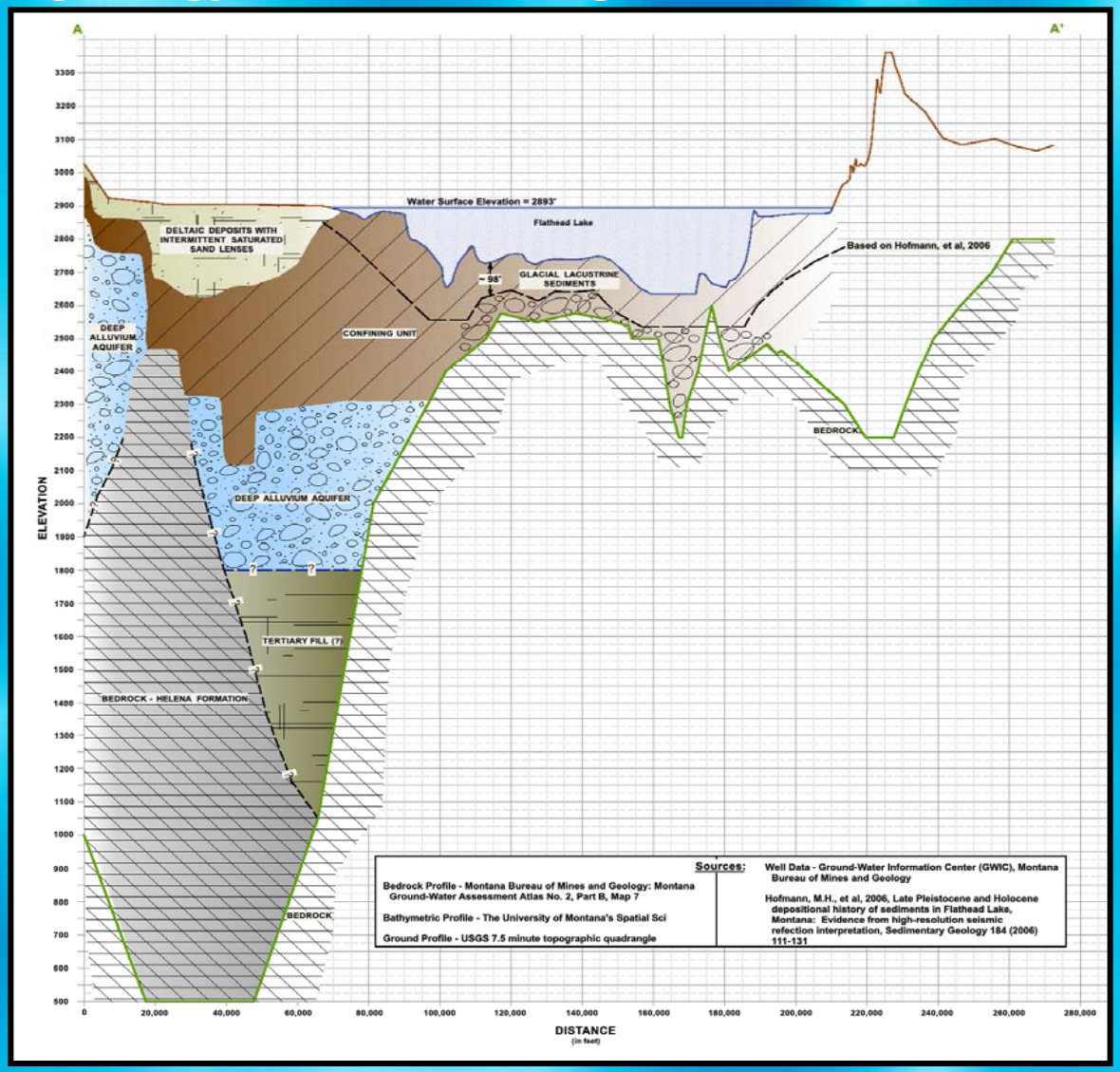
Hydrogeology- the twist

- Basin geology - varies among basins.



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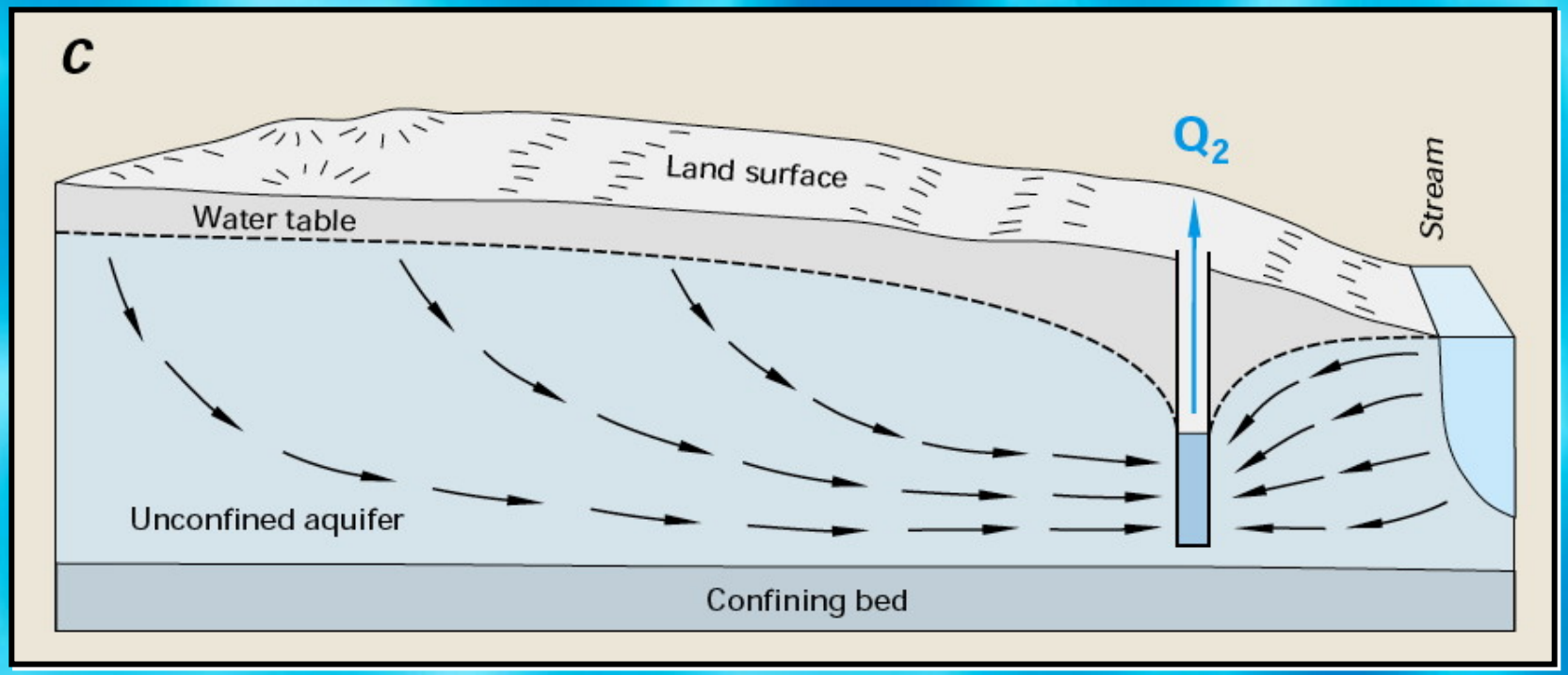
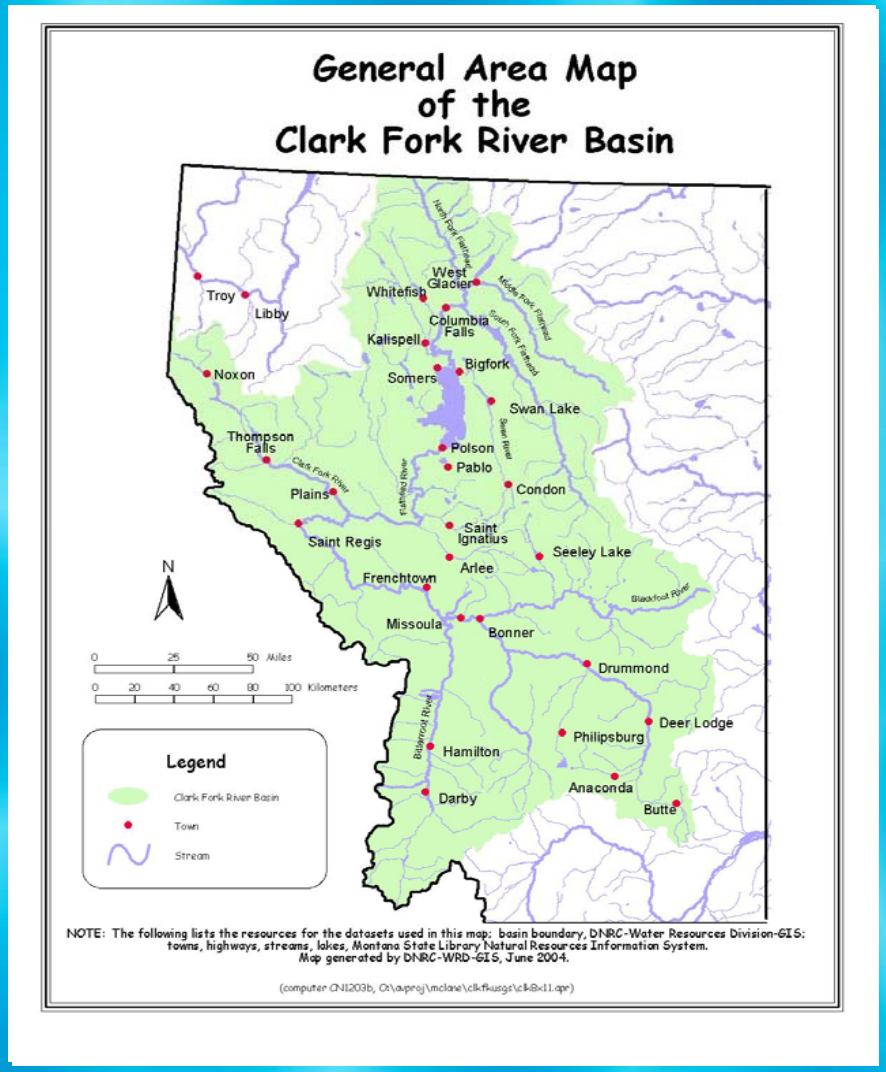
Hydrogeology - Alluvium



Typical surface water/groundwater connection

The Basin



Area - 21,833 Sq Miles
13,973,120 Acres

Dimensions
290 miles long
75 miles wide

Consists of
13 sub-basins

Average Annual Discharge
20,300 cfs
14,700,000 ac-ft

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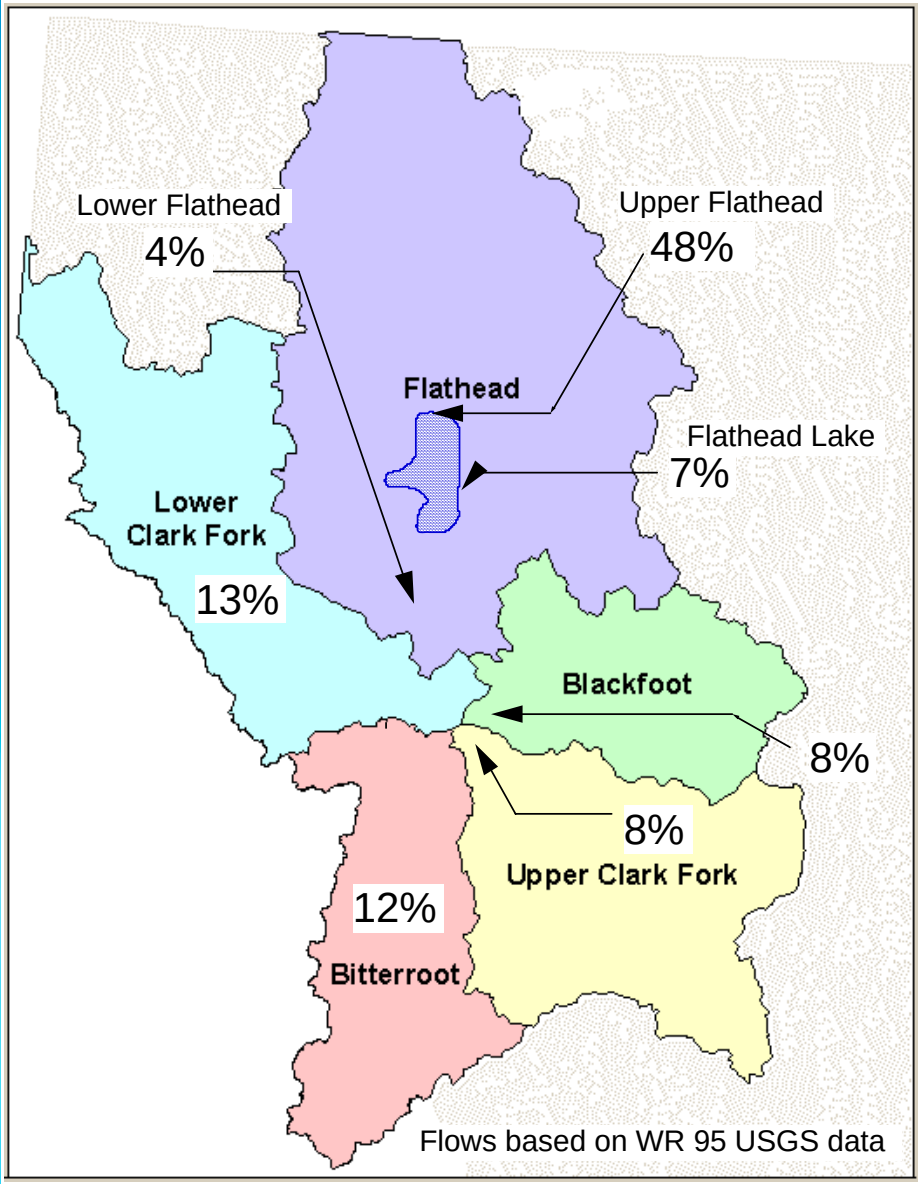
Watersheds



USGS 4th Order Code Flathead Basin

North Fork
Middle Fork
South Fork
Swan
Stillwater
Flathead Lake

Upper Clark Fork

Blackfoot
Upper Clark Fork
Flint-Rock
Bitterroot

Lower Clark Fork

Lower Flathead
Middle Clark Fork
Lower Clark Fork

59% of annual flow from Flathead

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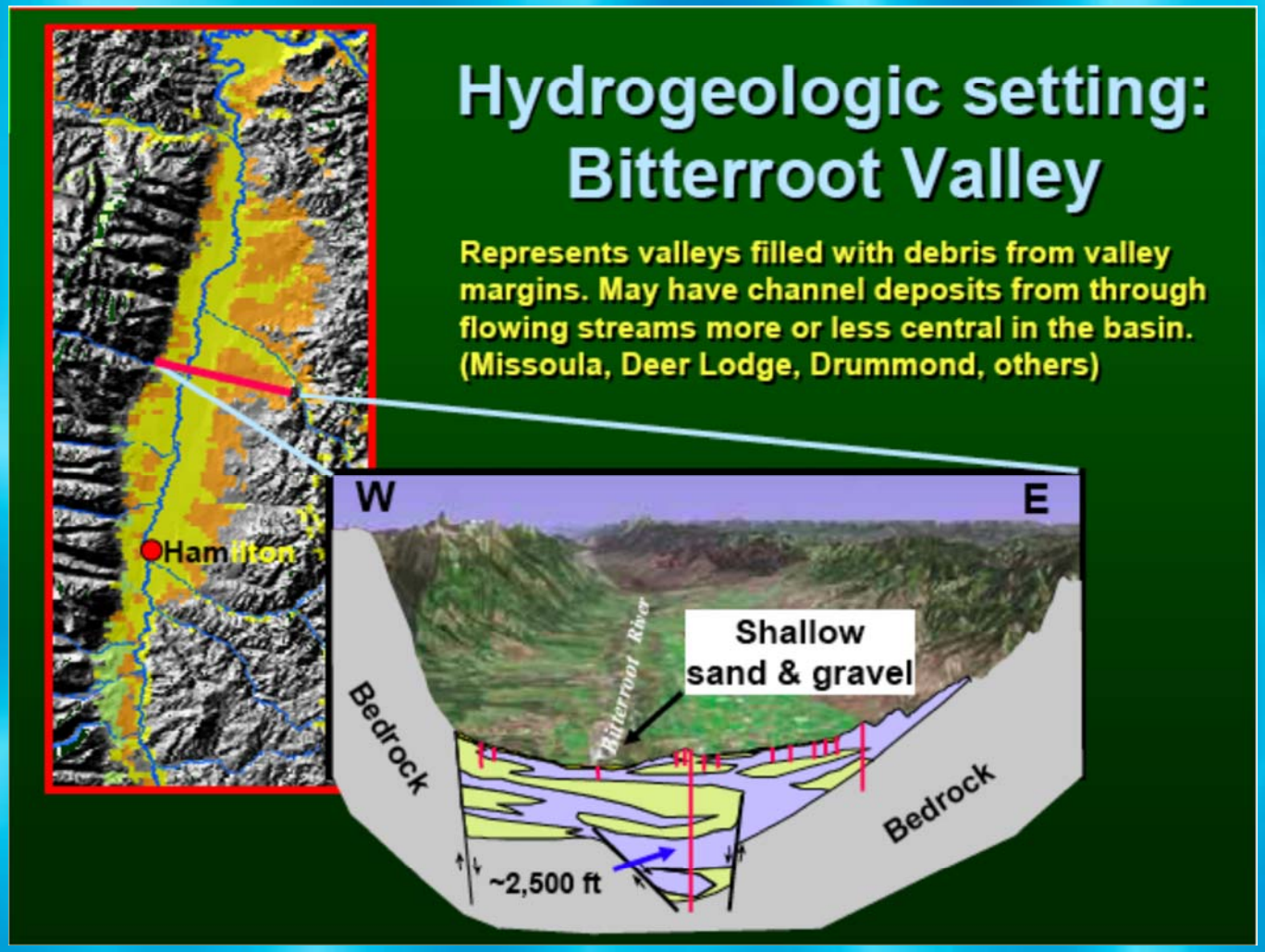
Bitterroot



