Iowa's Water Resources

Bob Libra - Iowa DNR – Geological Survey

Legislator Newsletter

September 2006

The State of Iowa Waters

Quantity

Quality

With what looked like a possible drought situation in parts of Iowa during the late summer months this year, discussions about Iowa's water availability came to light. While everyone believes Iowa has an abundance of water, can we actually quantify it? The answer was, "not really." State and federal funding has not only reduced the amount of funding to monitor **water quality**, but funding to monitor **surface and groundwater quantity** has either disappeared or is disappearing.

A State Water Plan was mandated by the 1982 Legislature. Chapter 455B of the Iowa Code requires an assessment of, "***the water needs of all water users… and prepare a general plan of water allocation in this state considering the quantity and quality of water resources available in this state designed to meet the specific needs of the water users.***

…to assess the water needs of all water users at five-year intervals for the twenty years beginning January 1, 1985, and ending December 31, 2004…"

Several objectives were to be met by the Water Plan.

- Describe the availability and quality of water in Iowa.
- Estimate present and future use (to 2005).
- Prepare an allocation plan.
- Propose a means of implementation.

Longer term objectives included implementation of the plan, and periodic updating of the water use projections. The availability studies examined both surface and ground water. The water use delineated present and projected water use for the next twenty years for all major types of use.

A State Water Plan was developed and published in January 1985 as the result of technical assessments by the Department of Natural Resources (then called the Department of Water, Air and Waste Management), a technical advisory committee and the general public.

Iowa has only actively managed and regulated its water resources since 1957 when the Iowa Water Law was unanimously adopted by the legislature. The action came as the result of a severe two-year drought that threatened both public and private supplies across Iowa. Droughts similar to 1957 occurred in the state during the 1930's and late 1970's.

In the 1985 report and in a recent presentation by Harry Hillaker, State Climatologist, Iowa Department of Agriculture – droughts occur on a 20-25 year cycle (approximate).

Planning and managing the waters of the state is needed to insure that future water needs and uses can be met. For example:

1. The *State Water Plan* projected water use for Polk County at 20-30 billion gallons per year by 2005. Des Moines Water Works pumped approximately 17.5 billion gallons in Polk County in 2005. (This does not include pumpage figures from the cities of Altoona, Grimes, or West Des Moines.)

The 1985 projection was probably close to actual water use and reinforces the need to update projections for the next 20 years and ensure Iowa's future water uses and needs can be met.

2. There are parts of the state more suited to handle increased water demands such as those of the ethanol industry.

In a report from the Department of Natural Resources, *Groundwater and Ethanol,* it indicates that 4 gallons of water are used for each gallon of ethanol produced. An additional consideration related to ethanol is the potential for significant concentration of cattle operations in the proximity of ethanol plants, to take advantage of less-costly feed by-products. Figures from the Iowa State University Beef Center suggest cattle water use is 15 gallons/day as an overall average.

This does not mean we shouldn't produce ethanol in Iowa – what it does say is that we need to plan and manage Iowa's water resources and determine the best locations for ethanol plants – or any other large water user in the state.

The 1957 Iowa Water Law declared waters the "wealth of the people."

Citizens of Iowa are adamant about prudent management of all state assets. They expect ongoing research, planning and management of Iowa's surface and ground water to identify existing problems or emerging issues with water quality and quantity changes. Surface and ground water are one of Iowa's biggest assets. Improving and protecting water quality and quantity is prudent management of this asset.

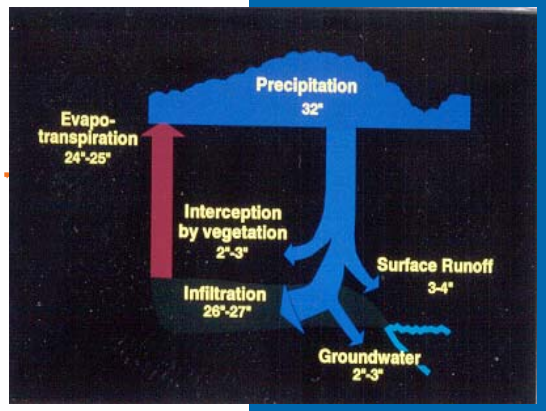
As an elected official commit to an inventory of Iowa's water assets – the quality, quantity and long-term dependability of both surface and ground water in all regions of the state.

Des Moines Water Works
2201 George Flagg Parkway, Des Moines, Iowa 50321
515-283-8706 FAX: 515-283-2610 E-mail: kinman@dmww.com

Is Iowa's Water Glass
Half Full
or Half Empty?

