

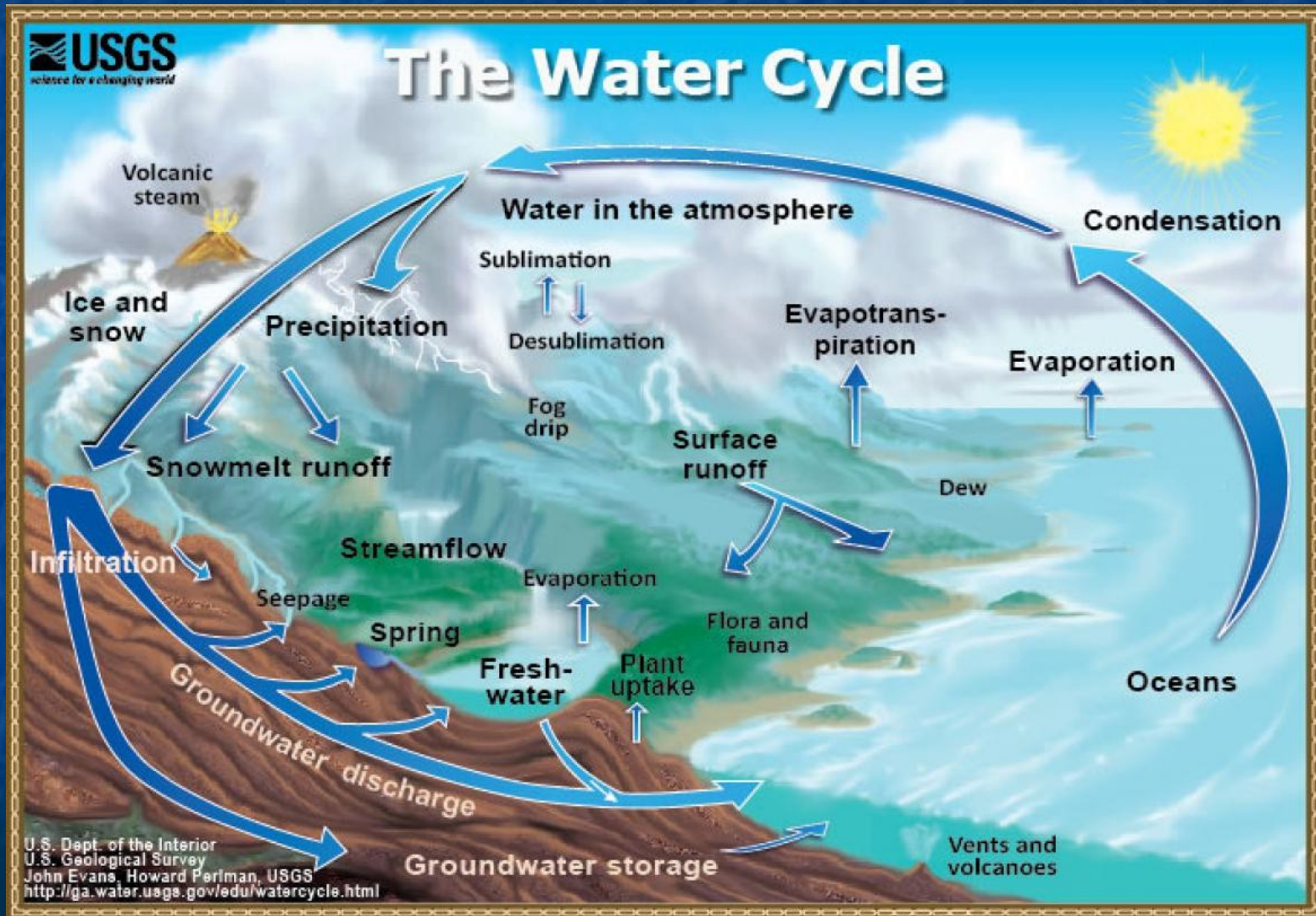
# Groundwater: Don't Just Scratch the Surface