Patton et al. 2006

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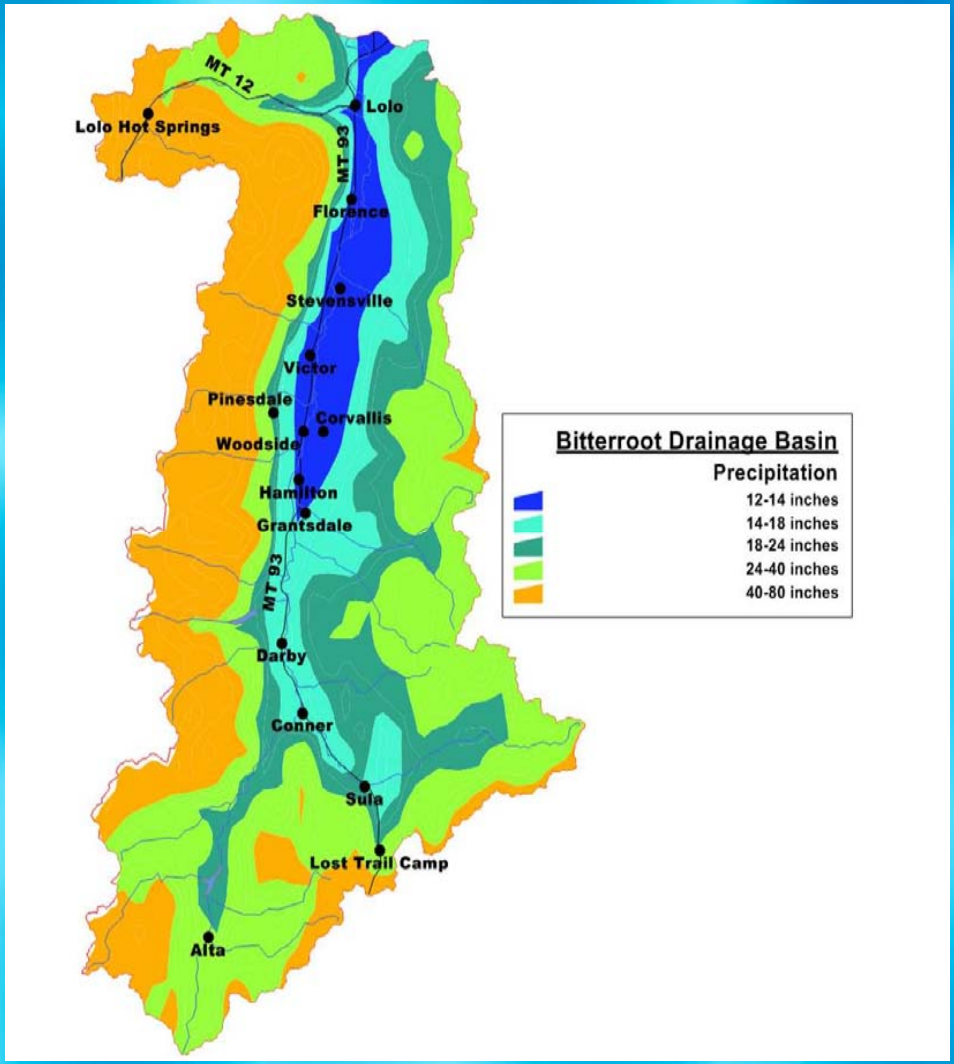
Bitterroot - Precipitation



PPT Range 12 - 80 inches

Total Ave. Annual Precipitation.
2,970,028 ac-ft/yr

Total Ave. Annual Runoff **(Farnes, 1978)**
2,047,704 ac-ft/yr

Total Ave. Annual Recharge **(Stephens, 1995))**
594,006 ac-ft/yr

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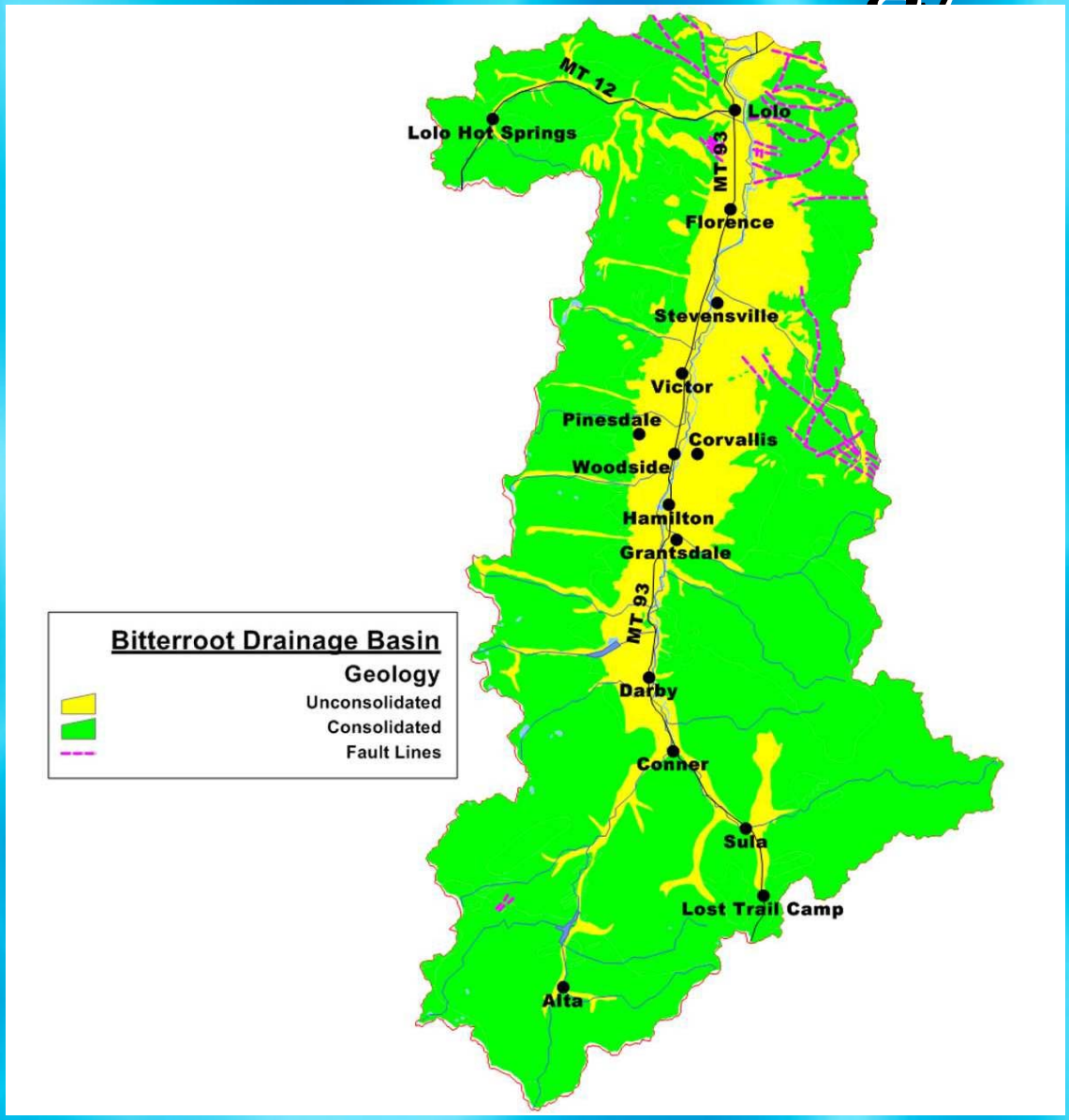
Bitterroot - Geology



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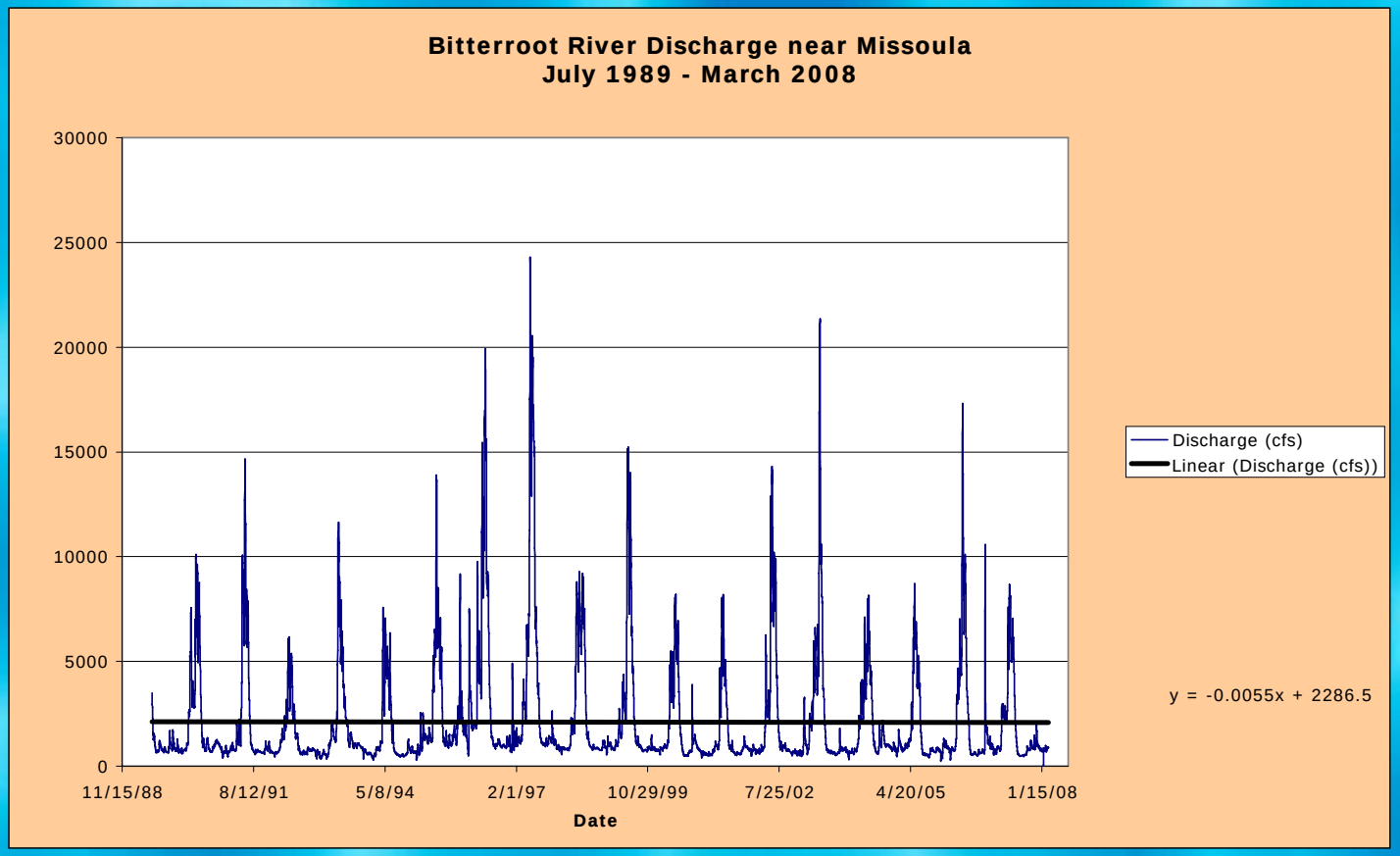
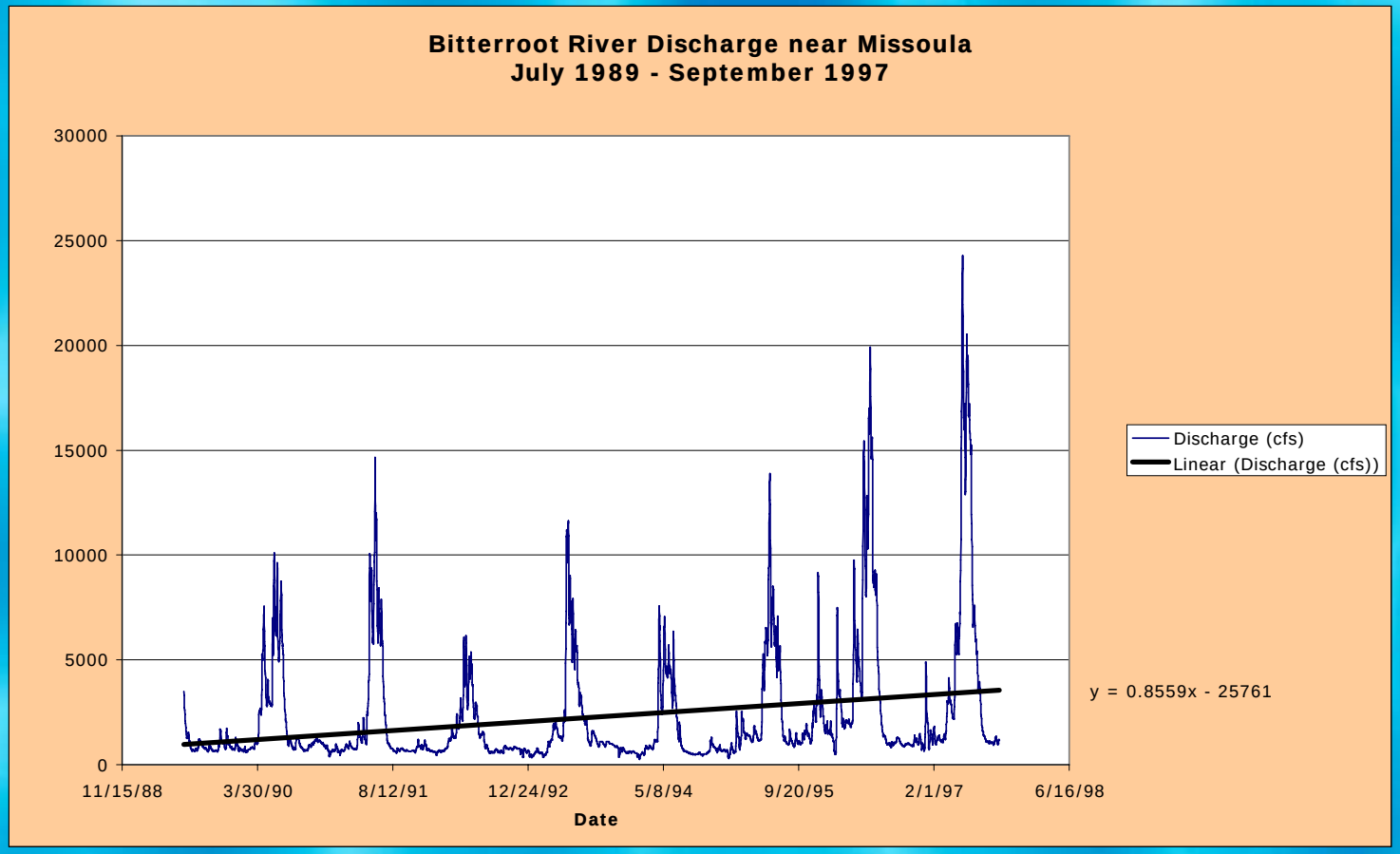
Bitterroot - Discharge