Water Use by Ethanol Plants

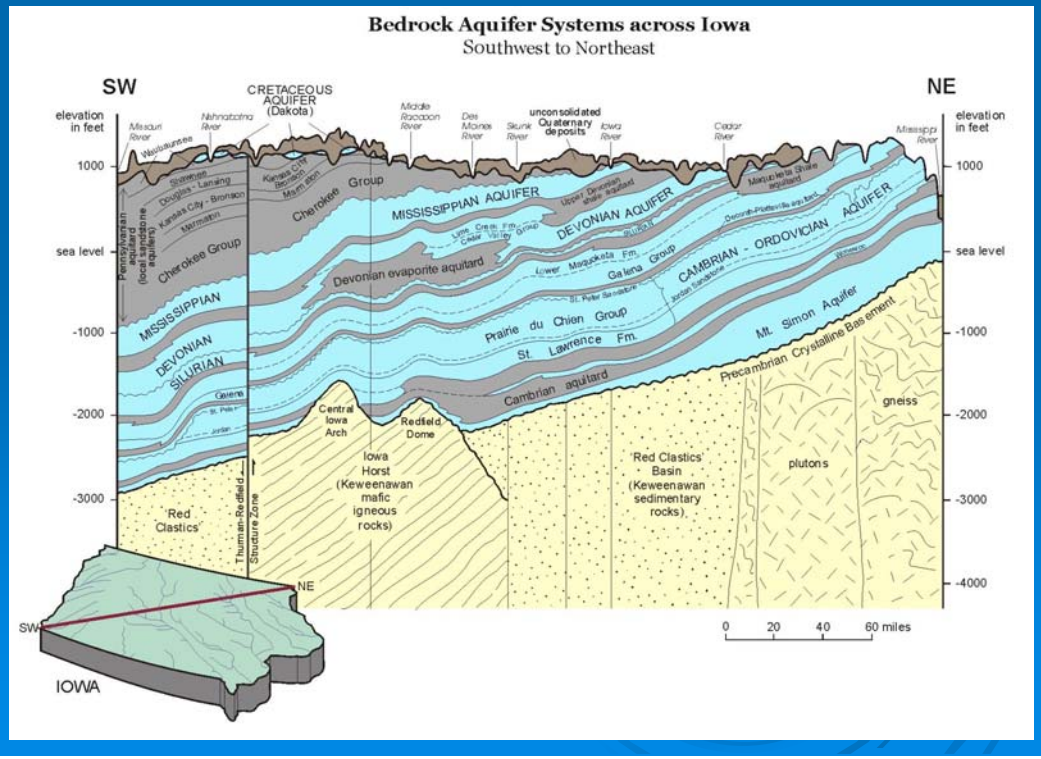
Potential Challenges



Institute for Agriculture and Trade Policy

Water- Key Resource for a Sustainable Economy

- What are our water resources?
- How much water do we have?
- How much water do we use?
- Who gets it and how?



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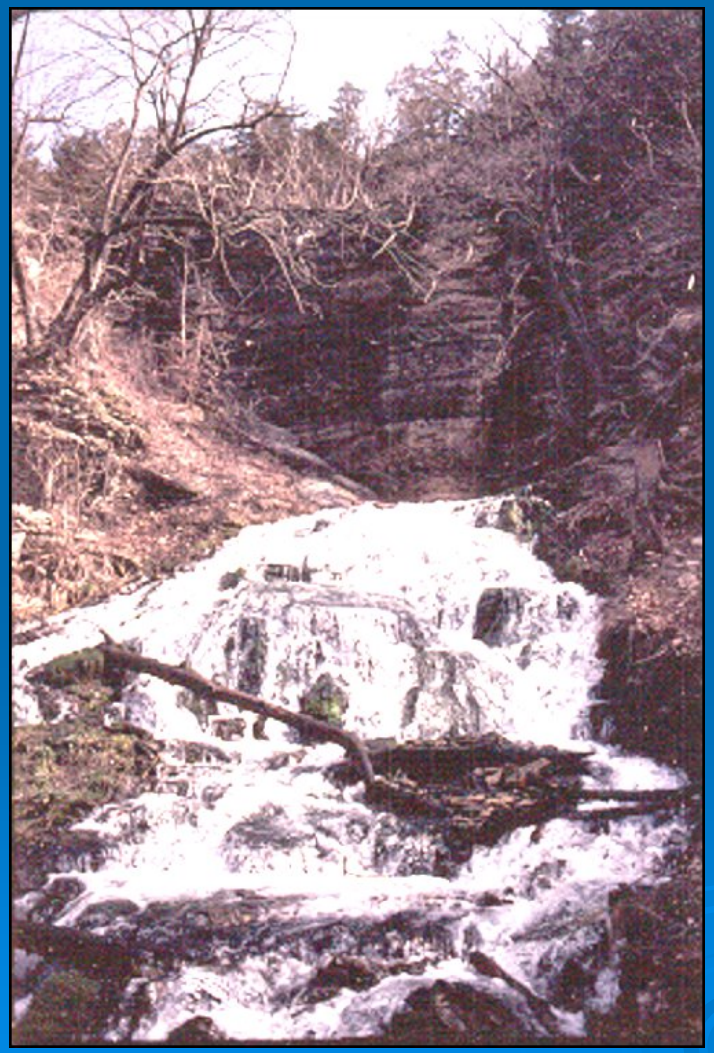
Kinds of Water Sources

