Hydrogeology of the Deep Confined Aquifer

John Wheaton
James Rose
Ali Gebril
Elizabeth Meredith
Andy Bobst

Ground Water Investigation Program
Montana Bureau of Mines and Geology

April 6, 2016
Science on Tap
First A little terminology

Water Table or Unconfined Aquifer
  Shallow

Confined Aquifer or Artesian
  Deeper
  Beneath a confining layer

Flowing wells are special cases
Unconfined Aquifer (water table)

Water is drained from pores between sand and gravel cobbles
Confined Aquifer (artesian)

Water is stored between sand grains,
Artesian pressure raises water above aquifer
Confined Aquifer (artesian)

Water is stored between sand grains,
Artesian pressure raises water above aquifer
Flowing well
Artesian pressure is higher than land surface
Mountain front recharge

Snowmelt and rain
Enter shallow fracture systems

Some enter shallow system

Some bypasses confining unit and enters deep system

Some may discharge as springs

Shallow flow system

Confining beds

Deep confined flow system
Simplified schematic of mountain front recharge

- Snowmelt and rain enter shallow fracture systems.
- Some enter shallow system.
- Some bypasses confining unit and enters deep system.
- Some may discharge as springs.
Deep Aquifer
Groundwater Budget (2011)

Values are approximate
Based on statistical mean

Inflow = 213,000 acre-feet / year
300 cfs

Pumping = 25,000 acre-feet / year
32 cfs

Outflow = 189,000 acre-feet / year
260 cfs
One final comparison

Flathead River near Polson
Annual discharge, 2009 ----- 6,700,000 acre-feet

Estimated Deep Aquifer water rights
Flathead Valley
Annual total, 2009 -------- 52,162 acre-feet

Estimated Deep Aquifer Pumping
Flathead Valley
Annual total, 2010 --------------- 17,484 to 35,234 acre-feet
Looking for the groundwater / surface water connection in Flathead Lake