Groundwater/Surface-Water Interactions and Hydrologic Response Times

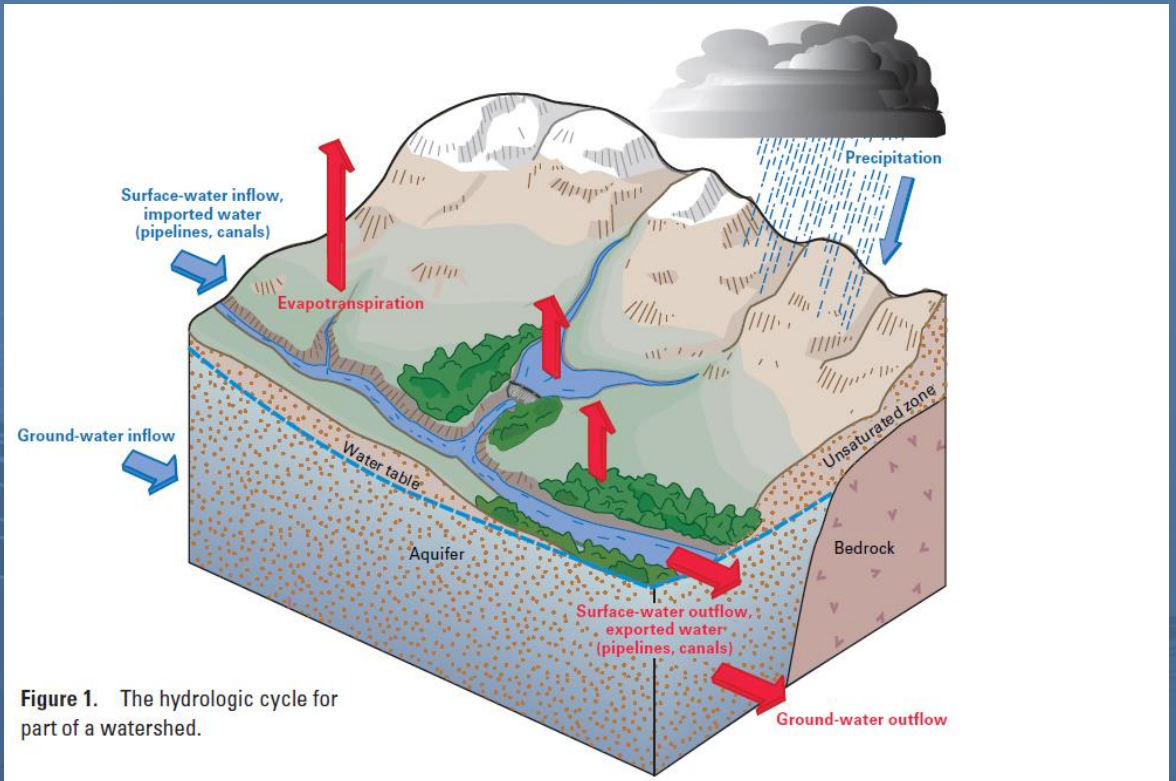

Figure 1. The hydrologic cycle for part of a watershed.

William M. Alley

Director of Science & Technology, NGWA

AGI Webinar, July 13, 2015

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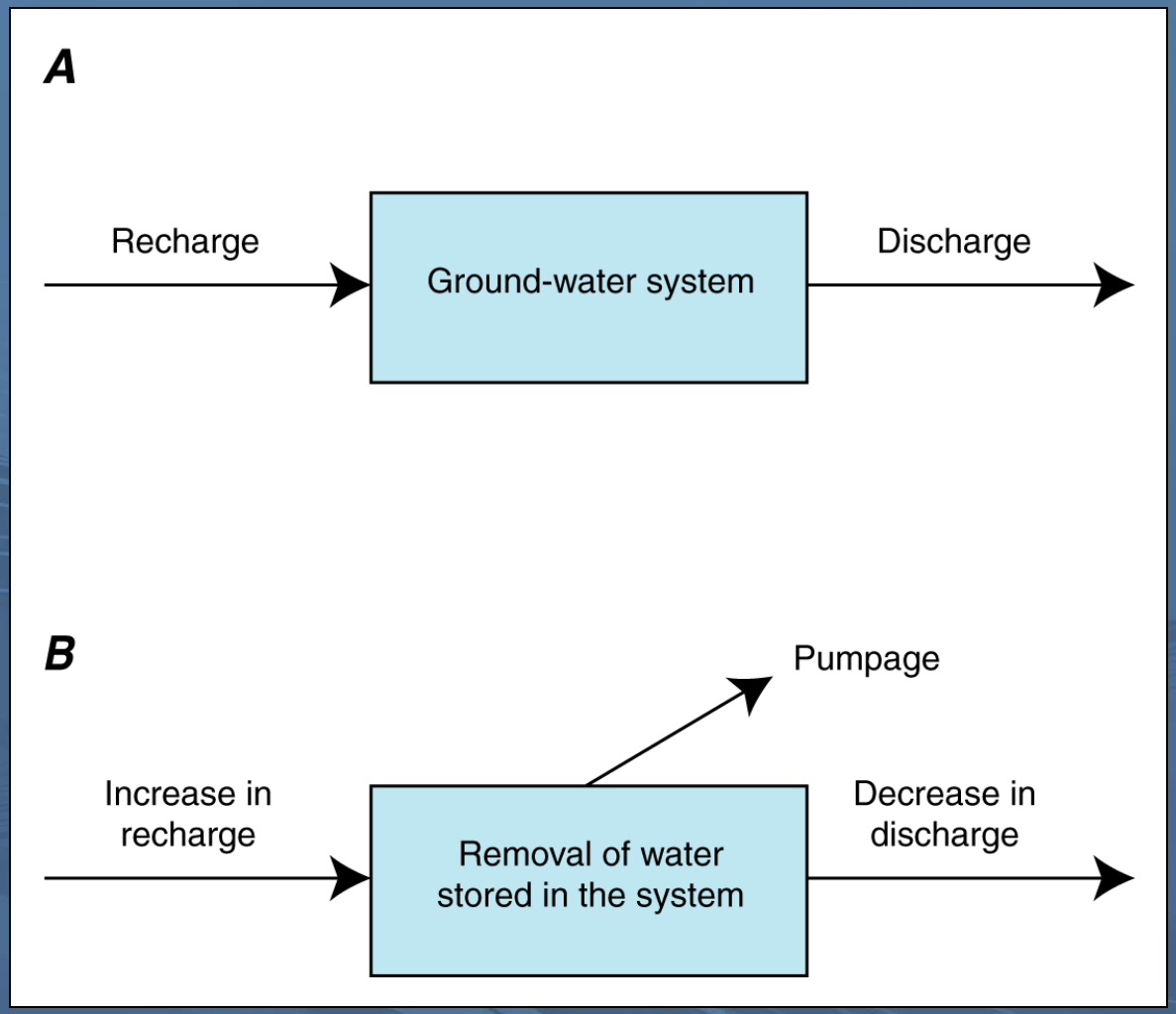
Sources of Water to a Pumping Well