Groundwater



Dunnings Spring
Winneshiek Co.

Surface water

Wapsipinicon River Linn Co.

Groundwater

Fills the spaces in porous earth materials.

Water Table

Marks the top of water- saturated earth materials. Seen as lakes and streams on the land surface.

Surface expression of water table

Des Moines River, Van Buren Co.

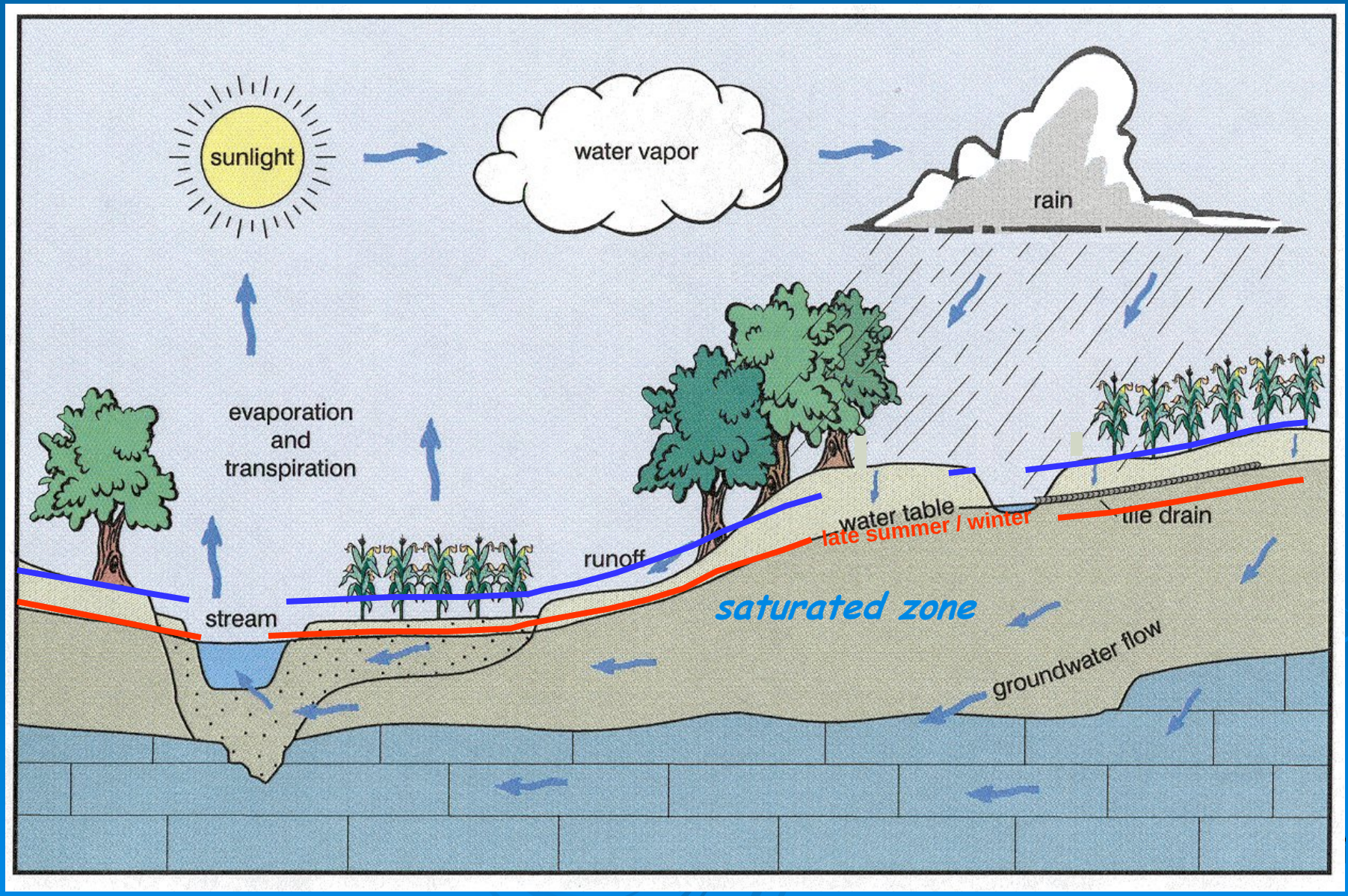
Surface expression of water table

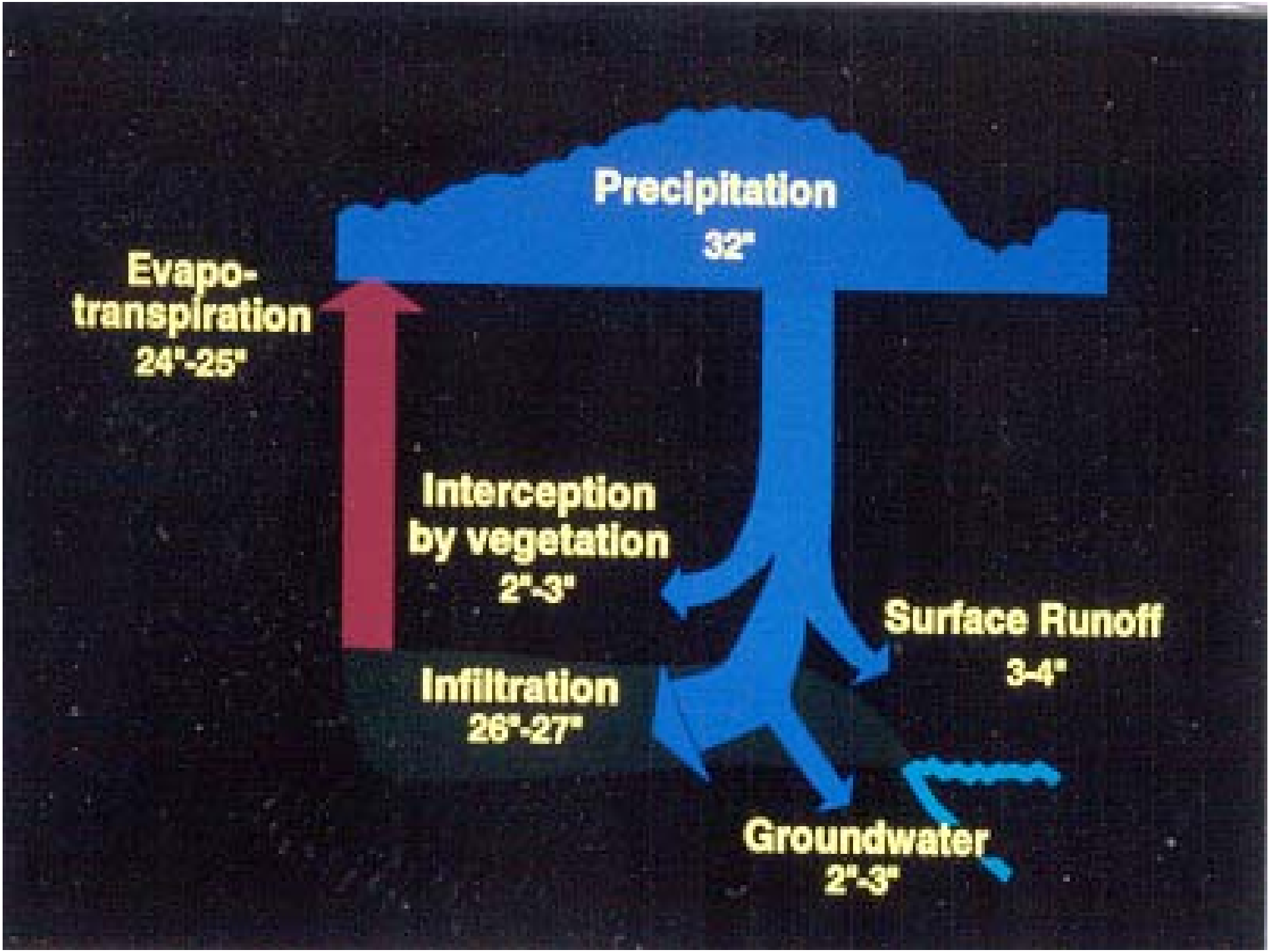
Kettle lakes, Palo Alto Co.

Surface expression of water table

Nelson Quarry, Des Moines Co.