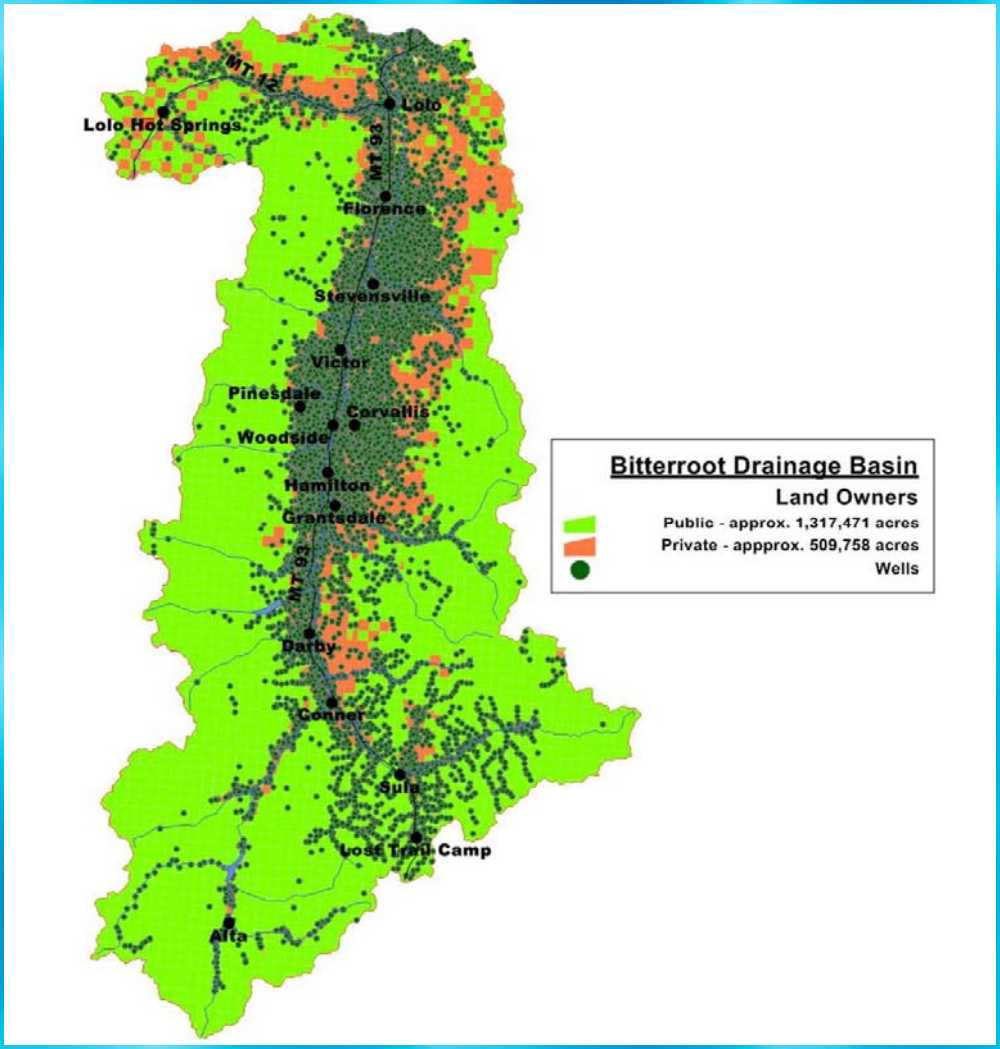
Note: Small negative trend with drought years included.

Bitterroot - Discharge



Note: Positive trend prior to drought.

Bitterroot - Wells



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Bitterroot - Well Impact

- A regression analysis of the number wells against the difference in base flows suggests no significant relationship (LaFave, 2007).

- There was a much better correspondence between long-term annual precipitation data and the difference in base flows (LaFave, 2007).

- Ground-water use represents a minor percentage of water that is stored in, and transmitted through, the shallow basin-fill aquifer (LaFave, 2007).

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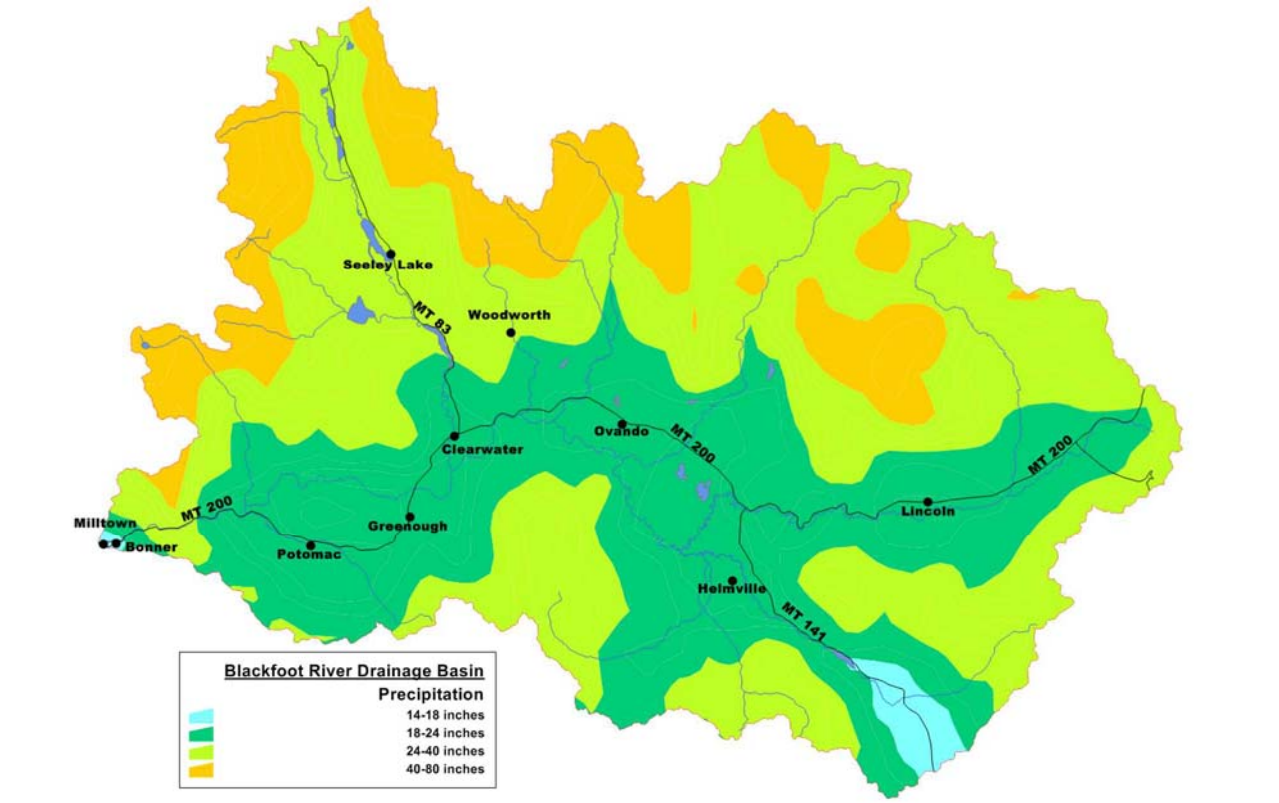
Blackfoot Precipitation



Average Annual Precipitation **2,327,399**

Average Annual Precipitation ranges from 14 - 80 in./yr.

Average Annual Recharge **465,480**

Average Annual Runoff **1,295,112 ac-ft/yr**

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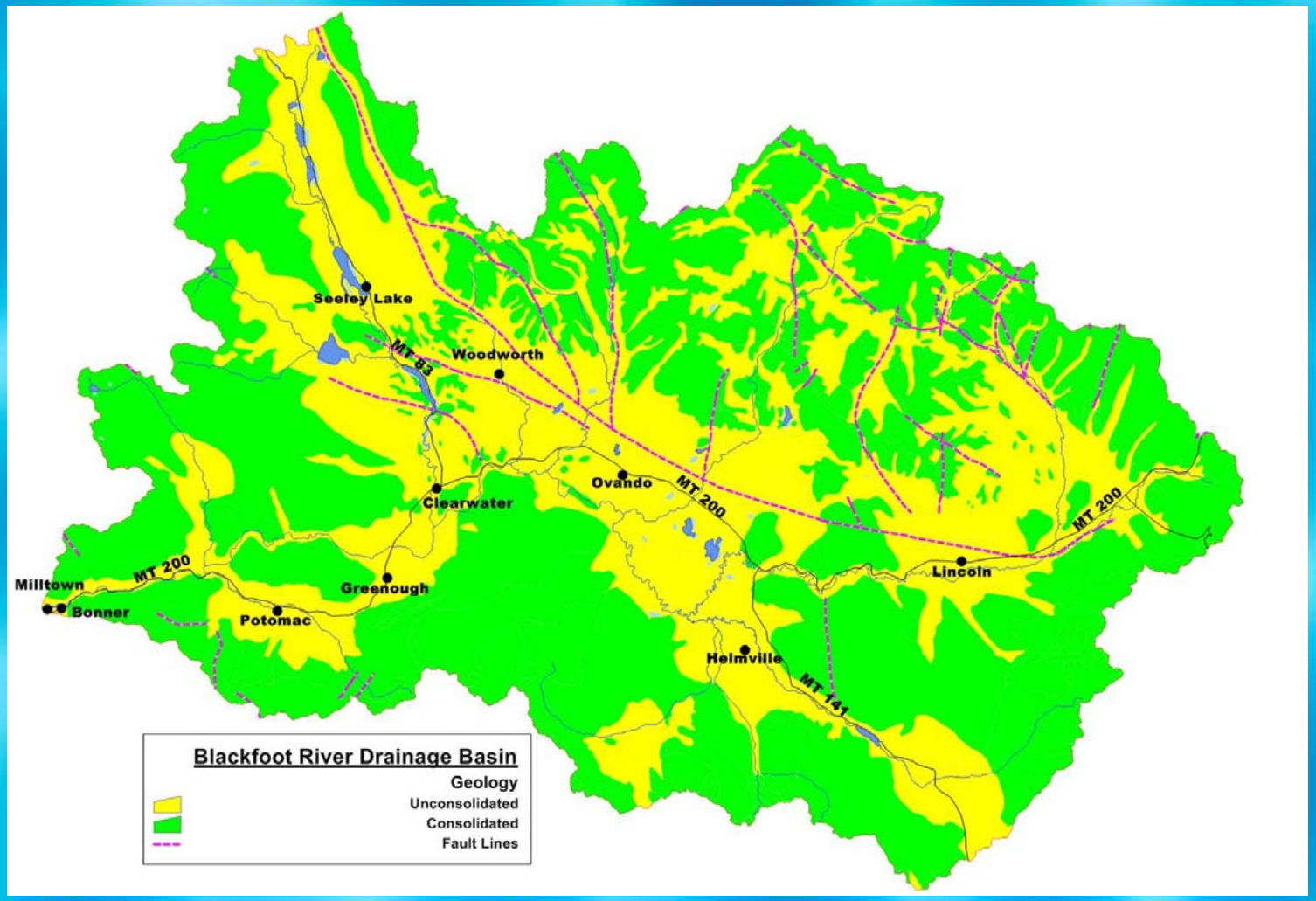
Blackfoot Geology



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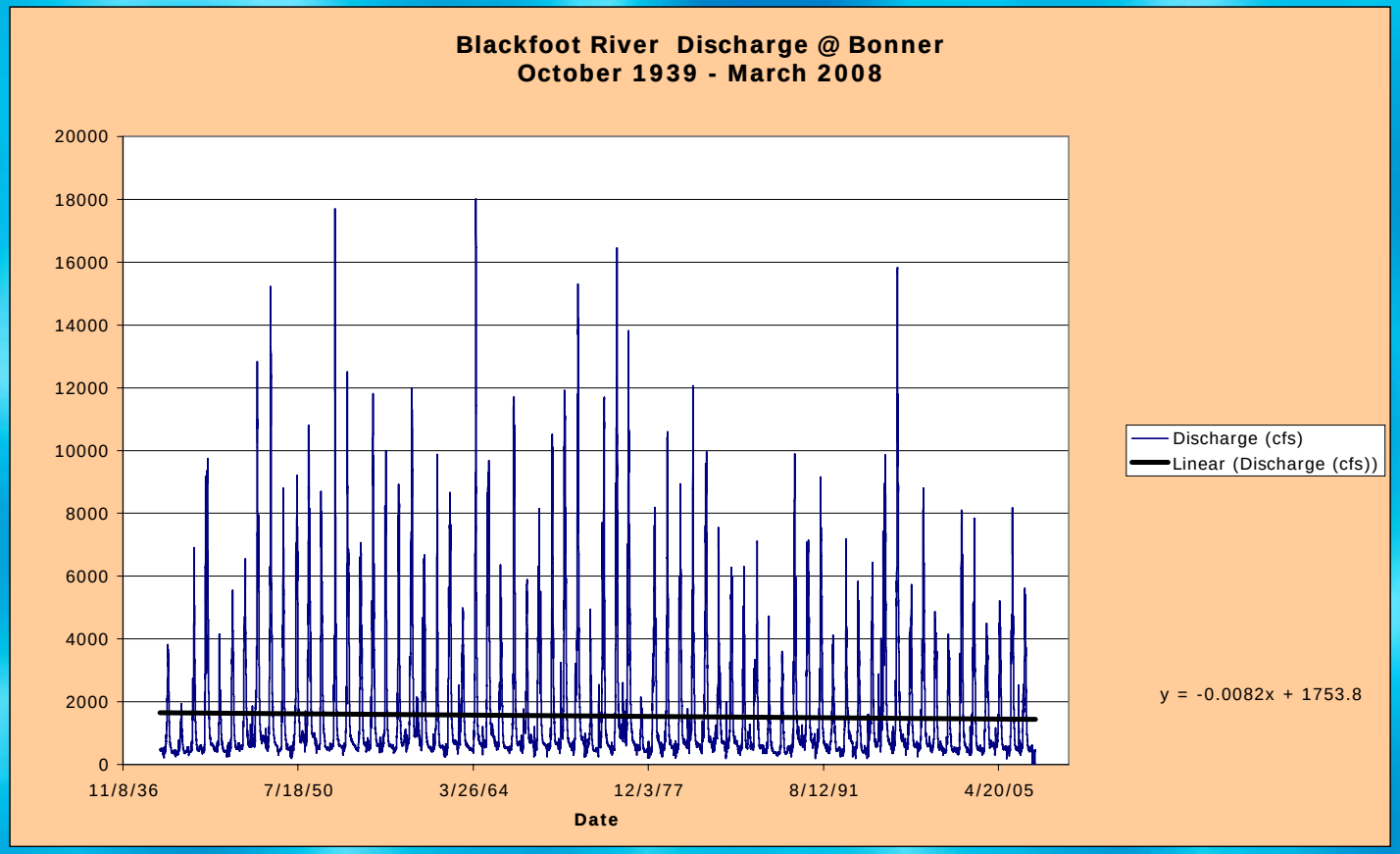
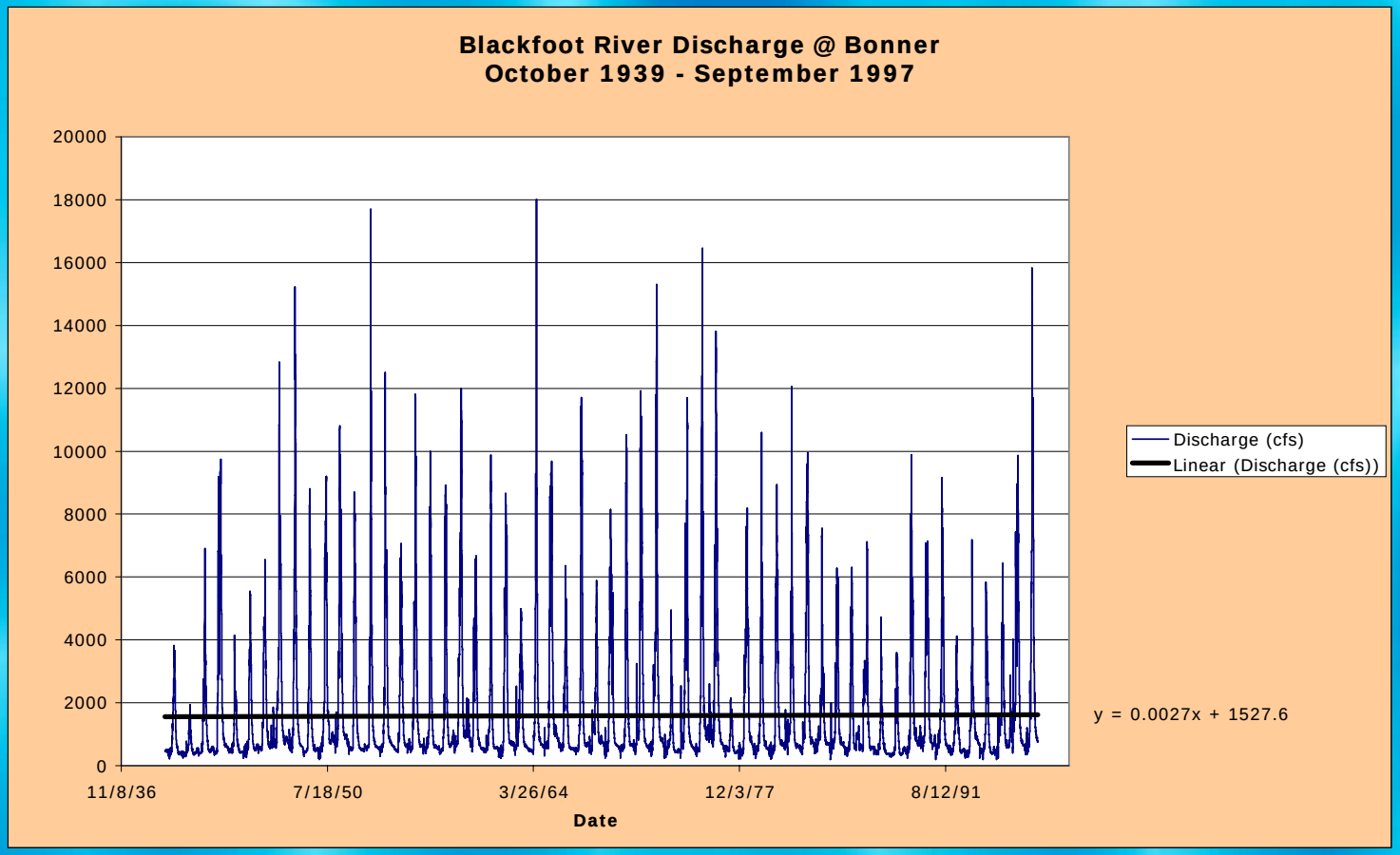
Blackfoot Discharge