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# Groundwater Part of the Cycle



# Surface Water Hydrologic Components

- Surface water components
  - Flow
  - Depth
  - Temperature

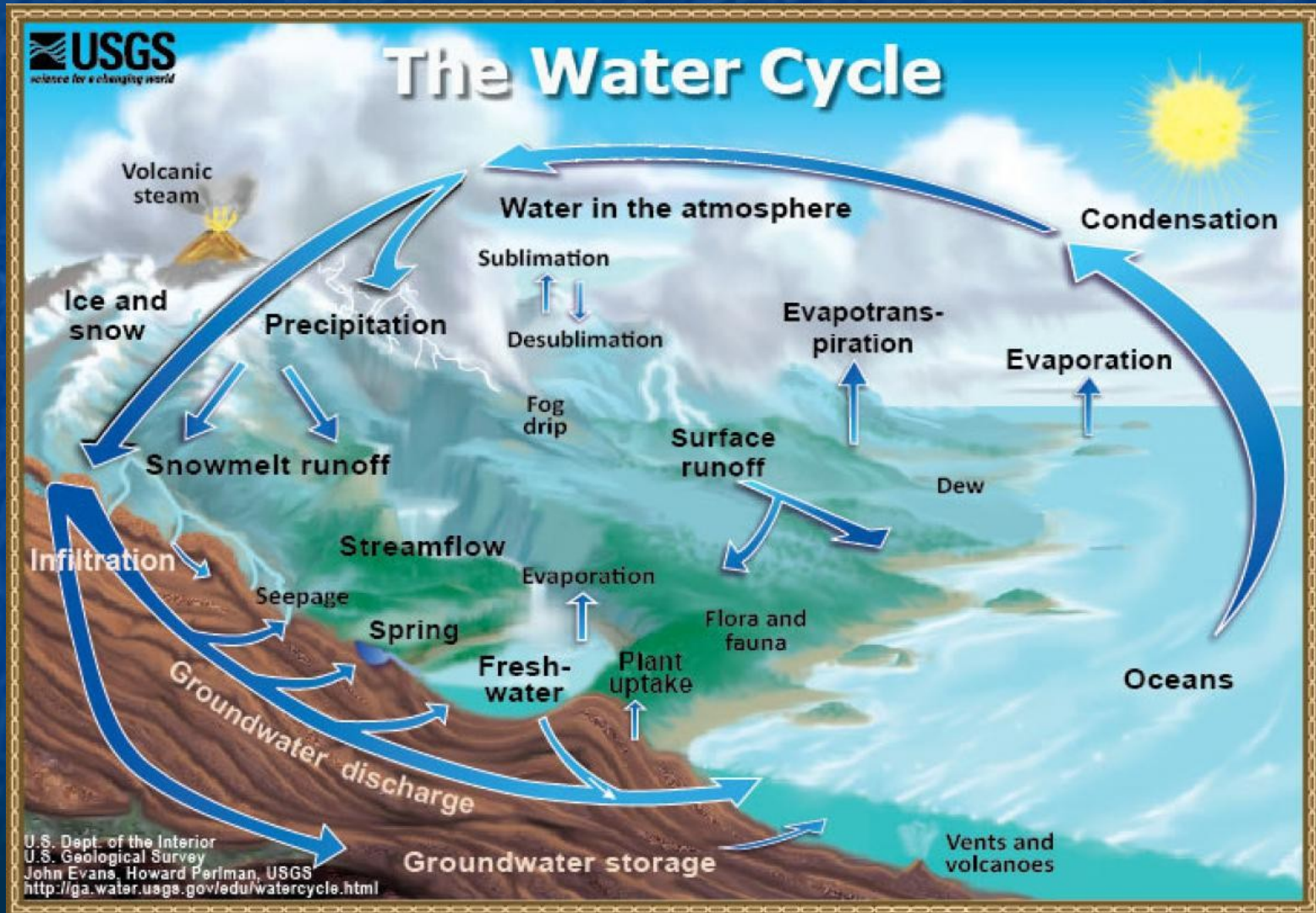


# Surface and Groundwater Hydrologic Components



All parts are **dynamically** linked

# Remove An Arrow...It's Not a Cycle



# The Urban-Myth Aquifer

- Deep, thick aquifer means lots of water
- Take water out
- Pump harder as it gets deeper
- When it is empty...