The Hydrologic Cycle




Precipitation
32"
Evapo-
transpiration
24"-25"
Interception
by vegetation
2"-3"
Surface Runoff
3-4"
Infiltration
26"-27"
Groundwater
2"-3"

Aquifer

Zone of porous earth material that yields enough water to supply wells and springs.

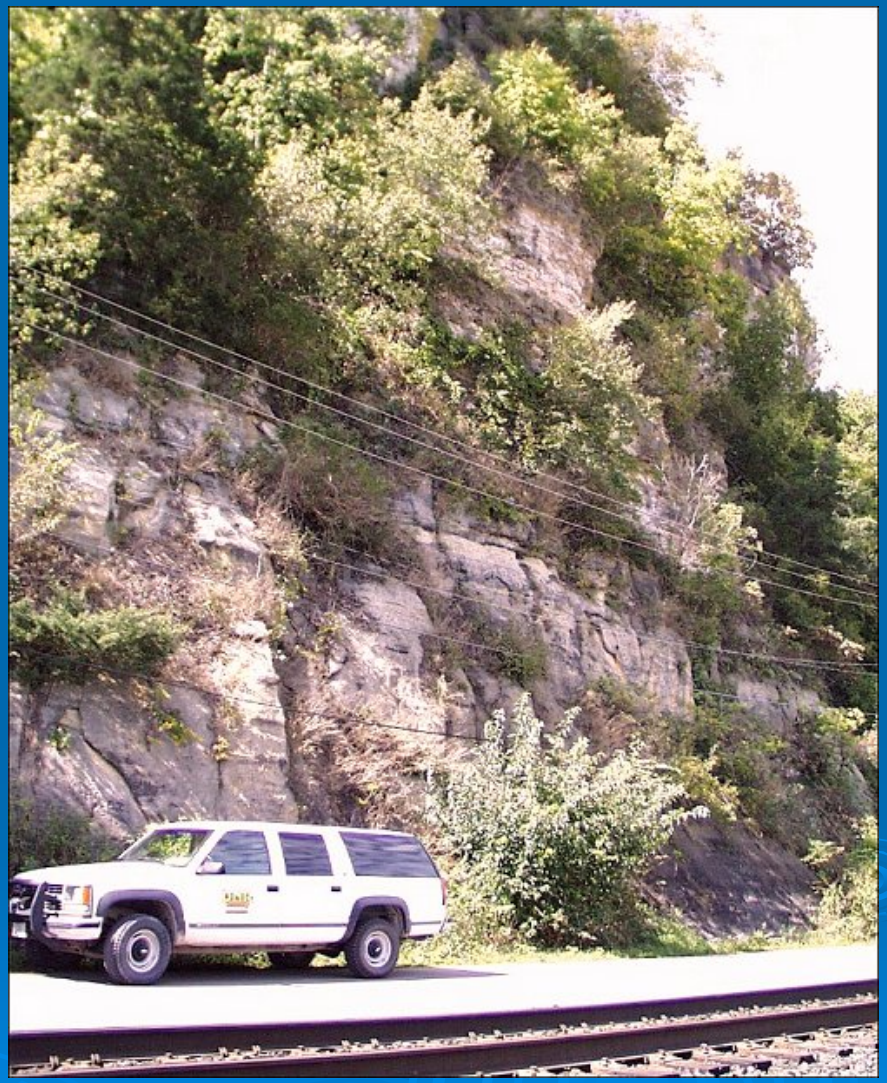
Confining layer

Dense, compact earth material that blocks the easy passage of water. These strata cap and pressurize "confined aquifers."