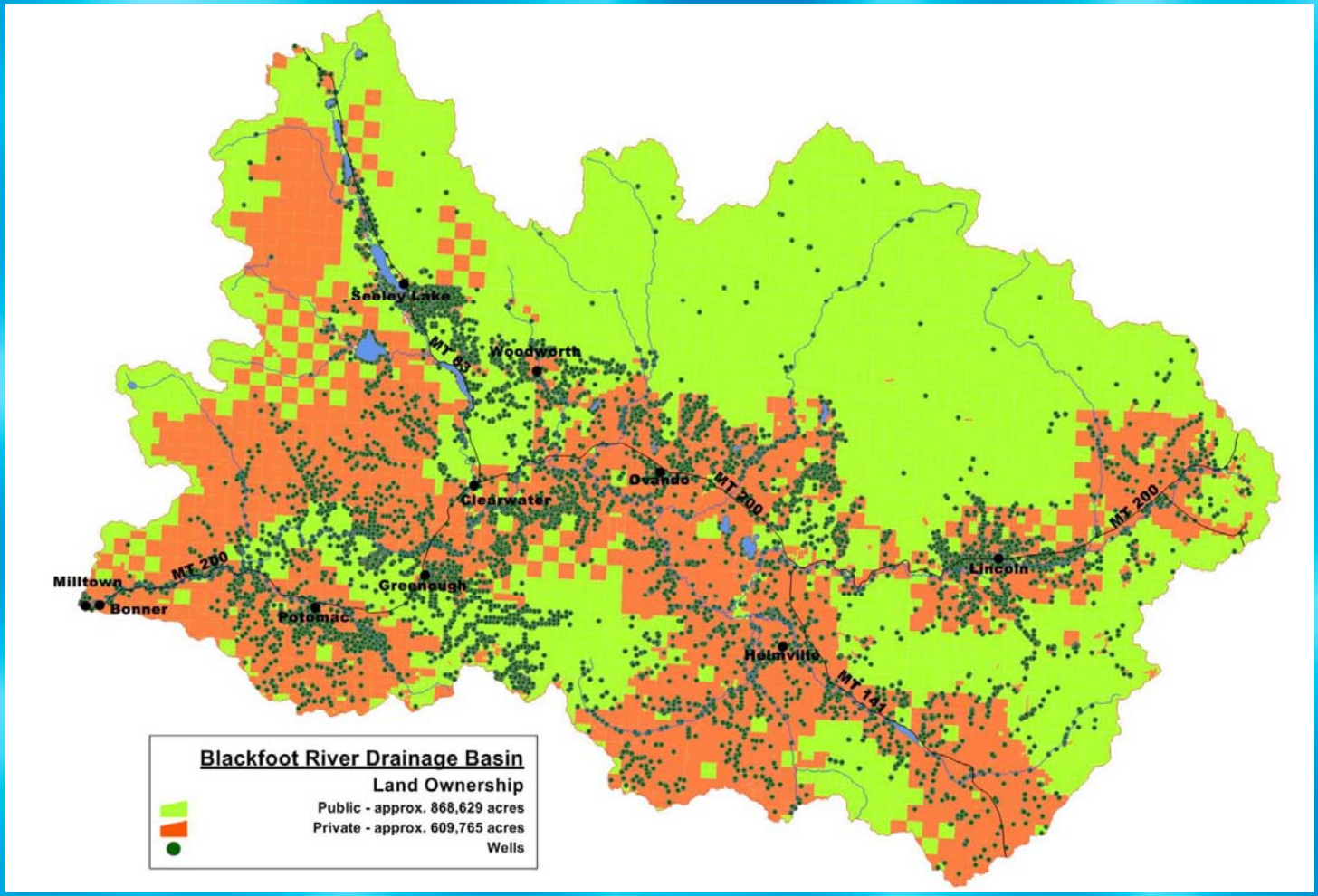
Note: small negative trend.

Blackfoot Discharge cont.



Note: Positive trend.

Blackfoot wells



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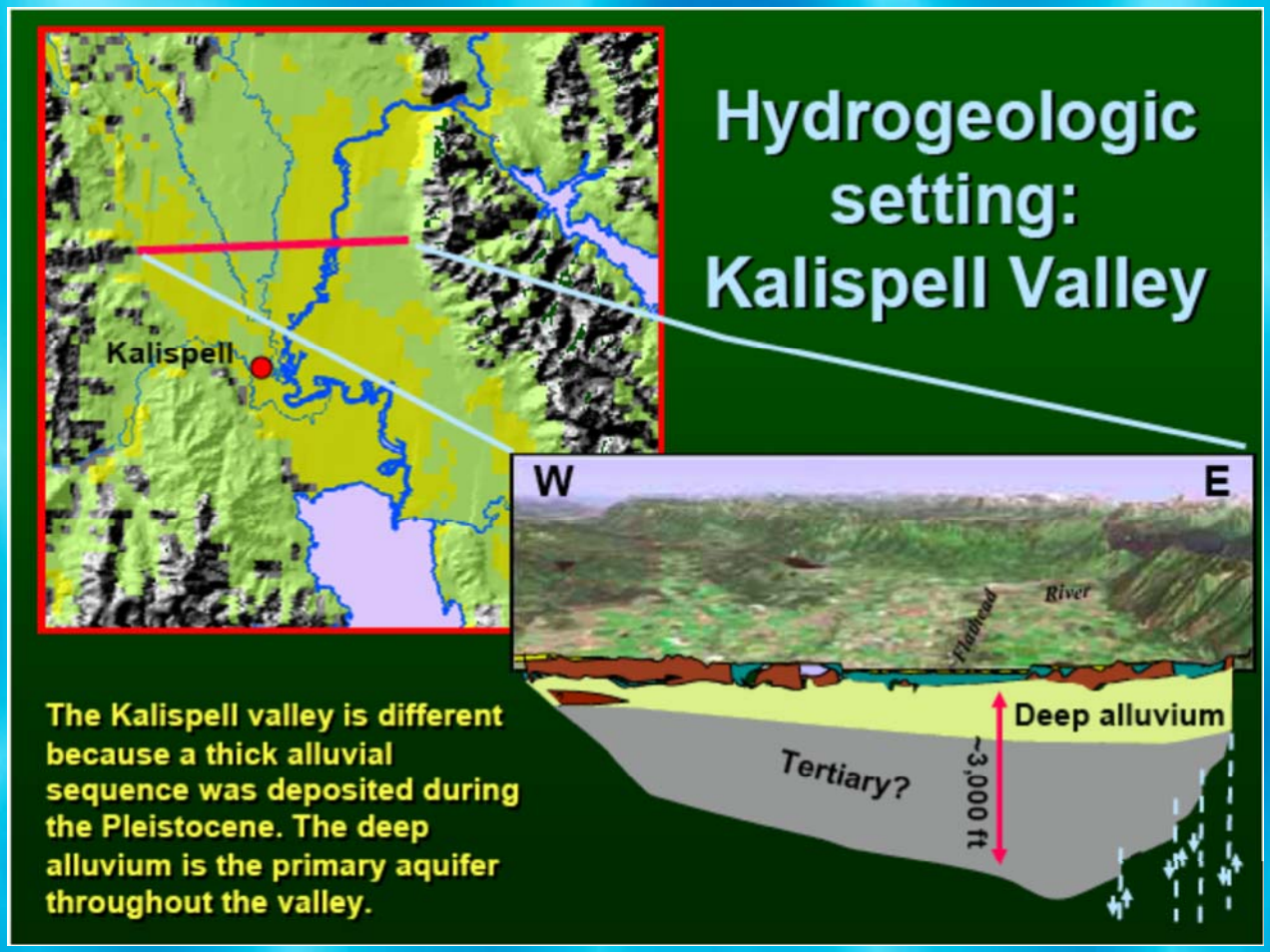
Flathead



Patton et al. 2006

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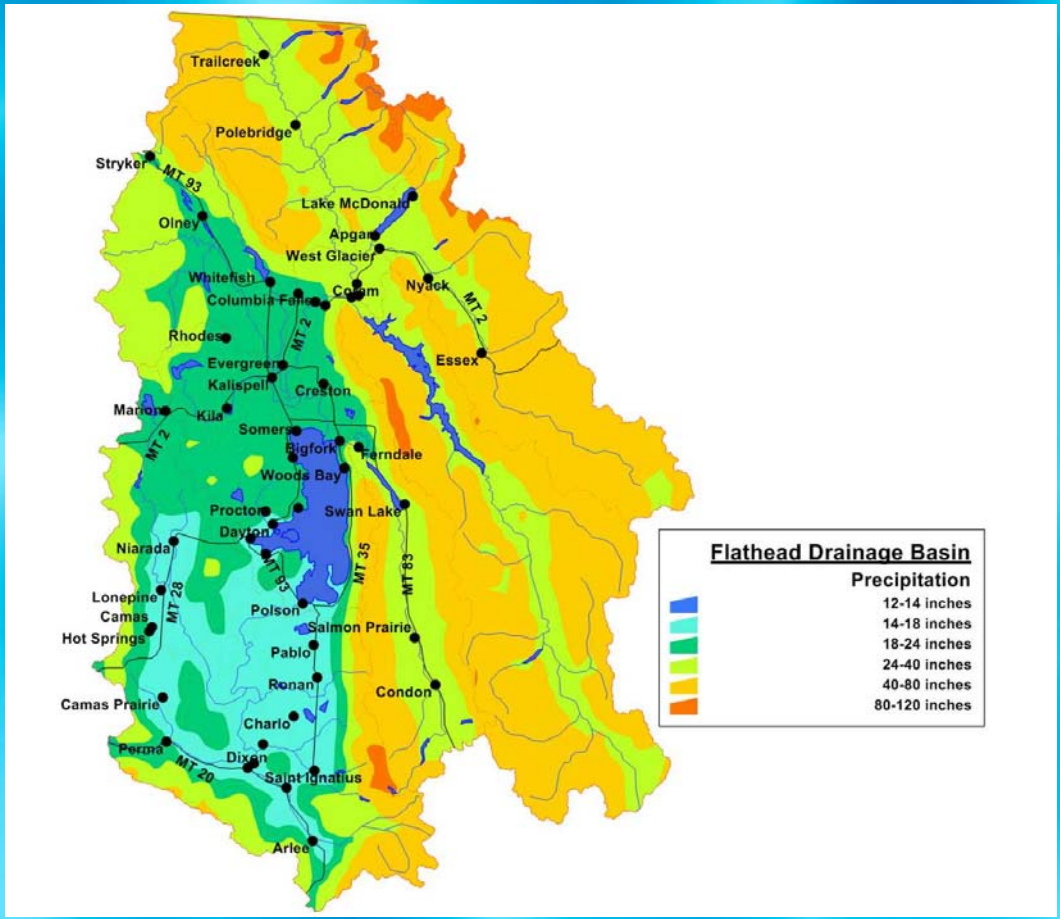
Flathead - Precipitation



Average Annual Precipitation
9,344,820 Ac-Ft/yr.

Average Annual Precipitation ranges from 12 - 120 in./yr.

Average Annual Recharge
1,868,964 Ac-Ft/yr.

Average Annual Runoff
7,526,702 Ac-Ft/yr.

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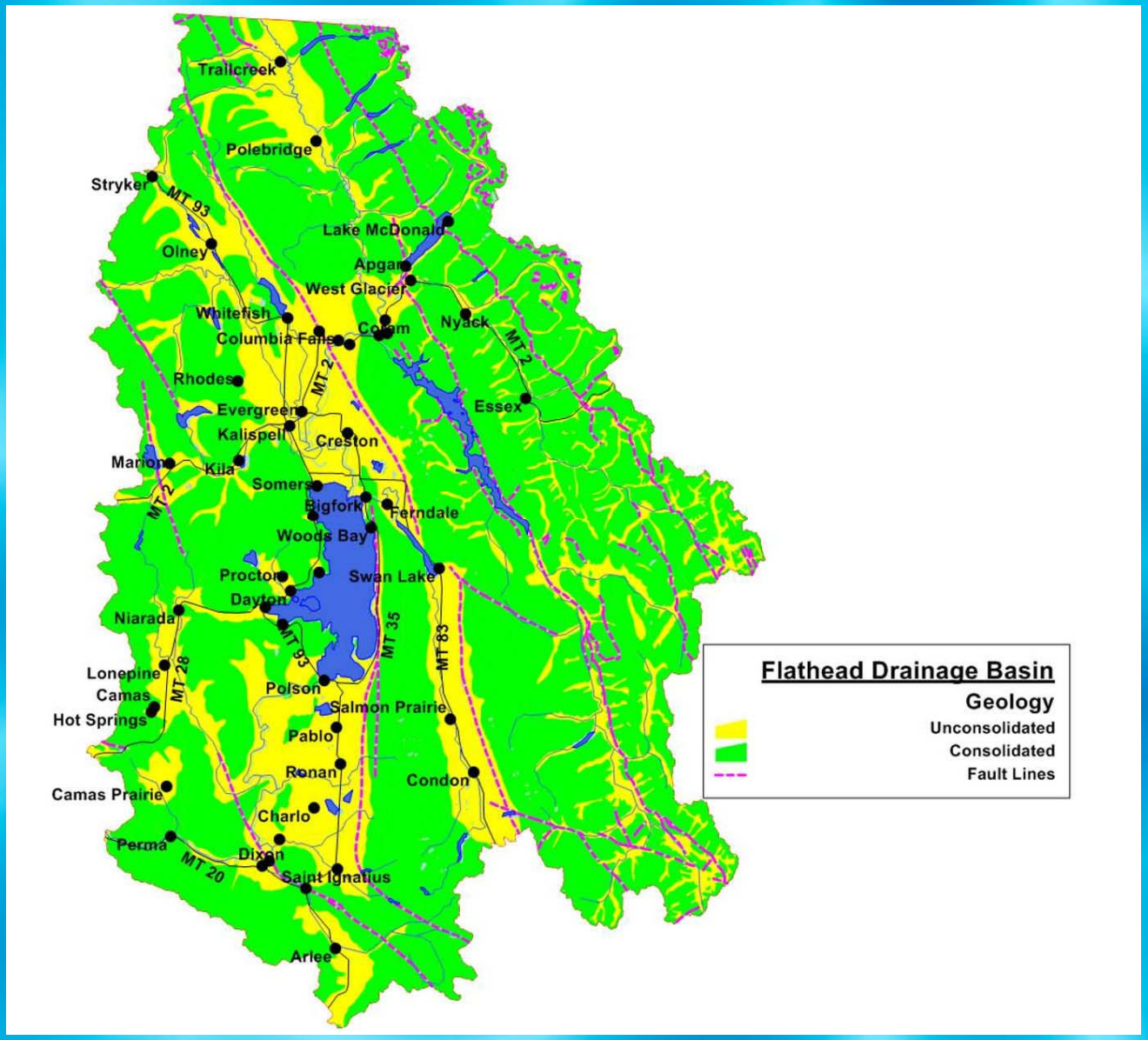
Flathead - Geology