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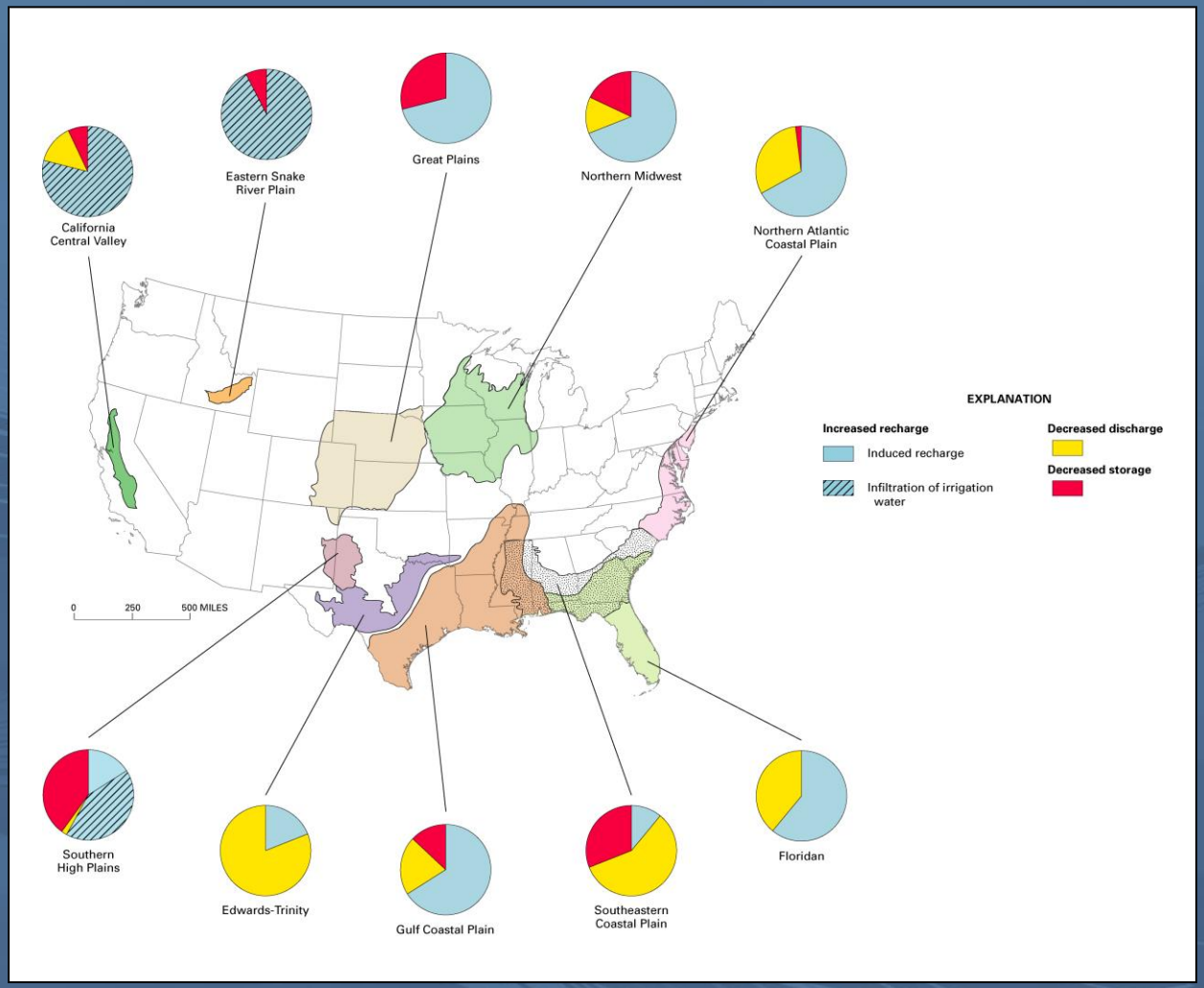
Each groundwater system is unique in its response to pumping