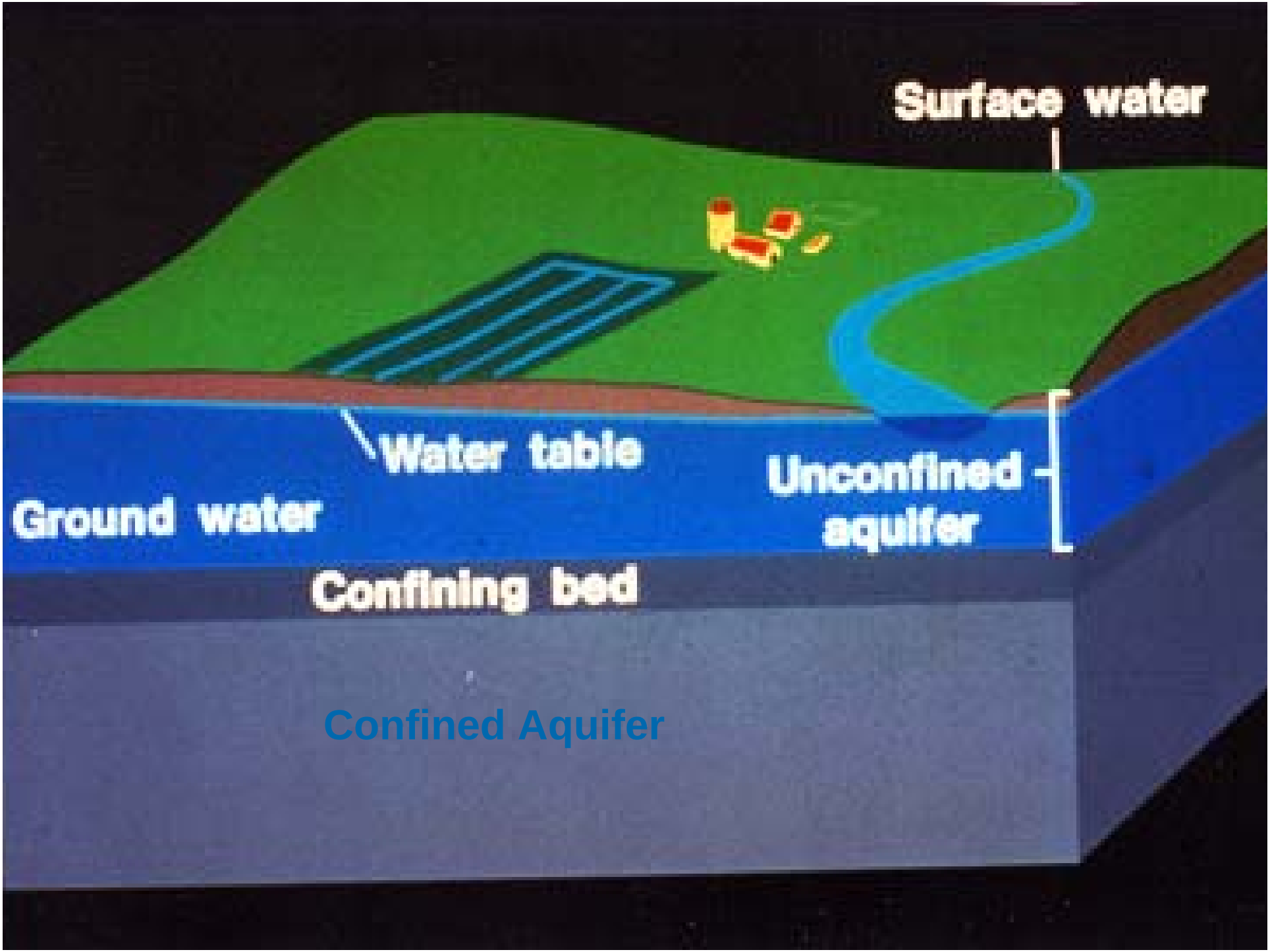
Aquifers

Glacial sand channel
Klien Quarry, Johnson Co.

Devonian, Cedar Valley Group
Klien Quarry, Johnson Co.