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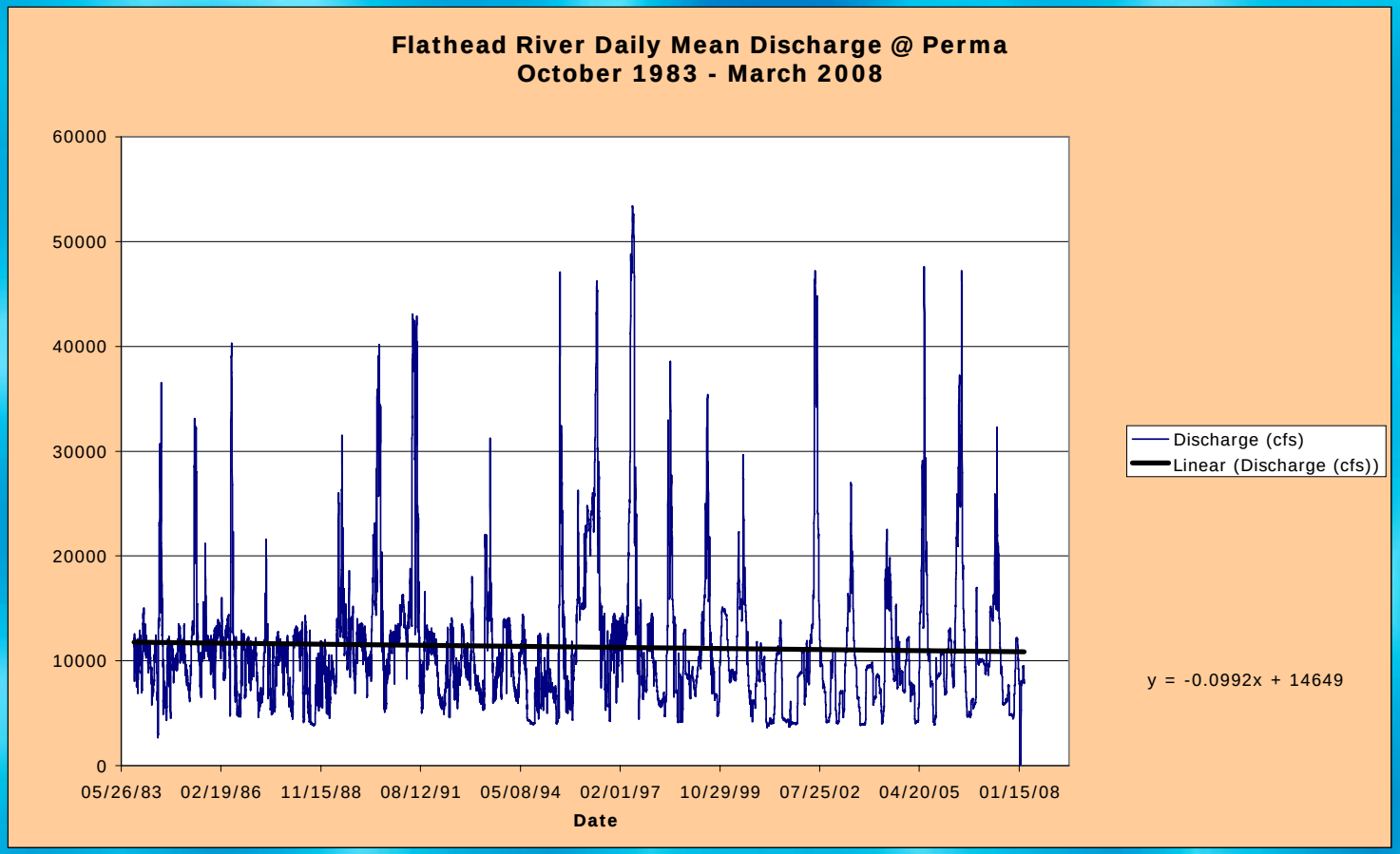
Flathead River - Discharge



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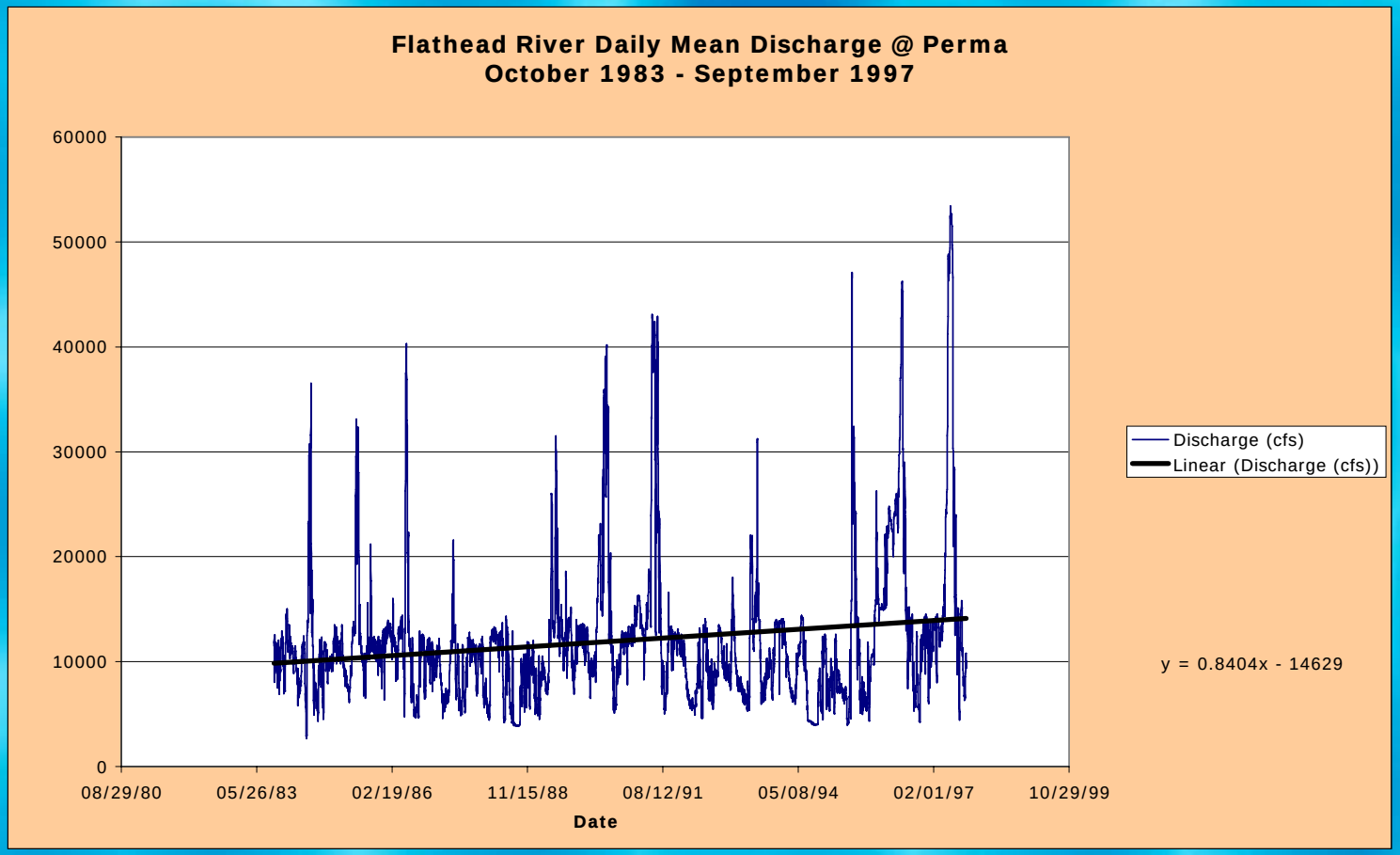
Flathead River - Discharge



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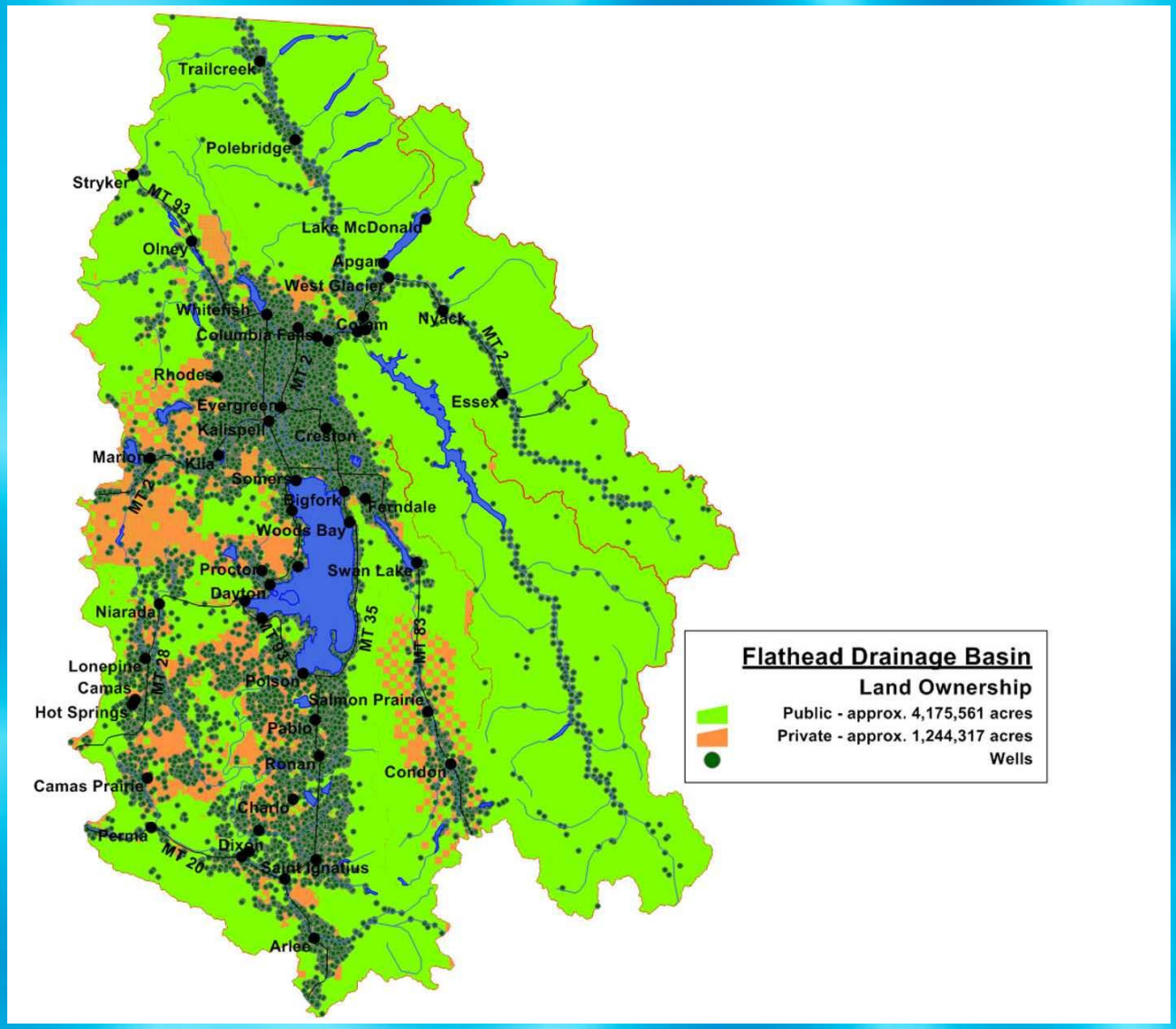
Flathead - Wells



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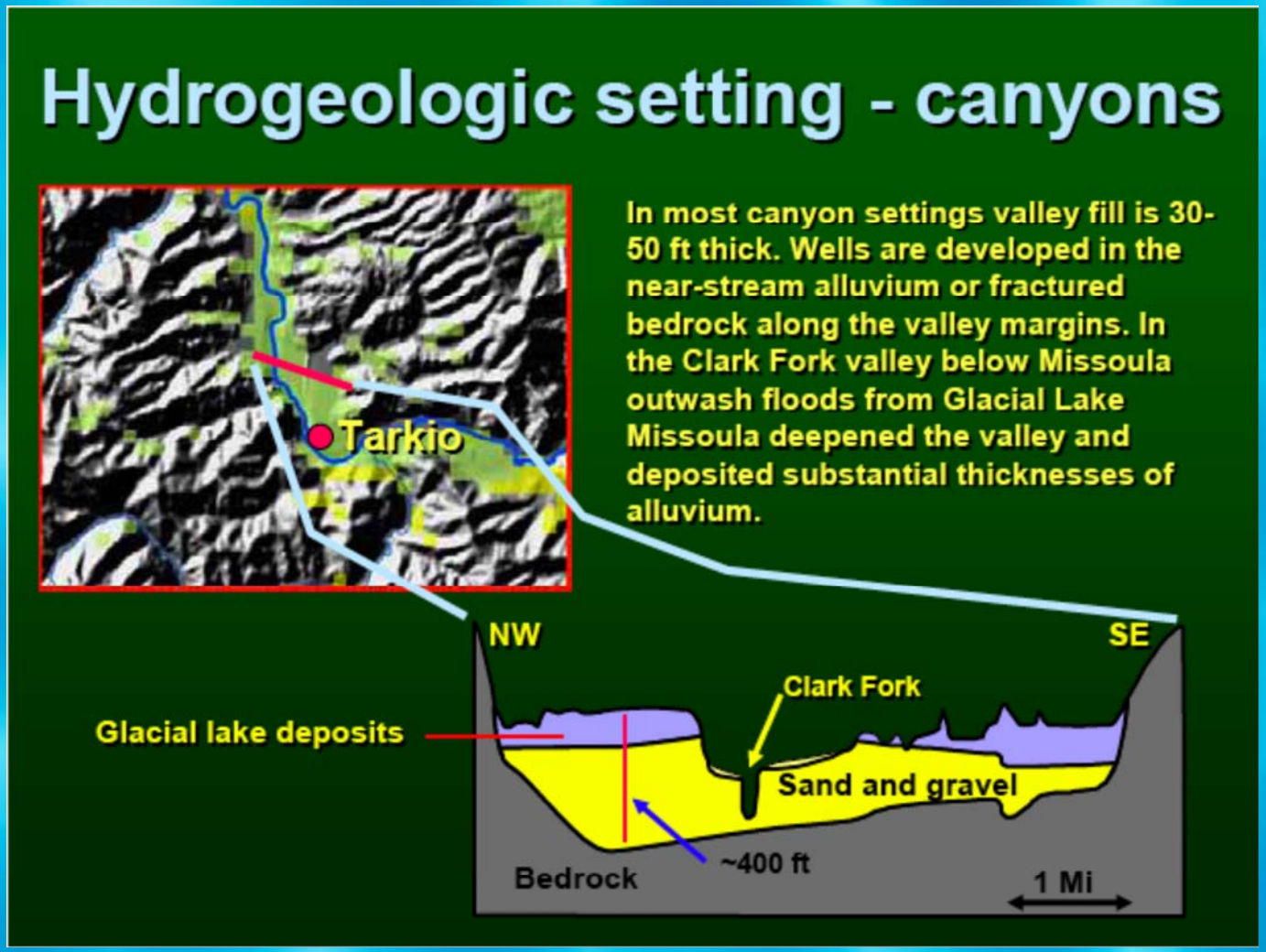
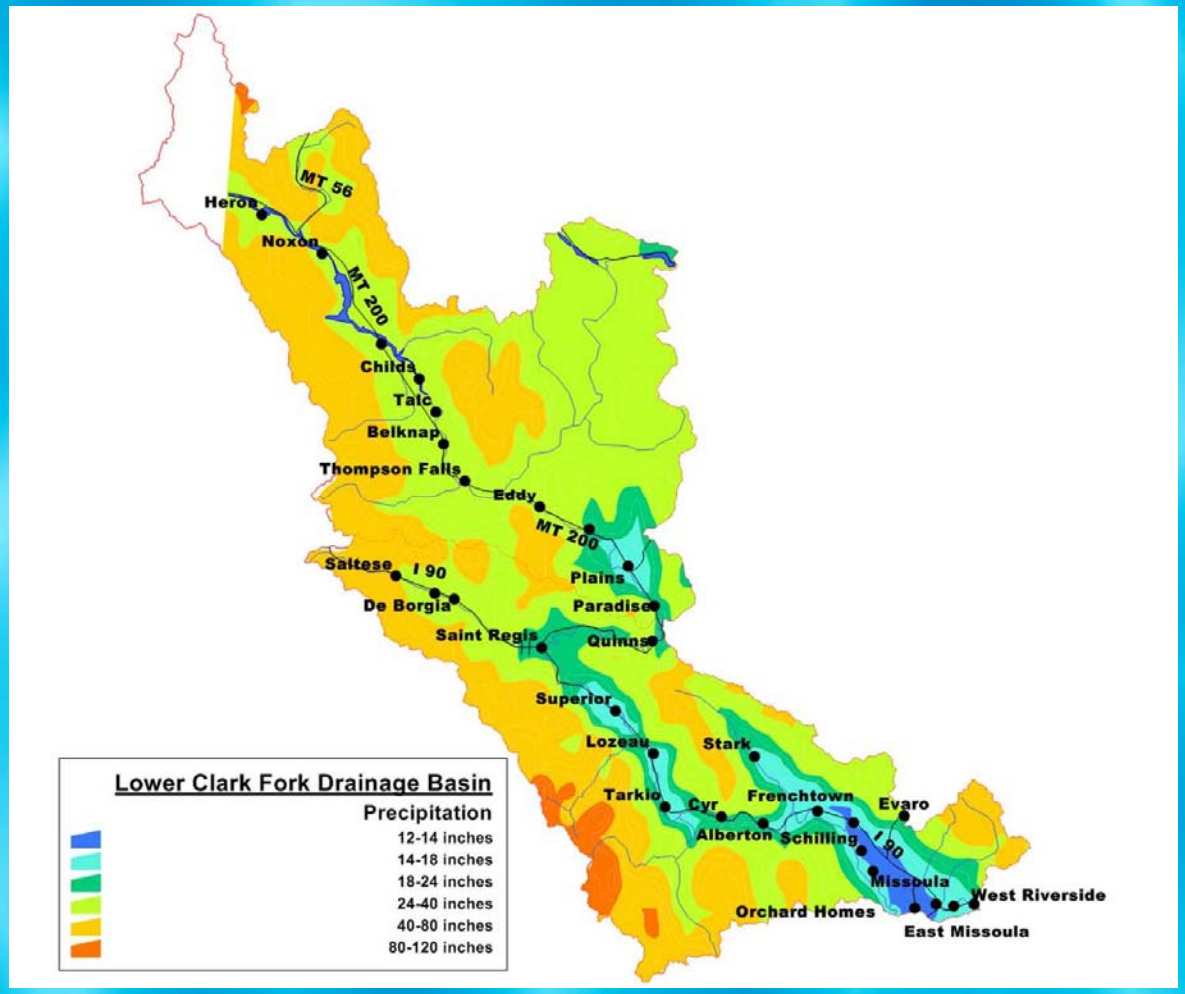
Lower Clark Fork