Alley and others, 2002; Data from Johnston, 1997

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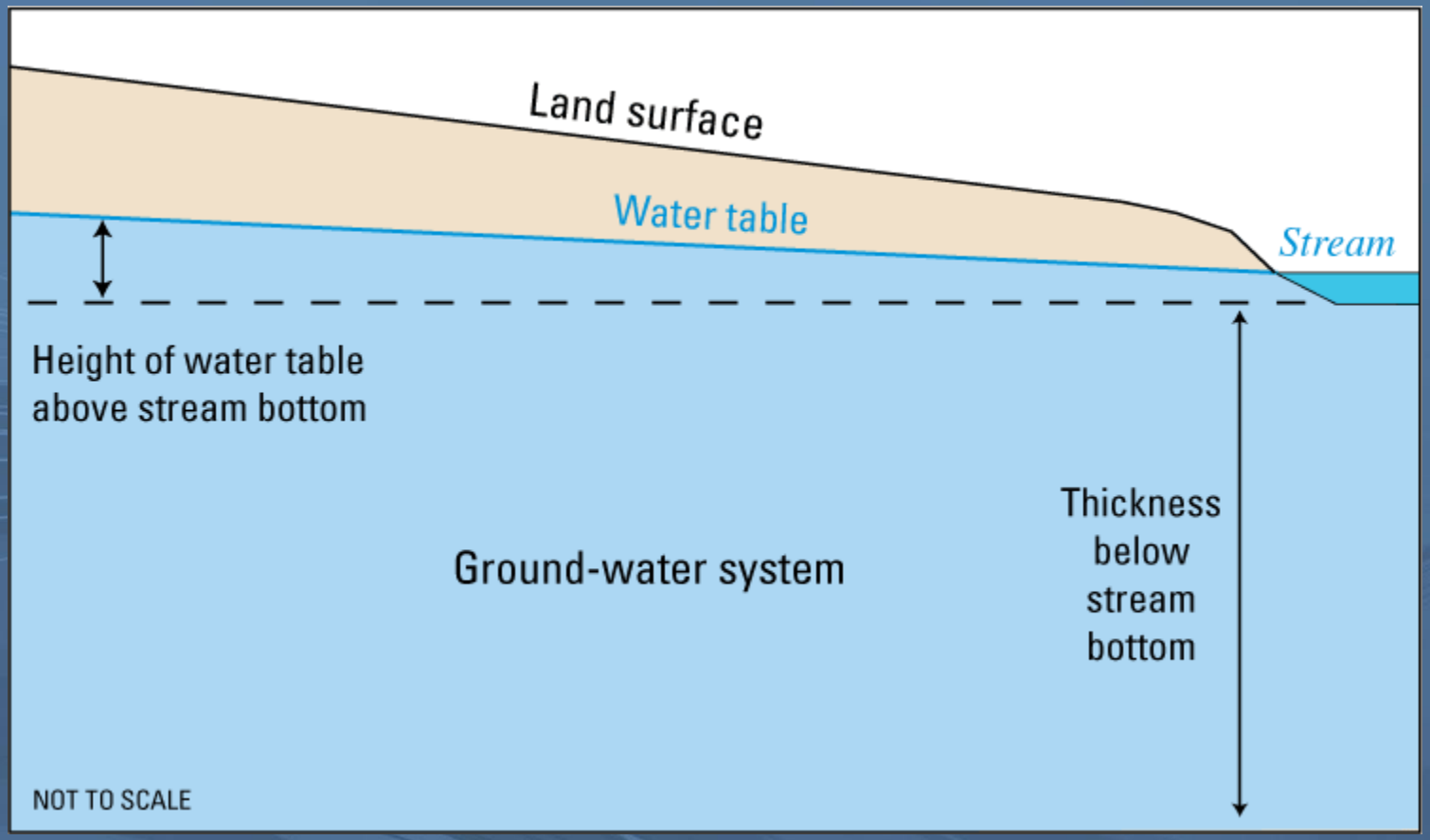

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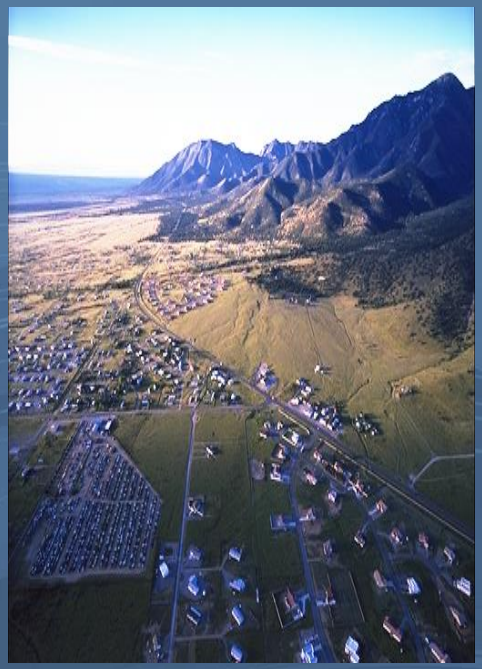
Depletion of a small part of the total volume of groundwater in storage can have large effects on surface water which become limiting factors to development.