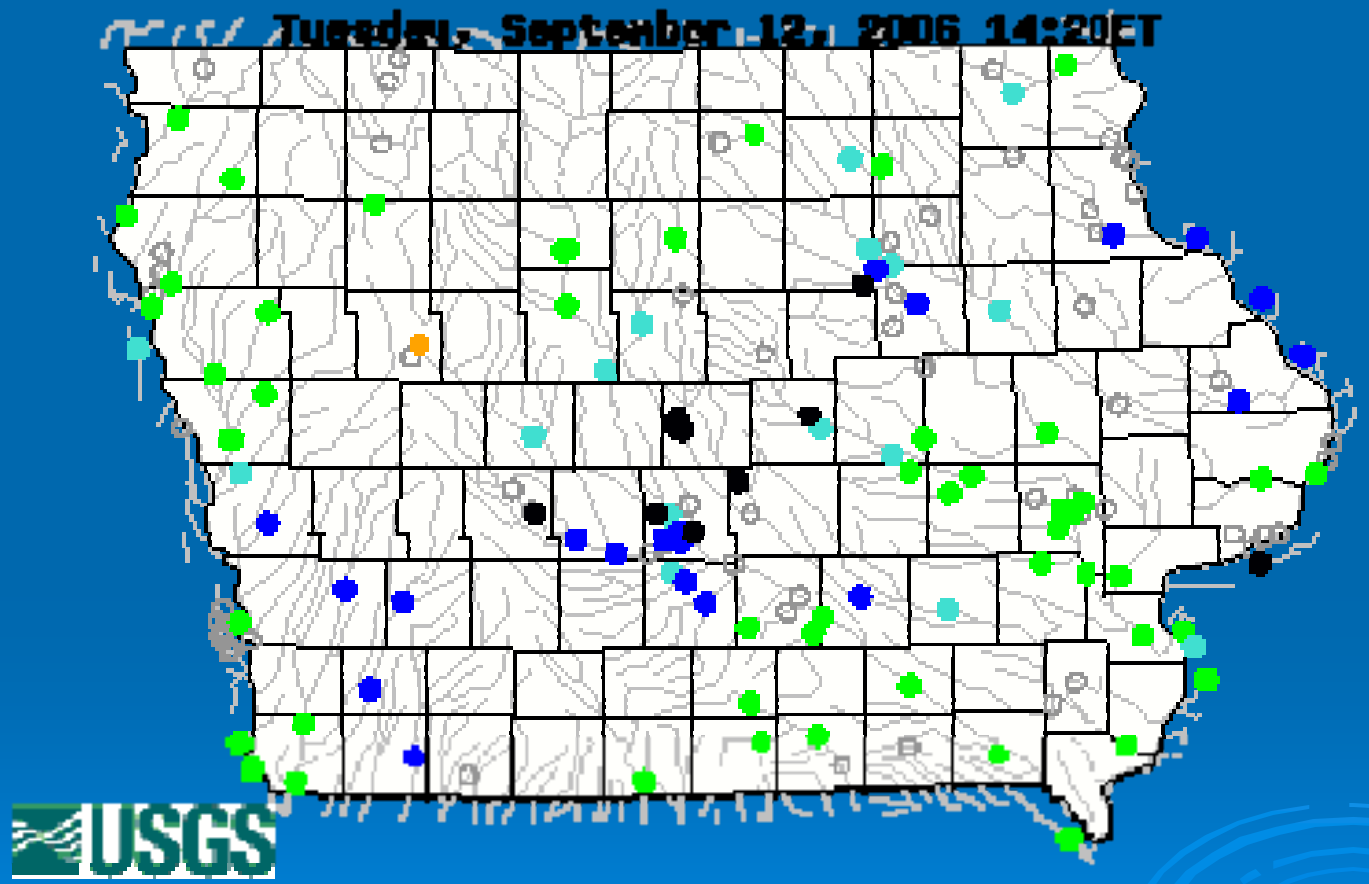
Cambrian, Jordan Sandstone
McGregor, Clayton Co.


Surface water
Water table
Ground water
Unconfined aquifer
Confining bed
Confined Aquifer

How Much Water Do We Have?

- It depends on where you are.
- It depends on when you need it.
- It depends on what quality you need.

How Much Surface Water: Flow Volumes are Measured At Stream Gages



Quality Assessed at many Gages as well.

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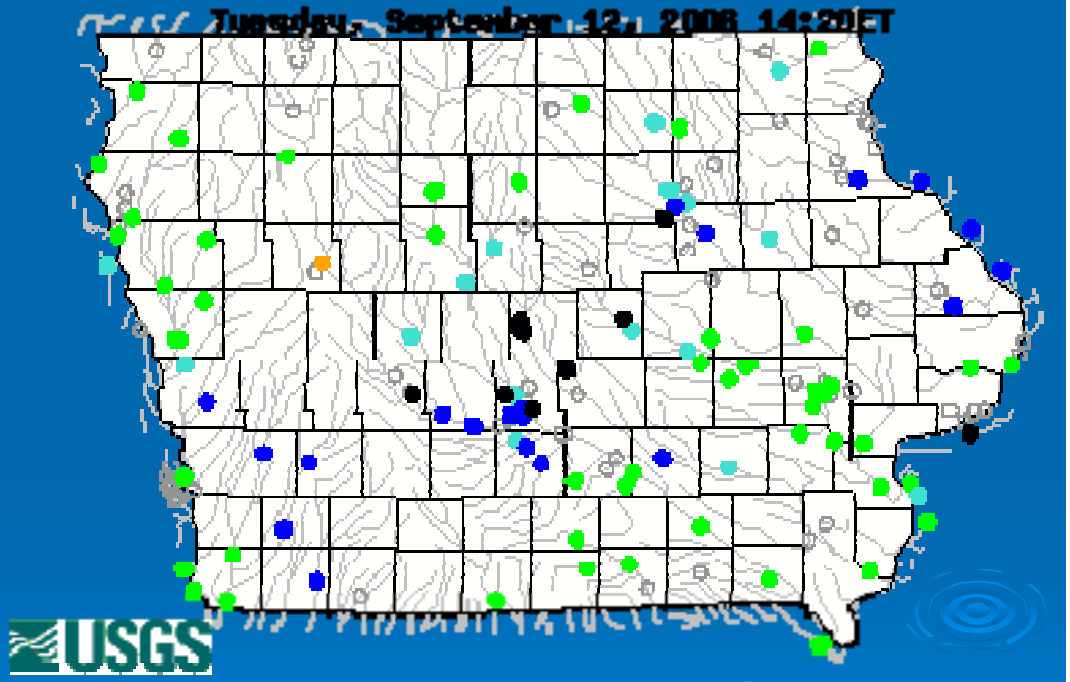
Measurements Paid for by a Variety of Entities for a Variety of Reasons