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# The Mythical Aquifer

- Deep, thick aquifer means lots of water
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# The Urban-Myth Aquifer

- Deep, thick aquifer means lots of water
- Take water out
- Pump harder as it gets deeper
- When it is empty...
- ....Stop.



# The Urban-Myth Aquifer

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# Can We Talk About Water Resources Using Financial Terminology?

- The financial analogy is:
  - Timely (shutdown, debt ceiling, furloughs)
  - Every-day concepts (savings, debt, payday)
- Surface water flow: living paycheck to paycheck
- Reservoir storage: savings account with fees
- Where does groundwater fit in?

# Is Groundwater Like Checking/Savings?

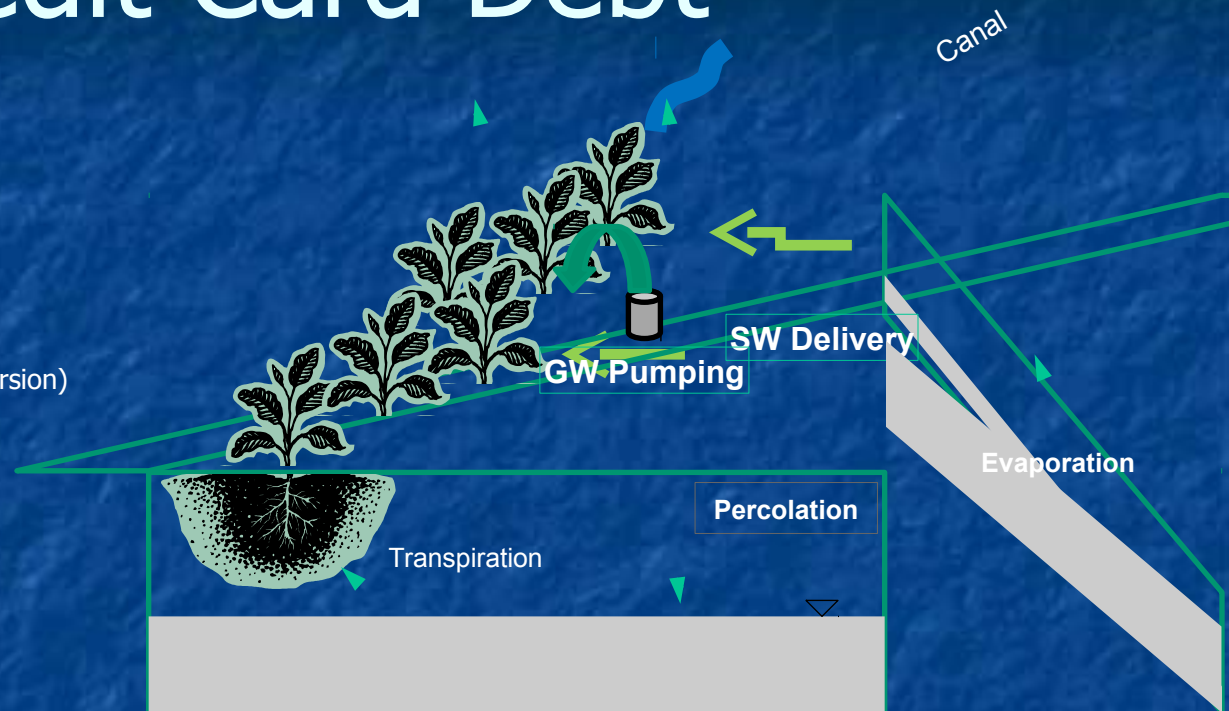
- Savings/checking: draw on it when needed
  - Limited cost (foregone interest), use it when we need it
  - ...but using more savings just means lower balance