Upper San Pedro Basin, AZ

Edwards Aquifer, TX

Republican River Basin, CO, KS, NE

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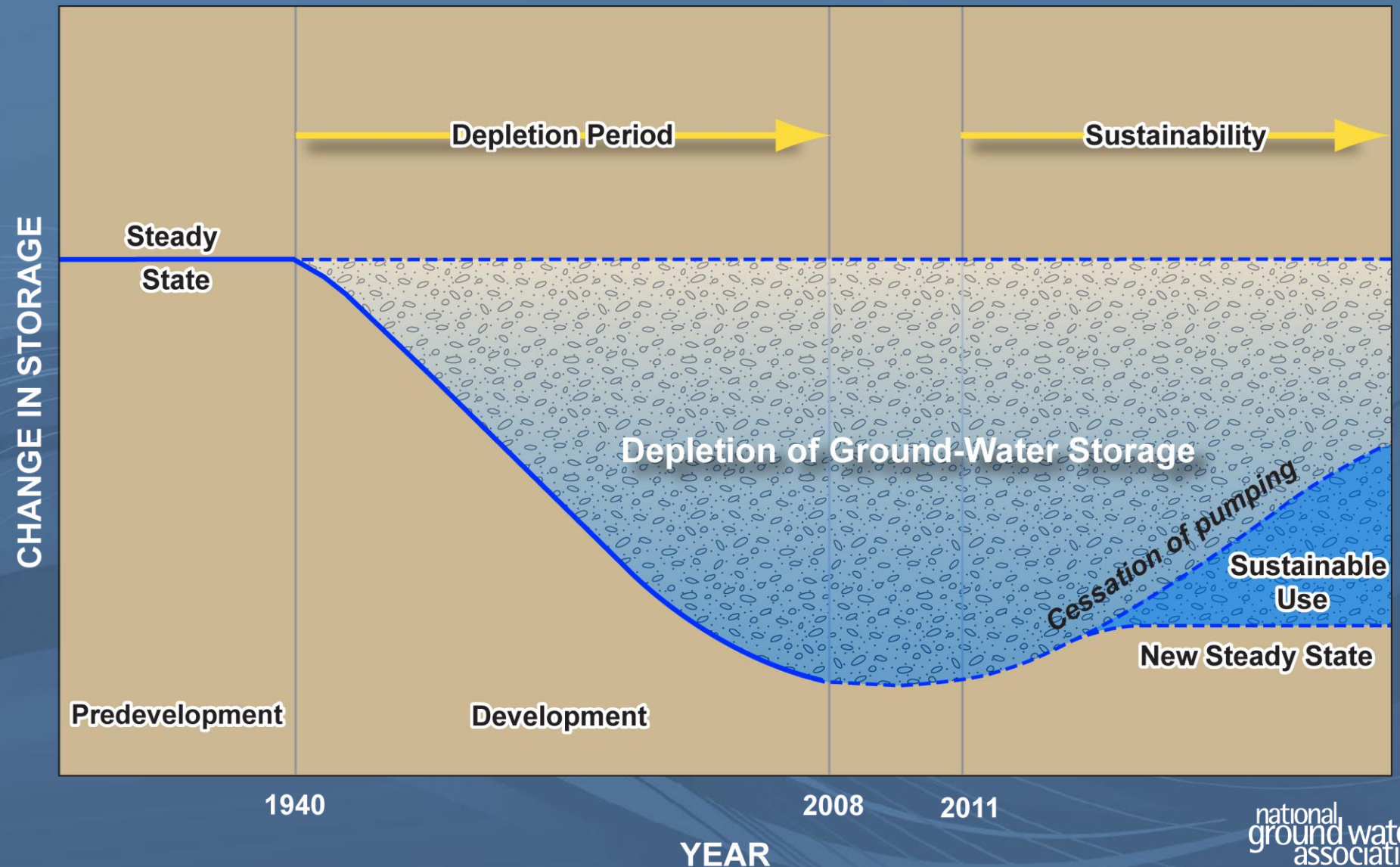
Storage Change and Sustainable Yield



Modified from Upper San Pedro Partnership

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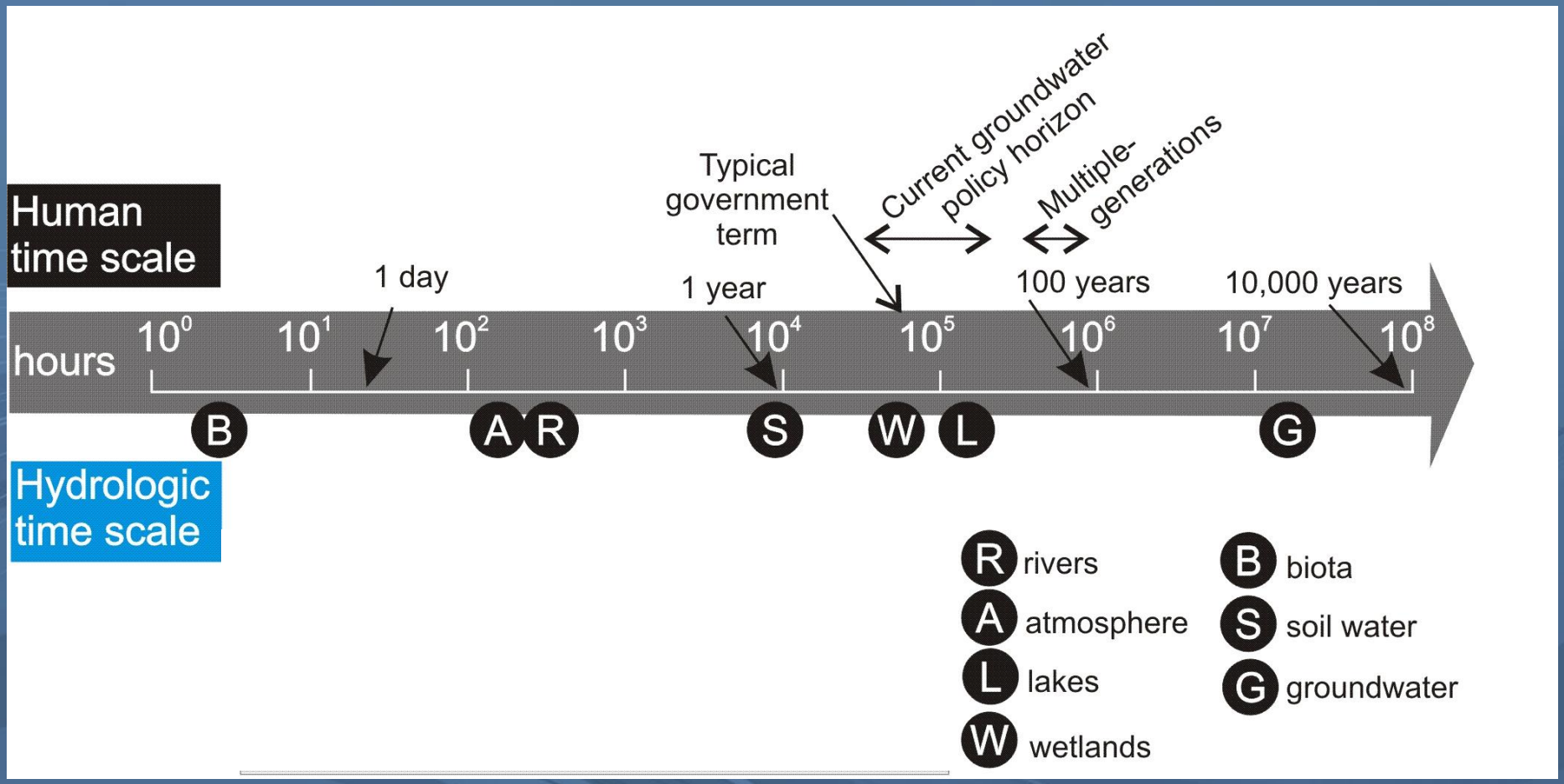
Human vs Hydrologic Time Scales