Patton et al. 2006

Lower Clark Fork- Precipitation



Average Annual Precipitation

4,633,912 Ac-Ft/yr.

Average Annual Precipitation ranges from 12 - 120 in./yr.

Average Annual Recharge

926,782 Ac-Ft/yr.

Average Annual Runoff

3,644,323 Ac-Ft/yr.

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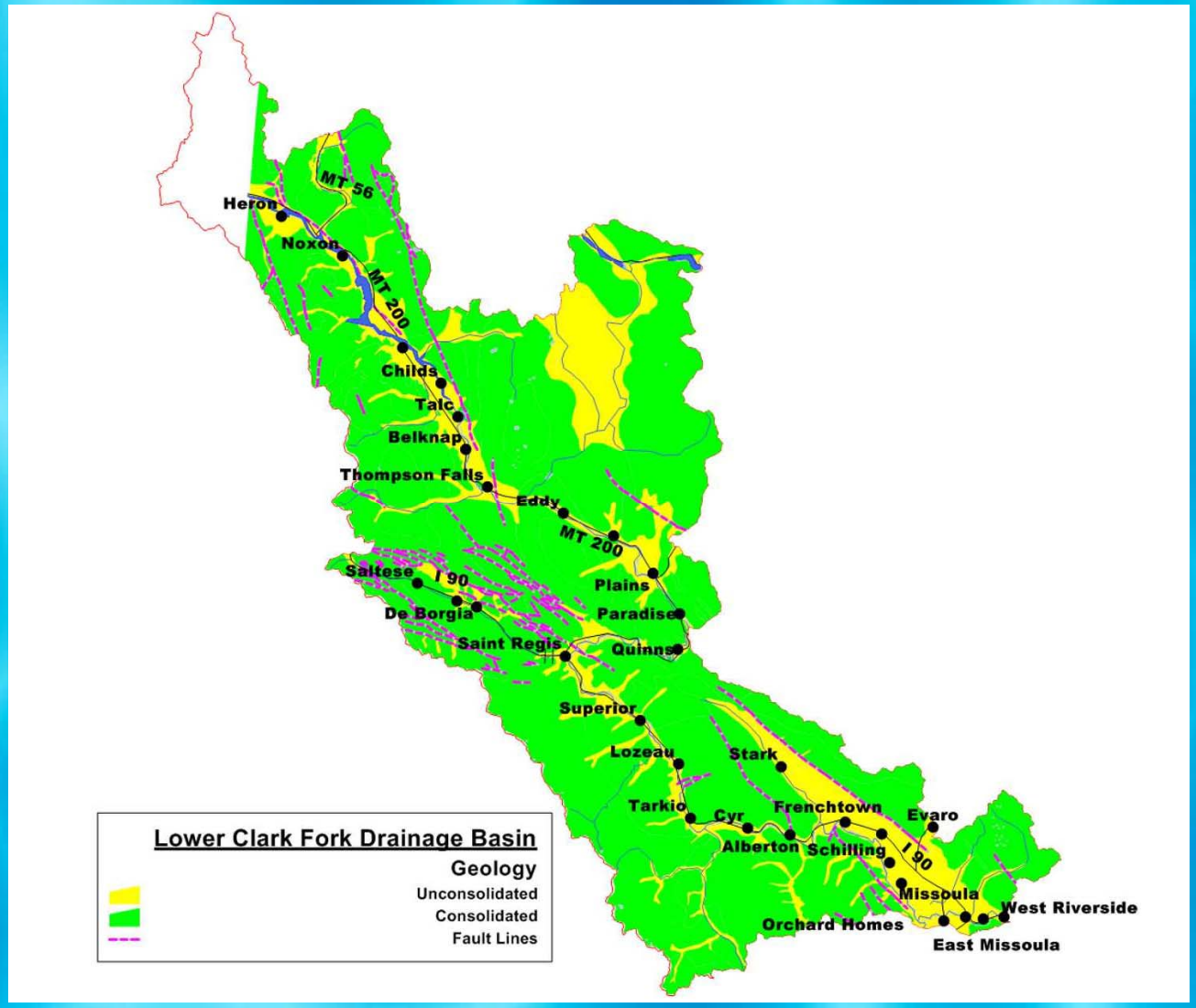
Lower Clark Fork- Geology



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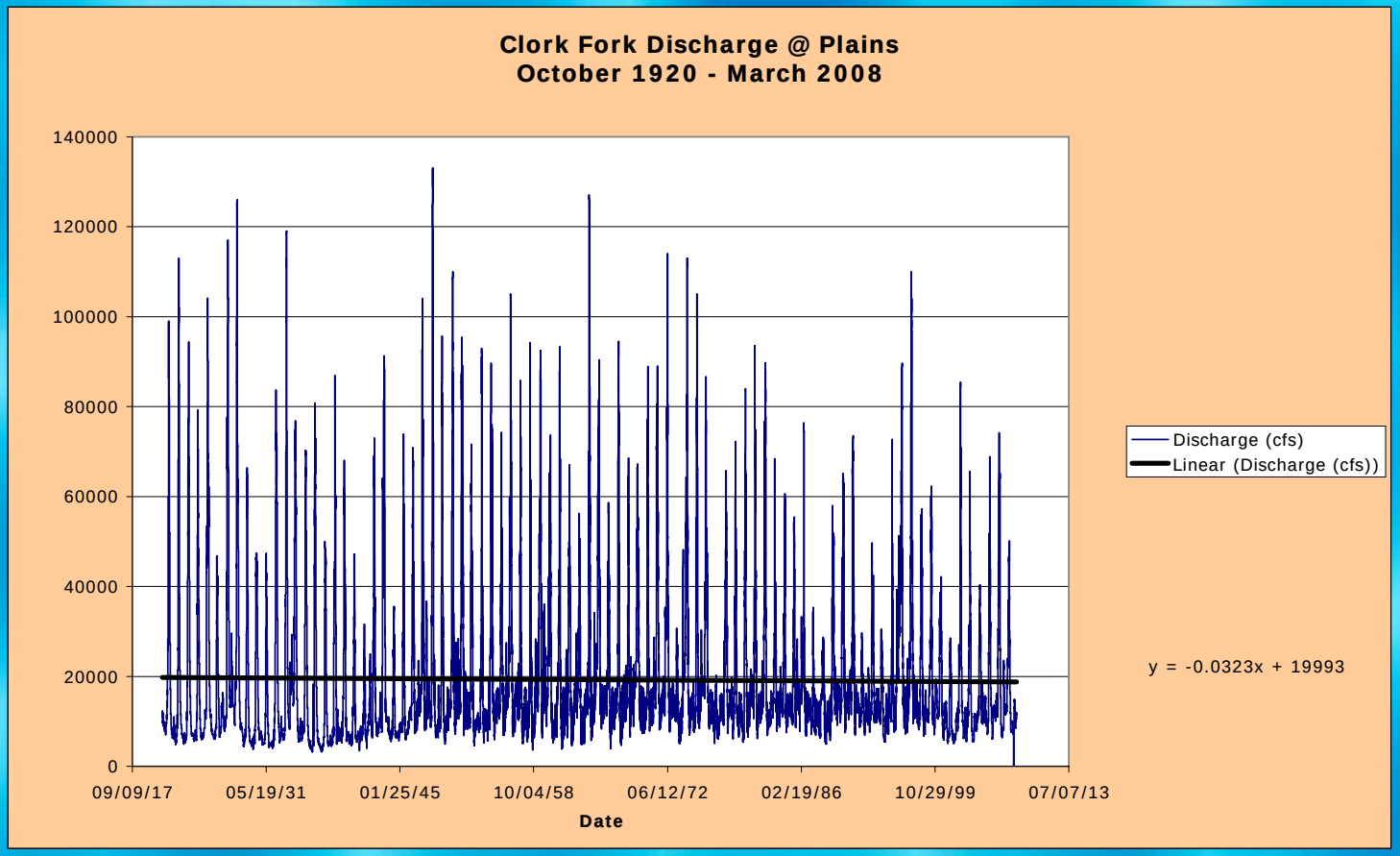
Lower Clark Fork- Discharge



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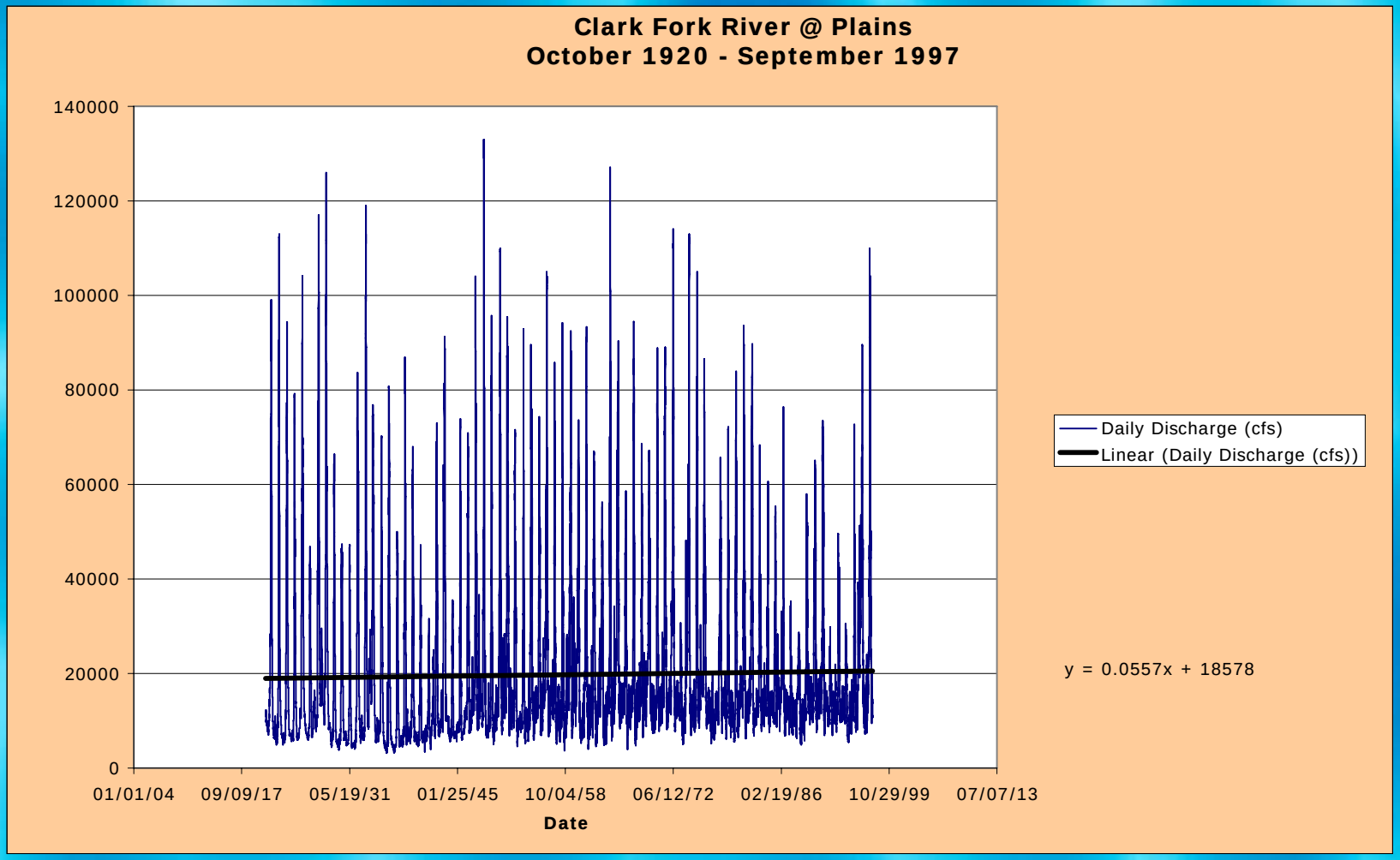
Lower Clark Fork- Discharge



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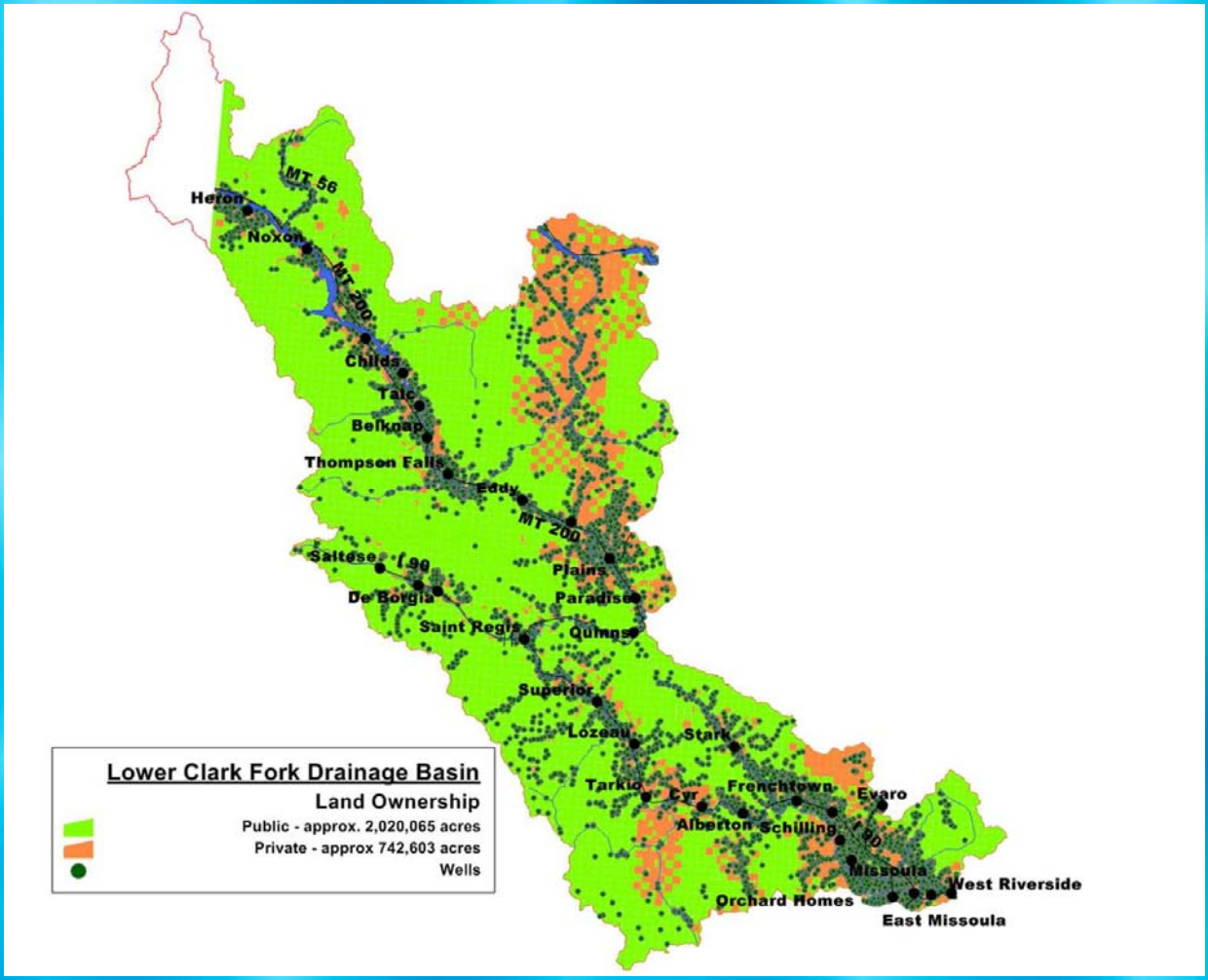
Lower Clark Fork- Wells