# Groundwater is Like a Credit Card

- Line of credit with activation fee
  - Immediate up front cost
    - Spring discharge
    - Root zone access
  - Interest payments: must pay off the debt, return water levels in order to restore springs, reduce seepage losses and revive root zone viability

# Credit Card Debt

- Northwestern river valley
- Salmonoid fishery habitat
- More than 100 years of ranching/farming
- Extensive canal network
  - Delivered ranching/farming water
  - Recharged river valley aquifer (~30% of diversion)

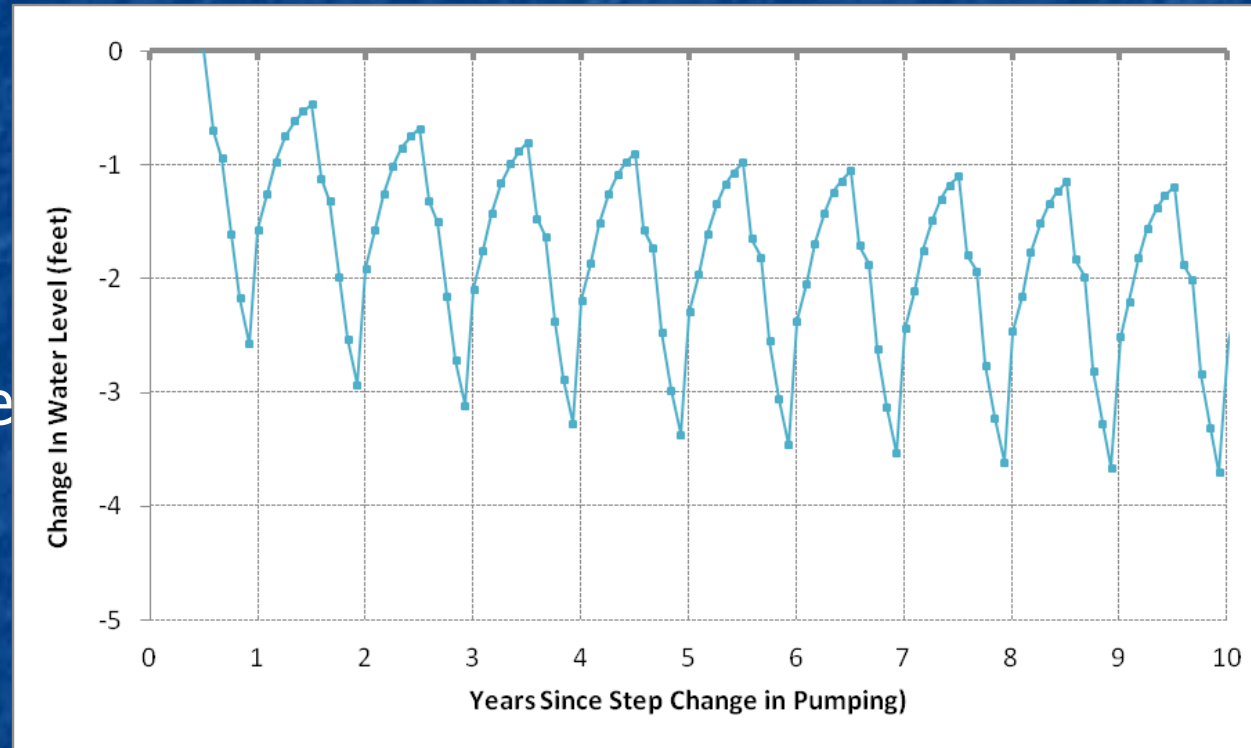


- Transition to more pumping over the last 40 years
  - Water pulled from aquifer
  - On-demand flow
- Convert from cash-flow to credit-line
  - Total "Budget" creep?
  - Timing shift?