Gleeson et al. (2012)

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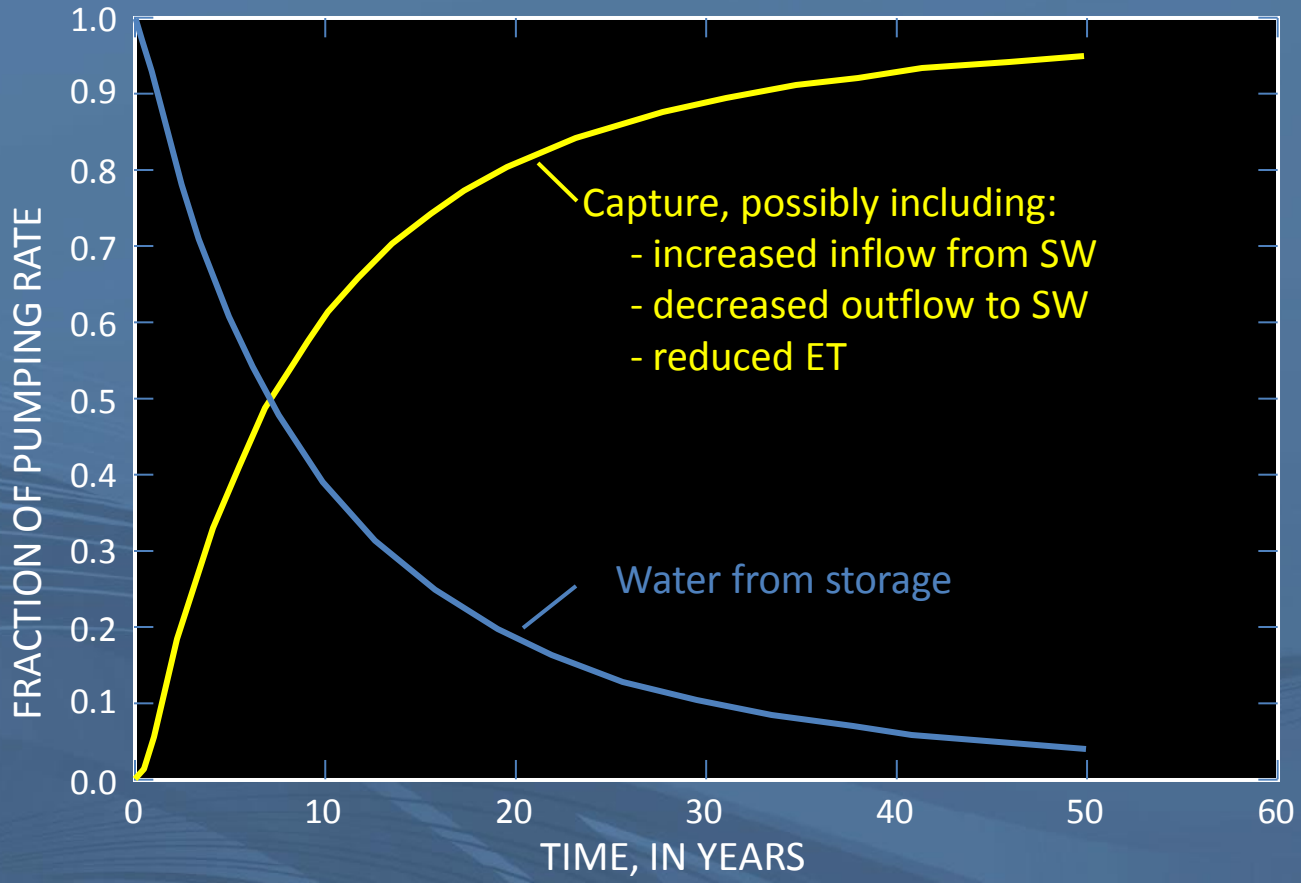
Sources of Water to a Well Pumped near a Stream



The timing of depletion depends on:

- Aquifer storage and transmissive properties
- Distance to connected surface-water features

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Three Examples

- Colorado Plateau, Arizona (Streamflow depletion)
- Paradise Valley, Nevada (Long-term capture)
- Chesapeake Bay (Nitrate contamination)