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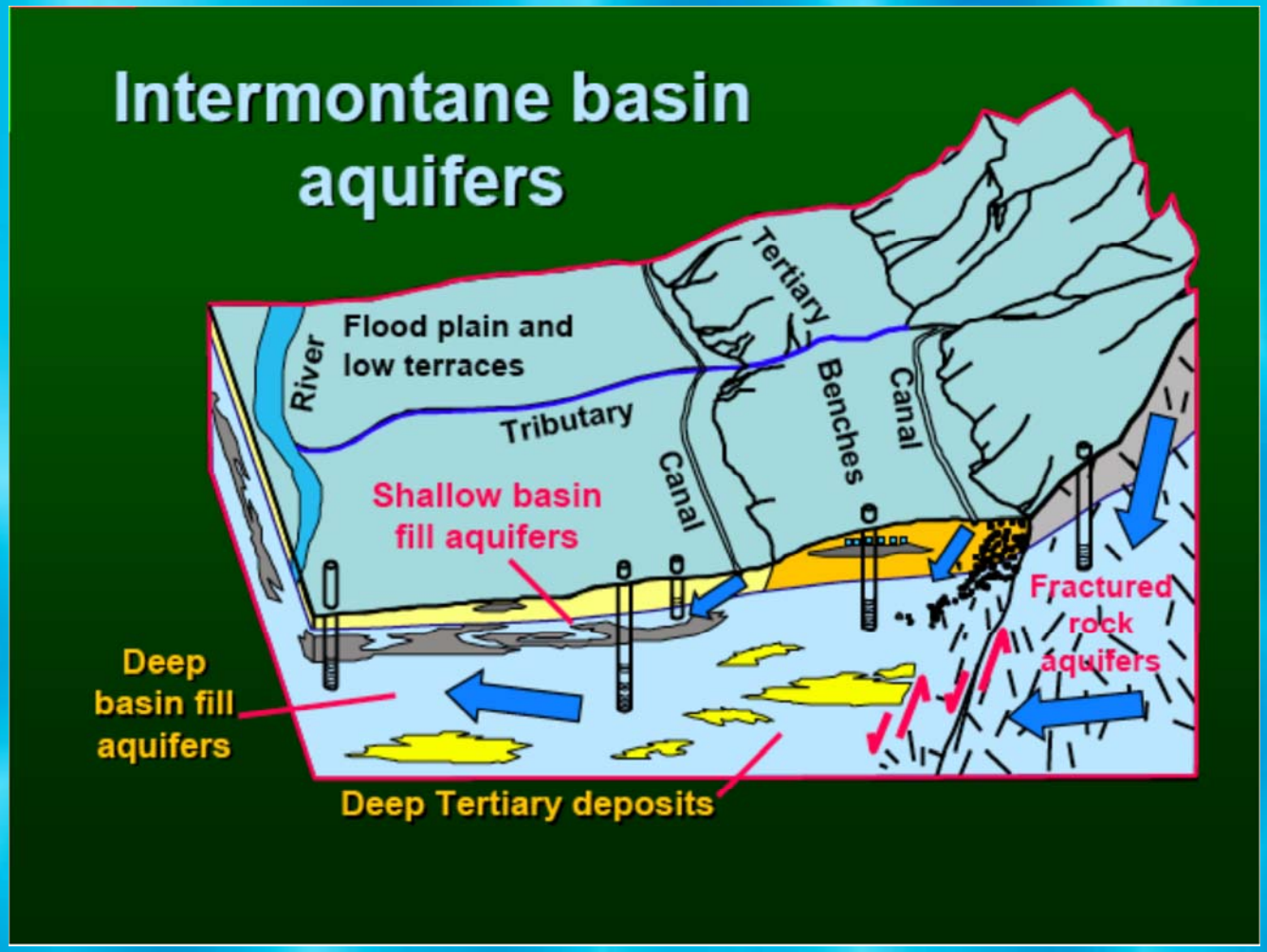
Upper Clark Fork



Patton et al. 2006

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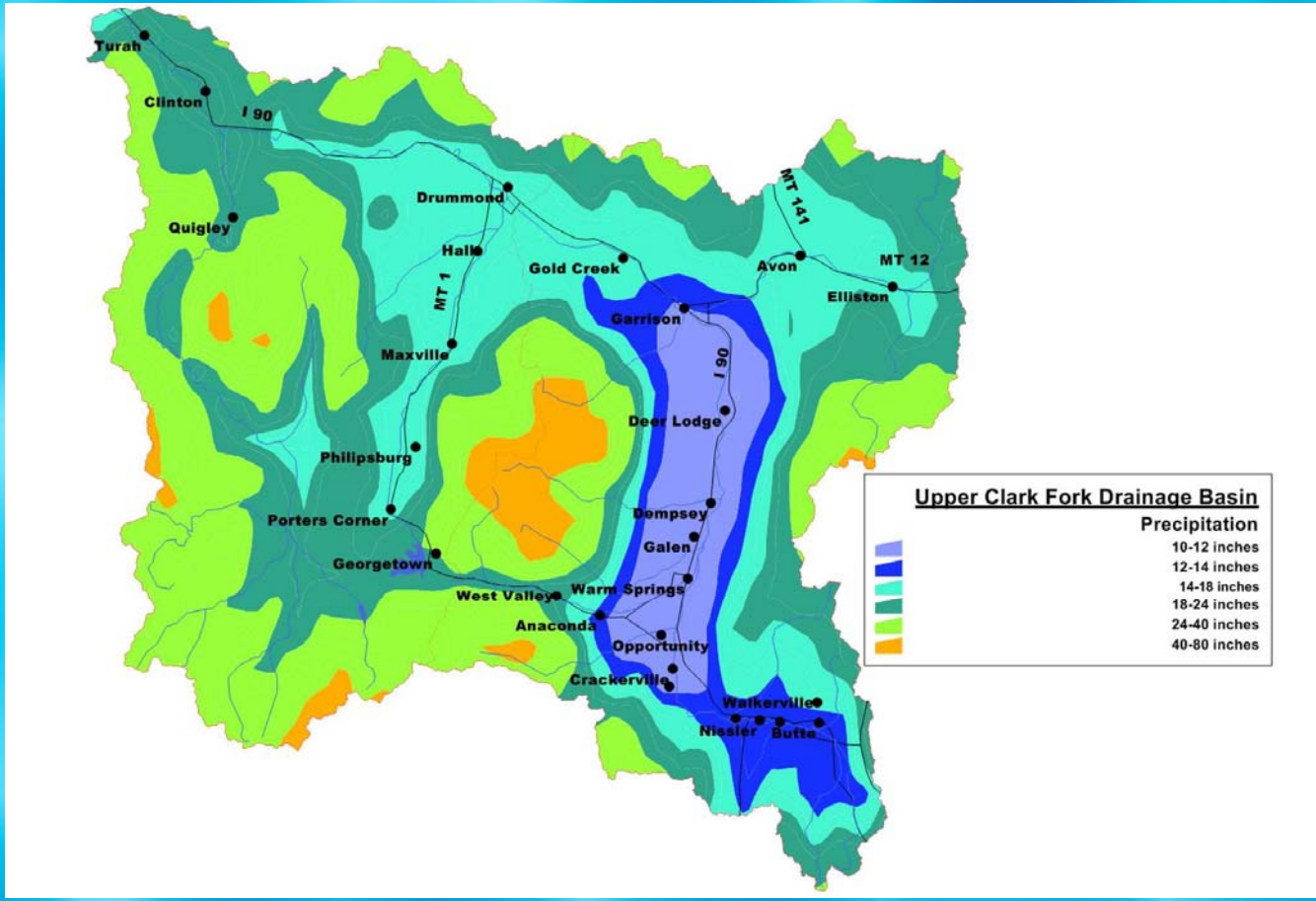
Upper Clark Fork-Precipitation



Average Annual Precipitation

3,217,917 Ac-Ft/yr.

Average Annual Precipitation ranges from 10 - 80 in./yr.

Average Annual Recharge

643,583 Ac-Ft/yr.

Average Annual Runoff

1,168,721 Ac-Ft/yr.

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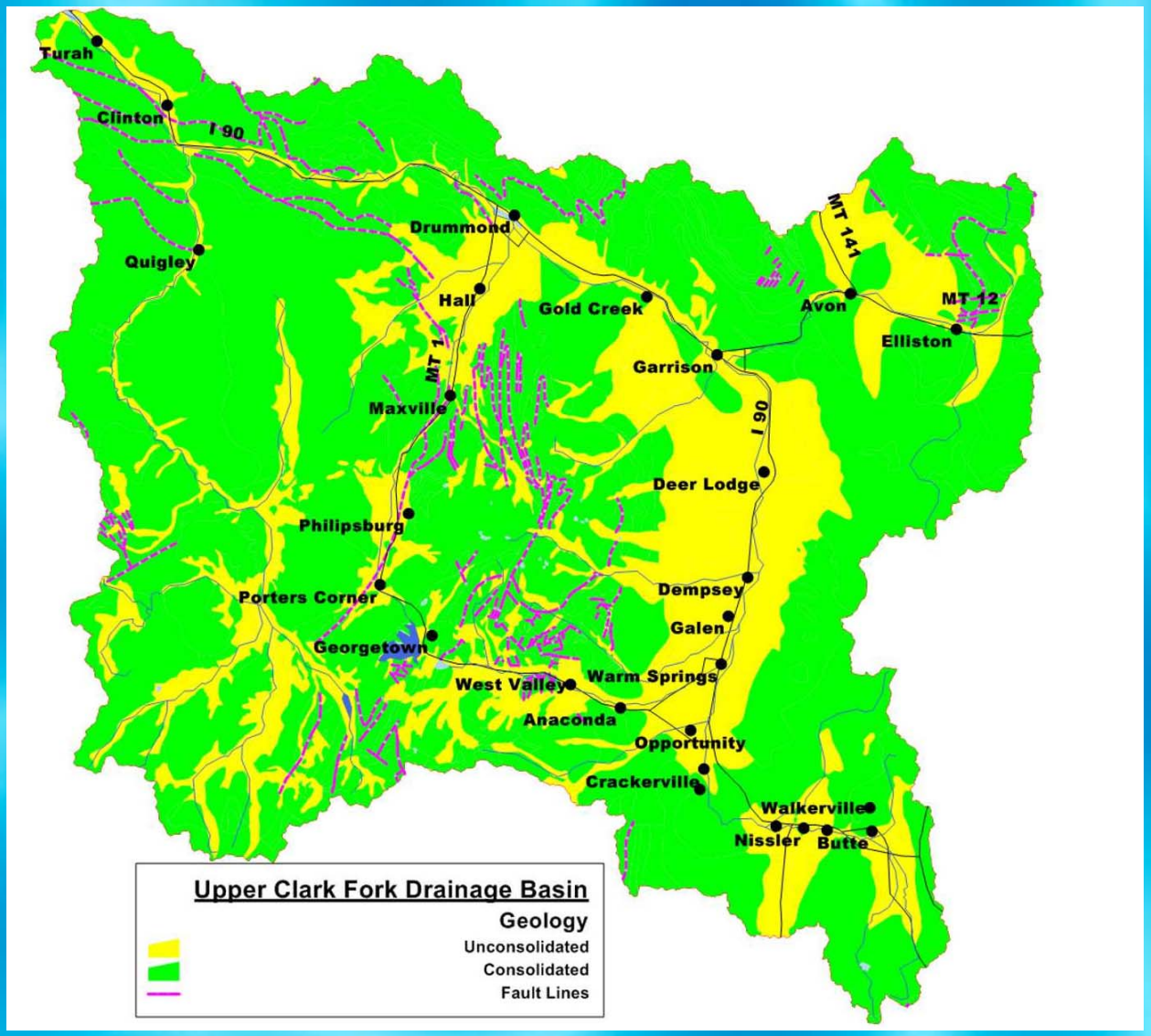
Upper Clark Fork- Geology



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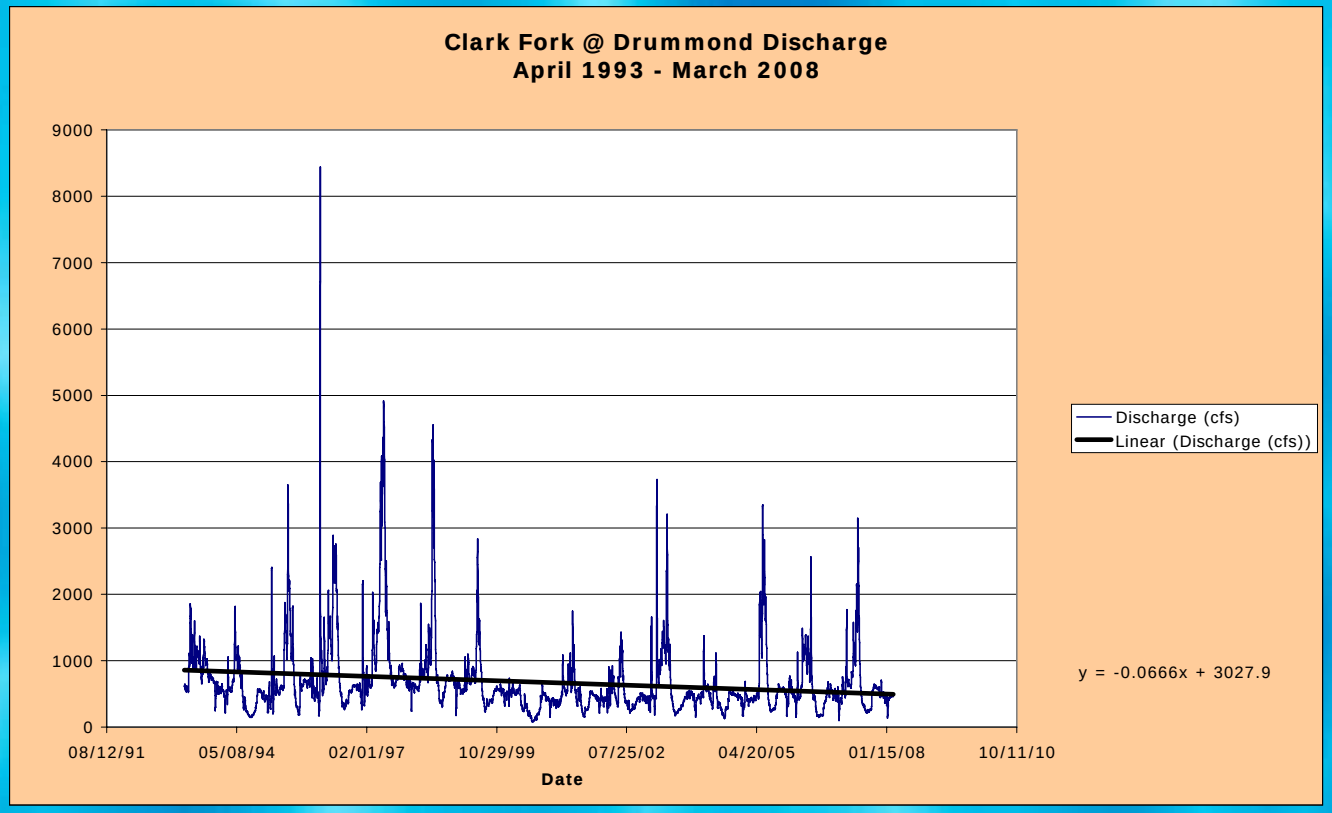
Upper Clark Fork Discharge