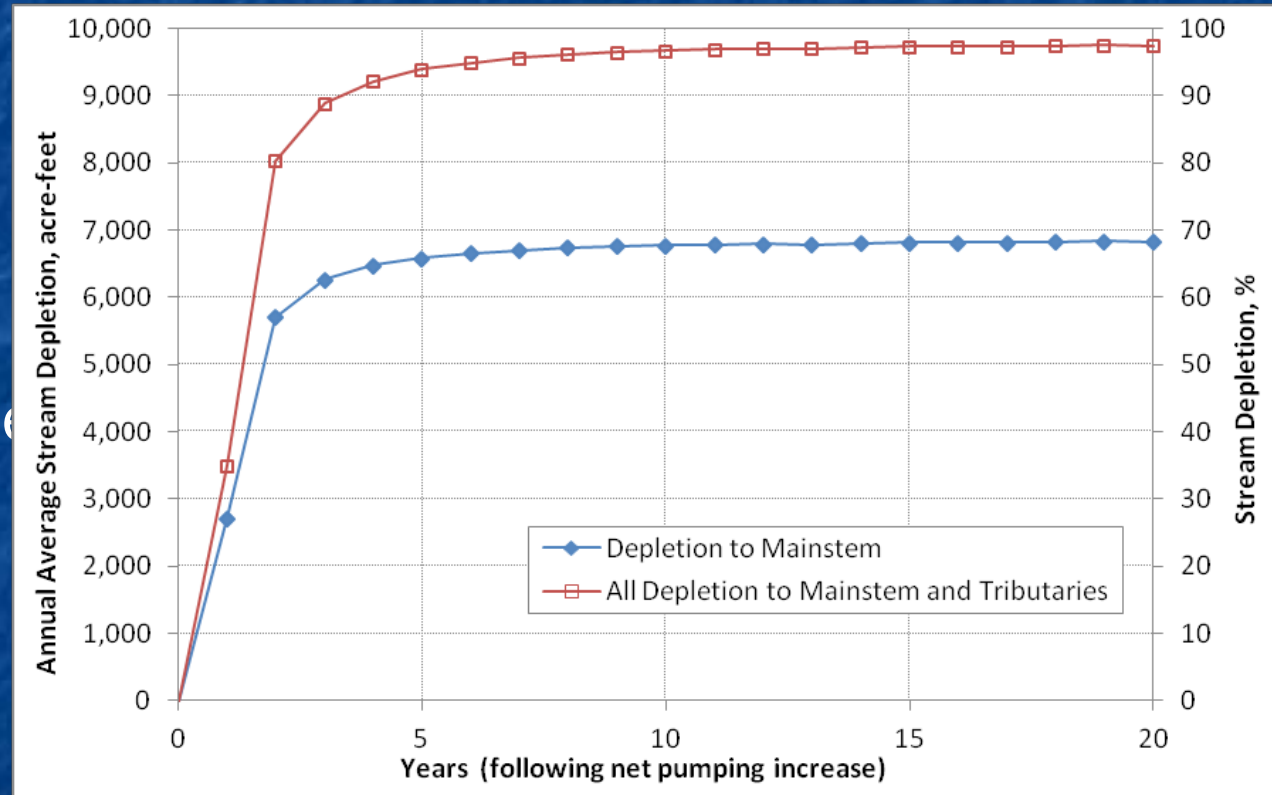
# Impacts for A "Step Change"

- Water levels drop from 1' to 4'
- Change in storage
- Stream depletion
- Step change taps the credit line