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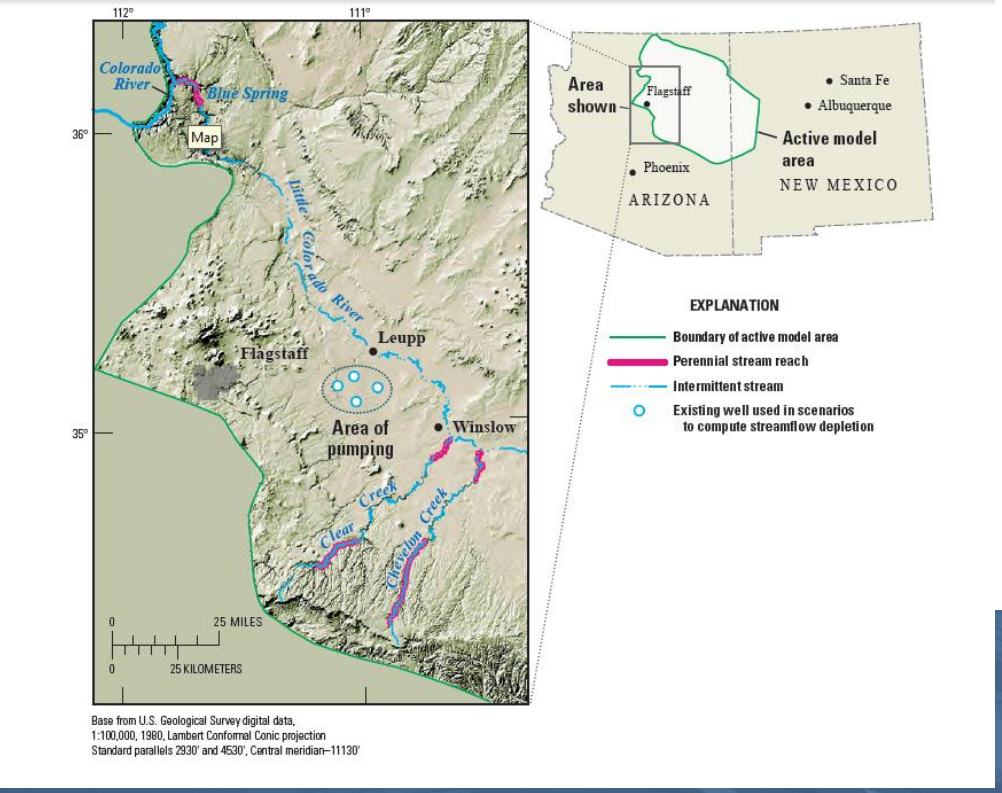
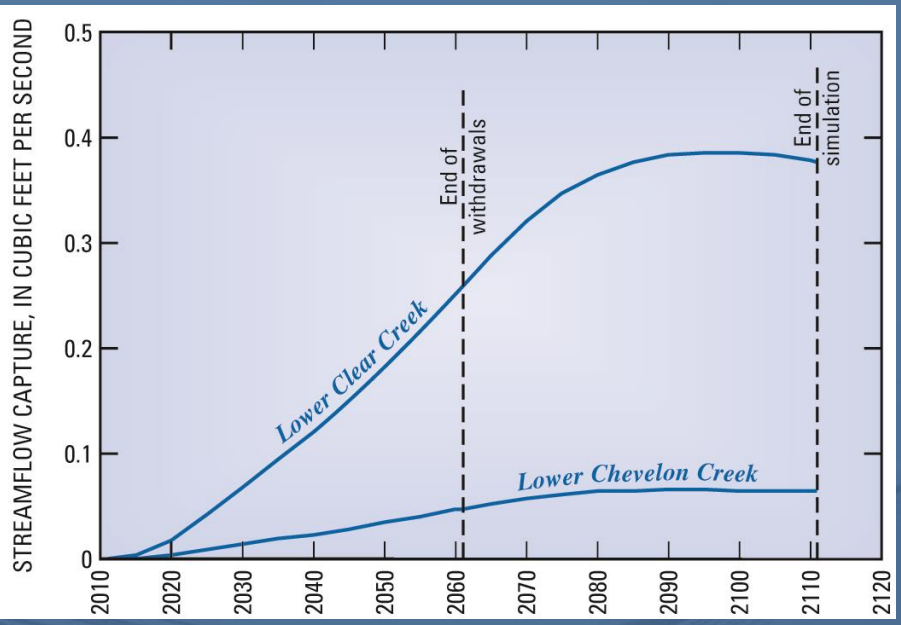
Colorado Plateau, Arizona