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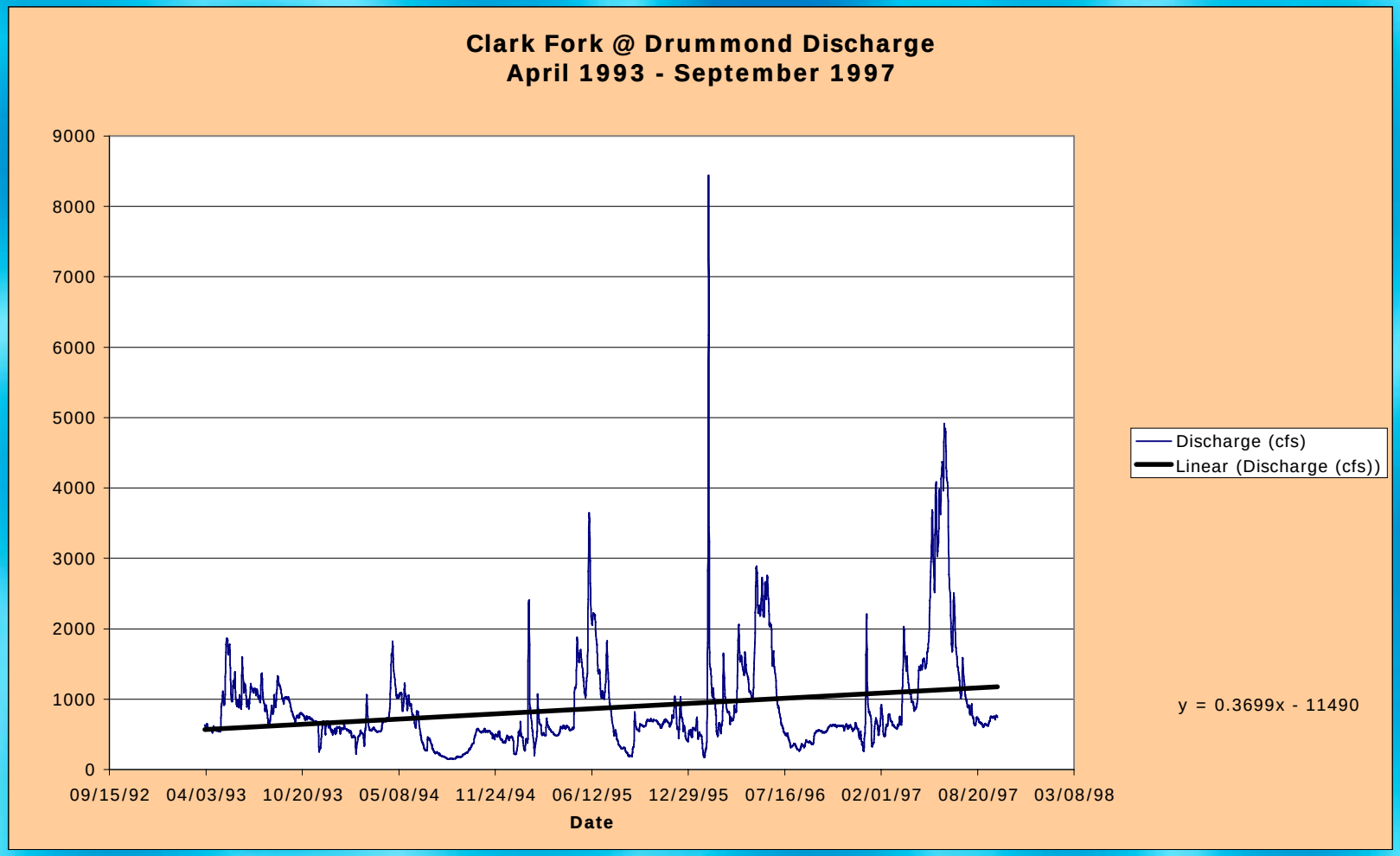
Upper Clark Fork Discharge



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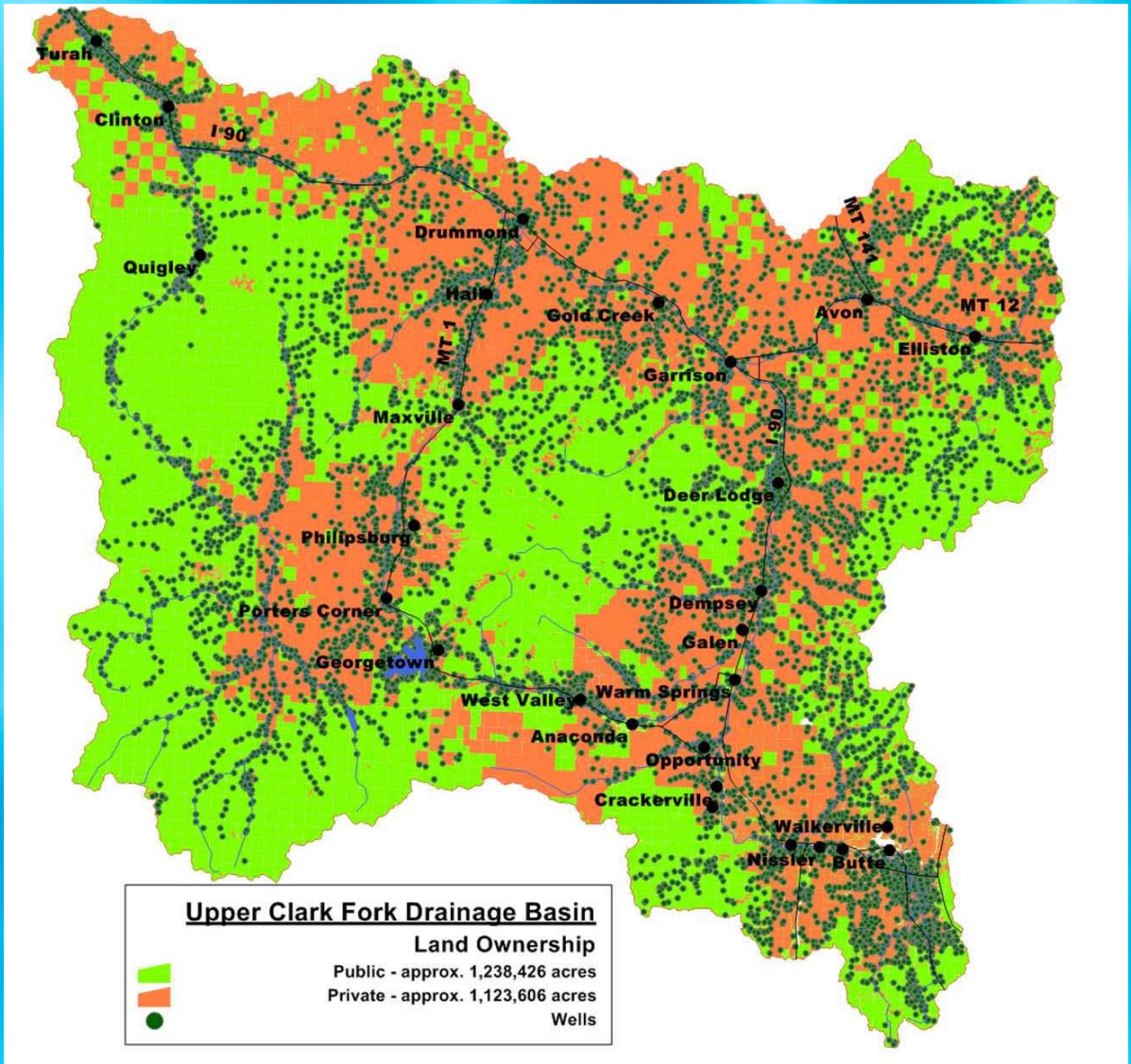
Upper Clark Fork- Wells



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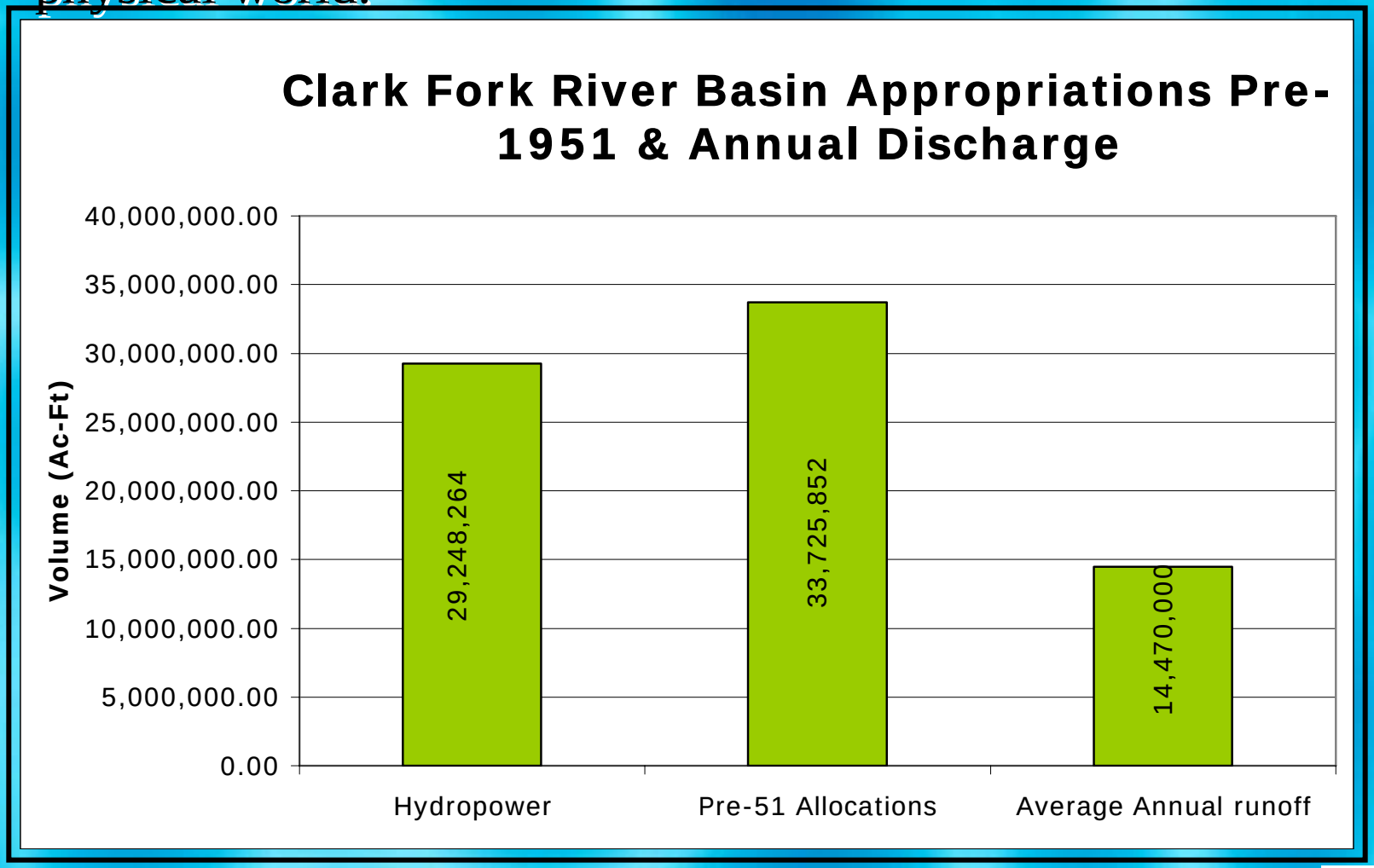
Are We Really Short of Water?

- the allocation accounting process doesn't reflect the physical world.



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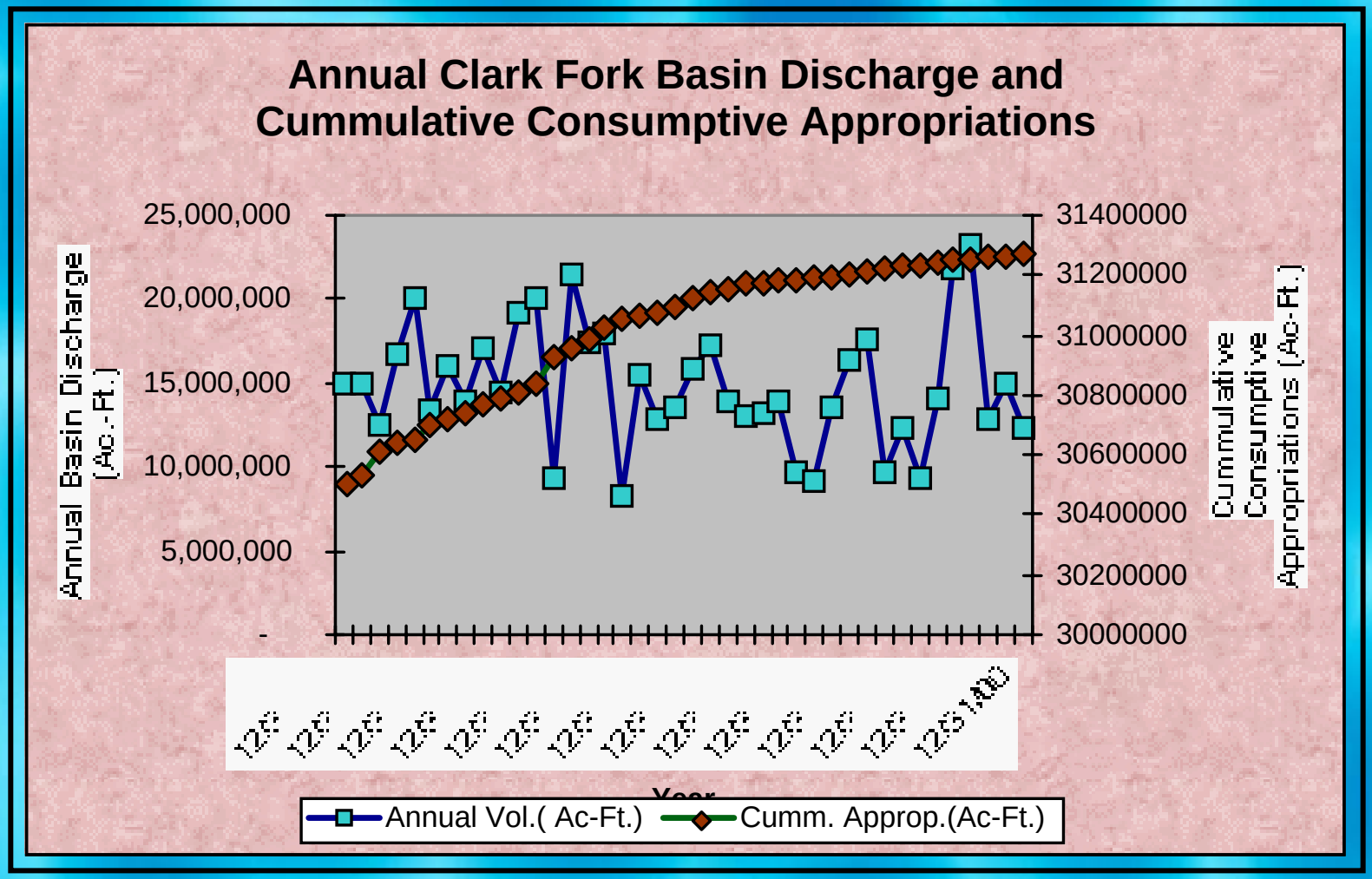
Cumulative Effects?

- Adjudication may alter this relationship.



How much water is really being used?
What and where are the return flows?

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Summary

	RLK Hydro	MBMG,2006
⊙ Estimated Consumptive Use in CF Basin -	**0.5** MM Ac-ft/yr	**0.57**
⊙ Total Precipitation in Basin	**22.5** MM Ac-ft/yr	**22.06**
⊙ Estimated total annual recharge	**4.5** MM Ac-ft/yr	
⊙ Total annual Runoff	**15.7** MM Ac-ft/yr	**13.74**
⊙ Estimated Annual Evaporation,		
Transpiration consumptive use	2.3 MM Ac-ft./yr	**7.75**

Consumptive use not affecting sub-basin annual discharge.

Climate (drought) is affecting sub-basin annual discharge.

At least in the instance of the Bitterroot, groundwater development is not affecting stream discharge.

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