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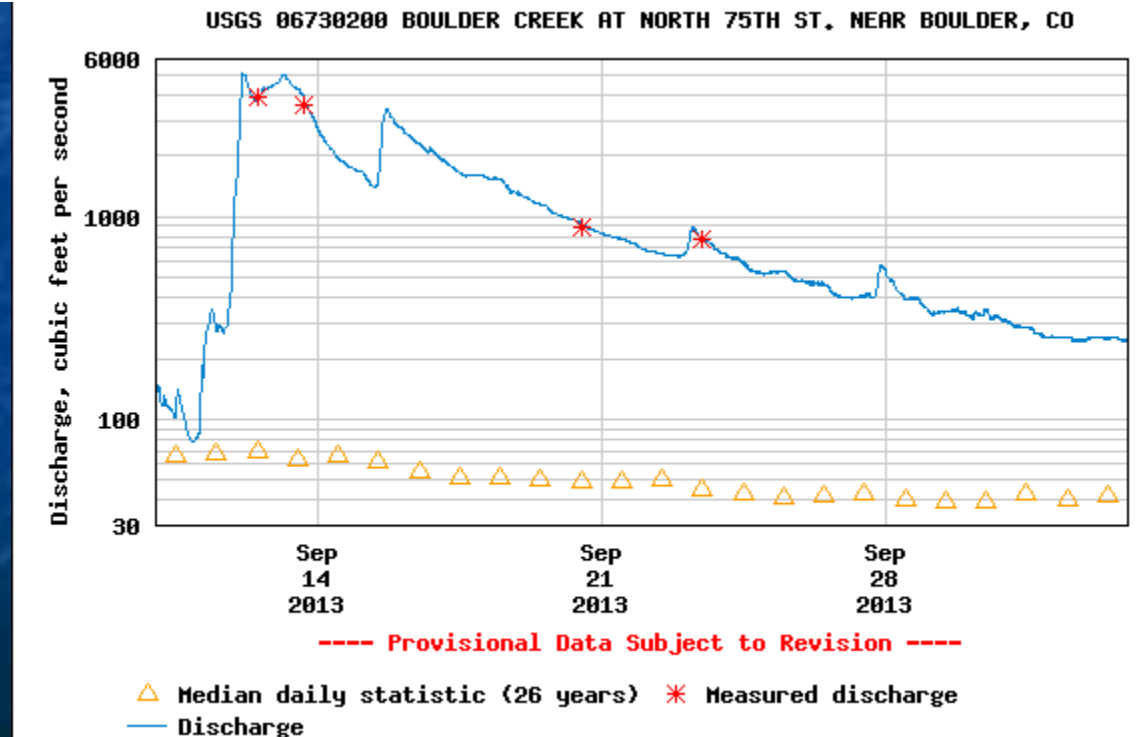
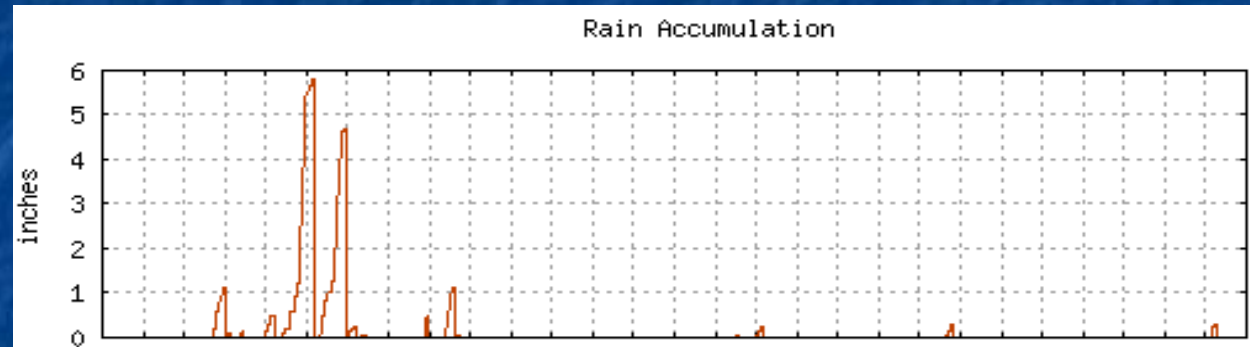