Leake, Hoffmann, and Dickinson, 2005

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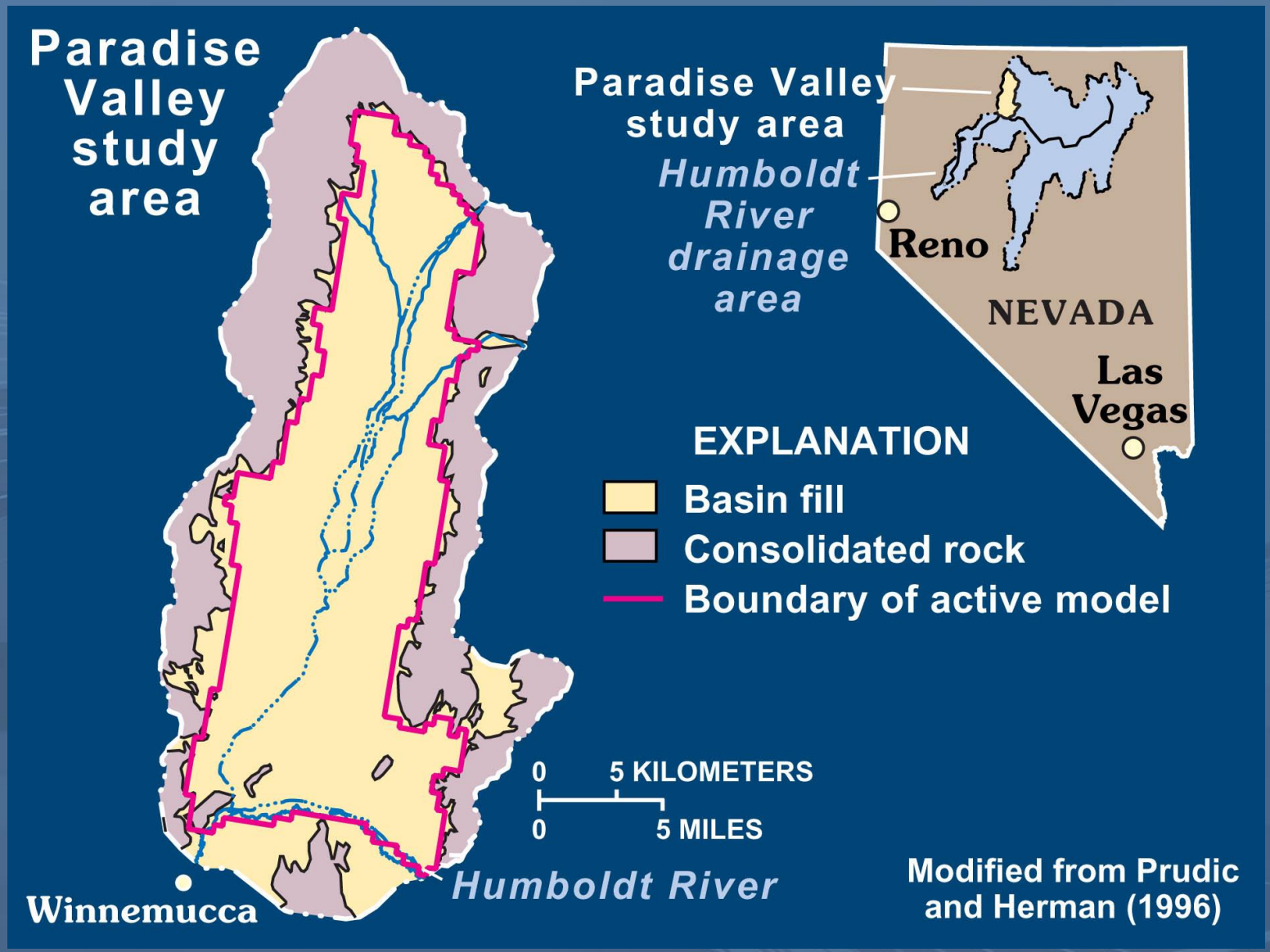
Paradise Valley, Nevada



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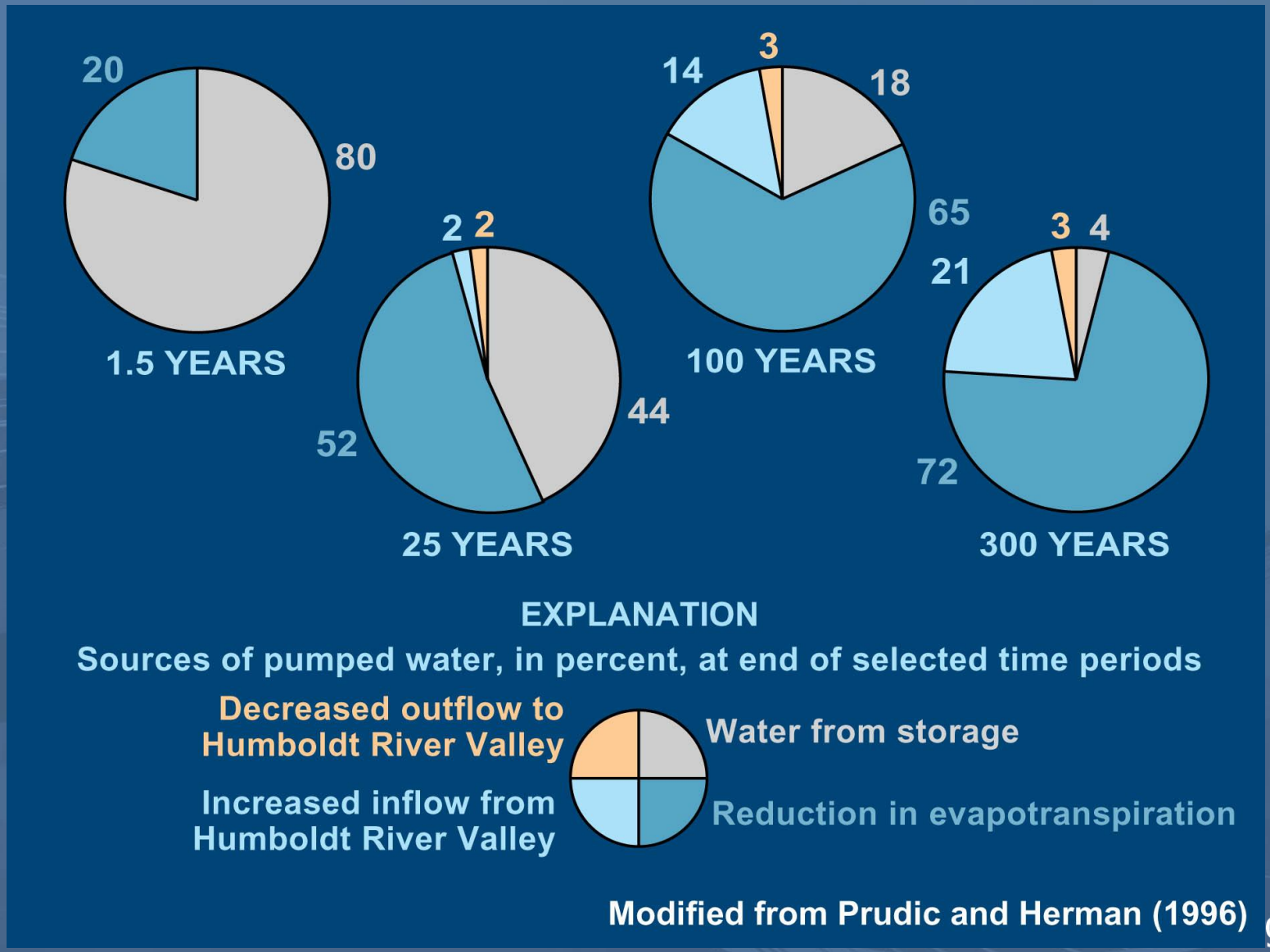
Paradise Valley, Nevada



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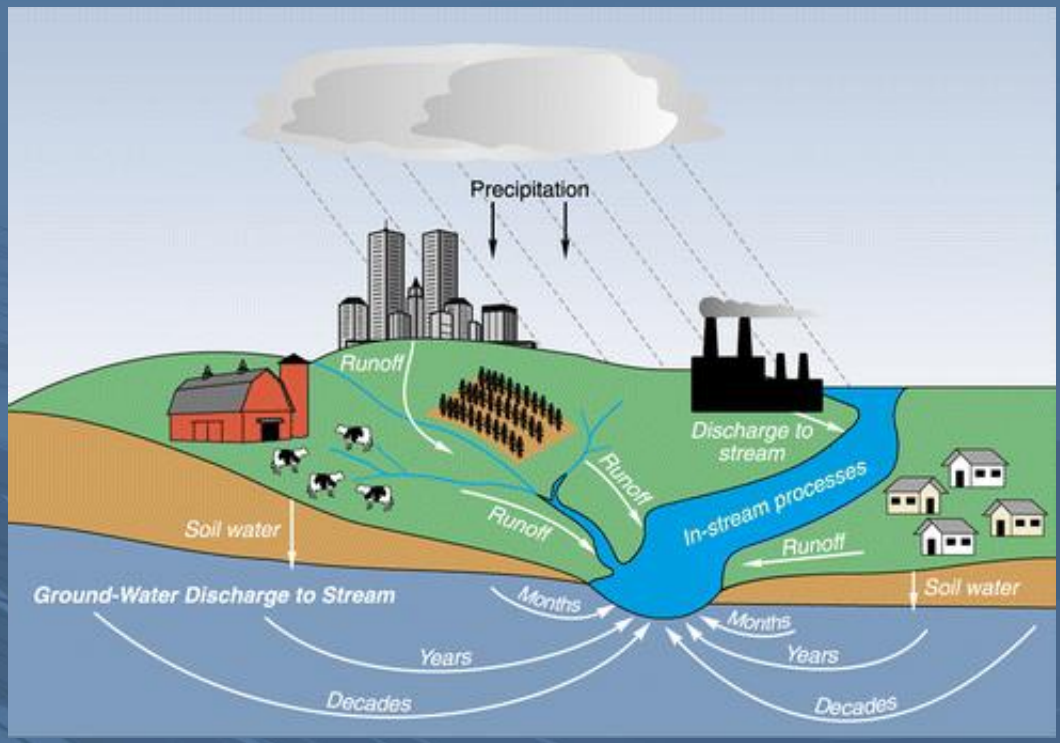
Nitrate to Chesapeake Bay



Phillips and others (1999)

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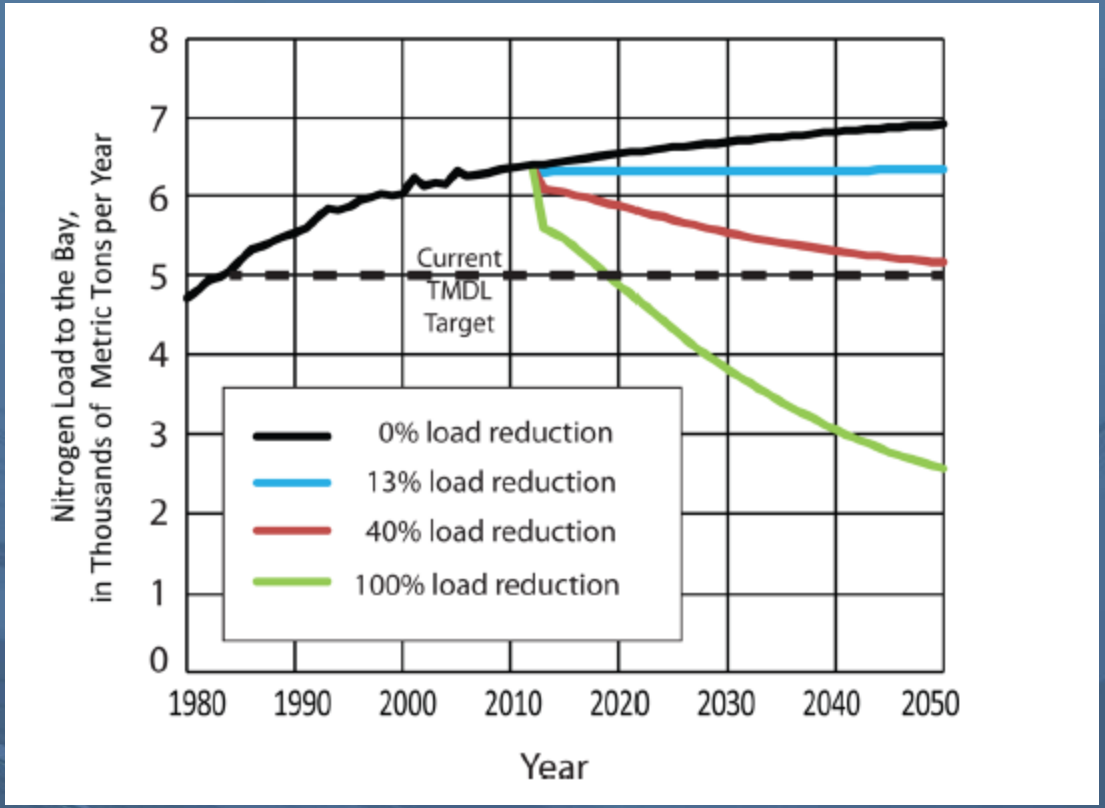
Nitrate to Chesapeake Bay

Baseflow age distribution
Sanford and Pope (2013)



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Questions?

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