# Cannot Create Water, Can Credit Card Buy You Some Time

- Every credit card is a bit different,
  - Some have higher up front payments with more perks
  - Some have minimal fee, longer grace periods, but higher interest rates
- Example: impact delays from distance or separation

# Surplus = Annuity?

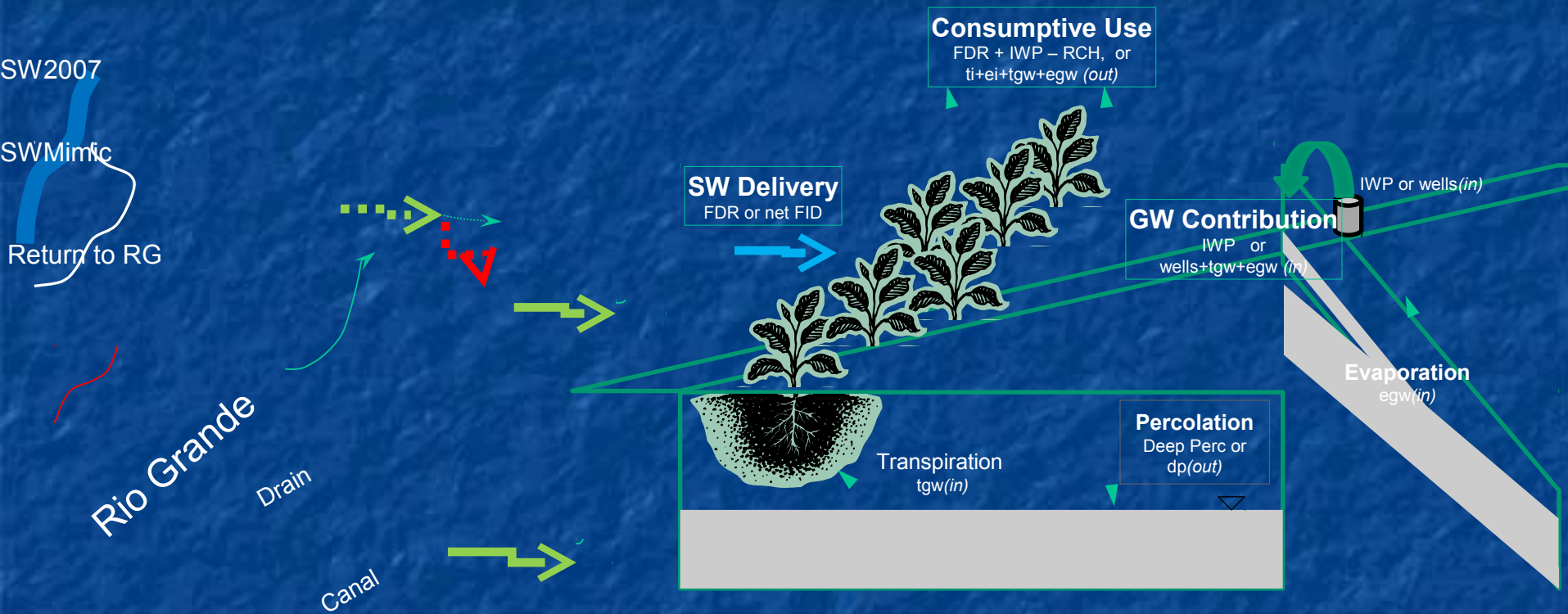
- What about if you exceed storage?
- Boulder Creek peaked just under 6,000 cfs
- Recession curve indicates lots of water from the storm is still coming out of storage



# Summary

- Pulling down water levels is not like drawing from checking/savings, it has more immediate costs
- Pumping groundwater is not taking from savings, it is more like tapping a credit line
- With more separation costs are deferred... but the costs still accrue

# Hydrologic Components



- Also evaluated:
- Simulated Canal Losses
  - Rio Grande Losses
  - Rio Grande Depletions