- Flood forecasting
- Wastewater load allocations
- Water quality assessments
- And others….including Water supply allocation
- **Additional gages needed for water allocation**



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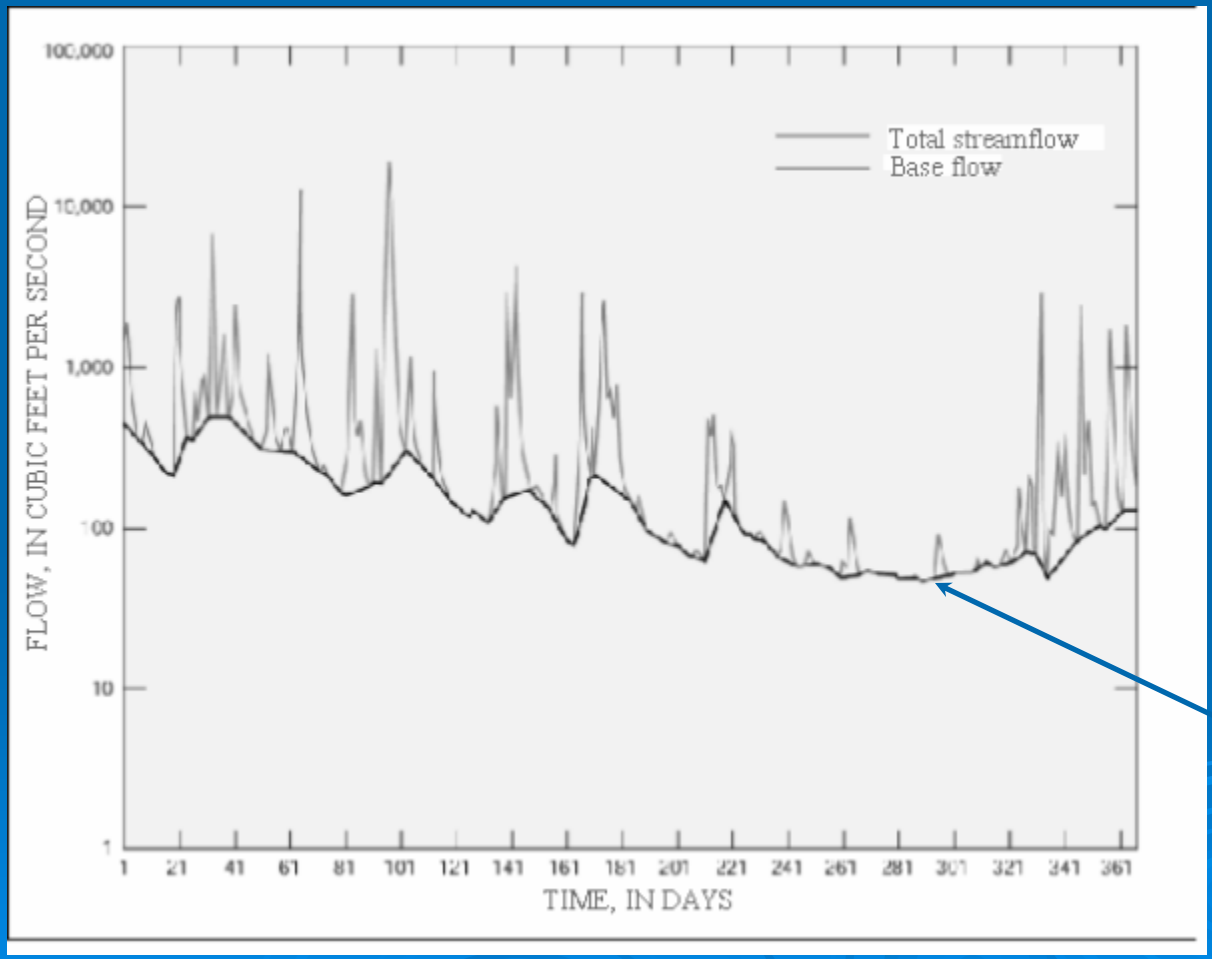
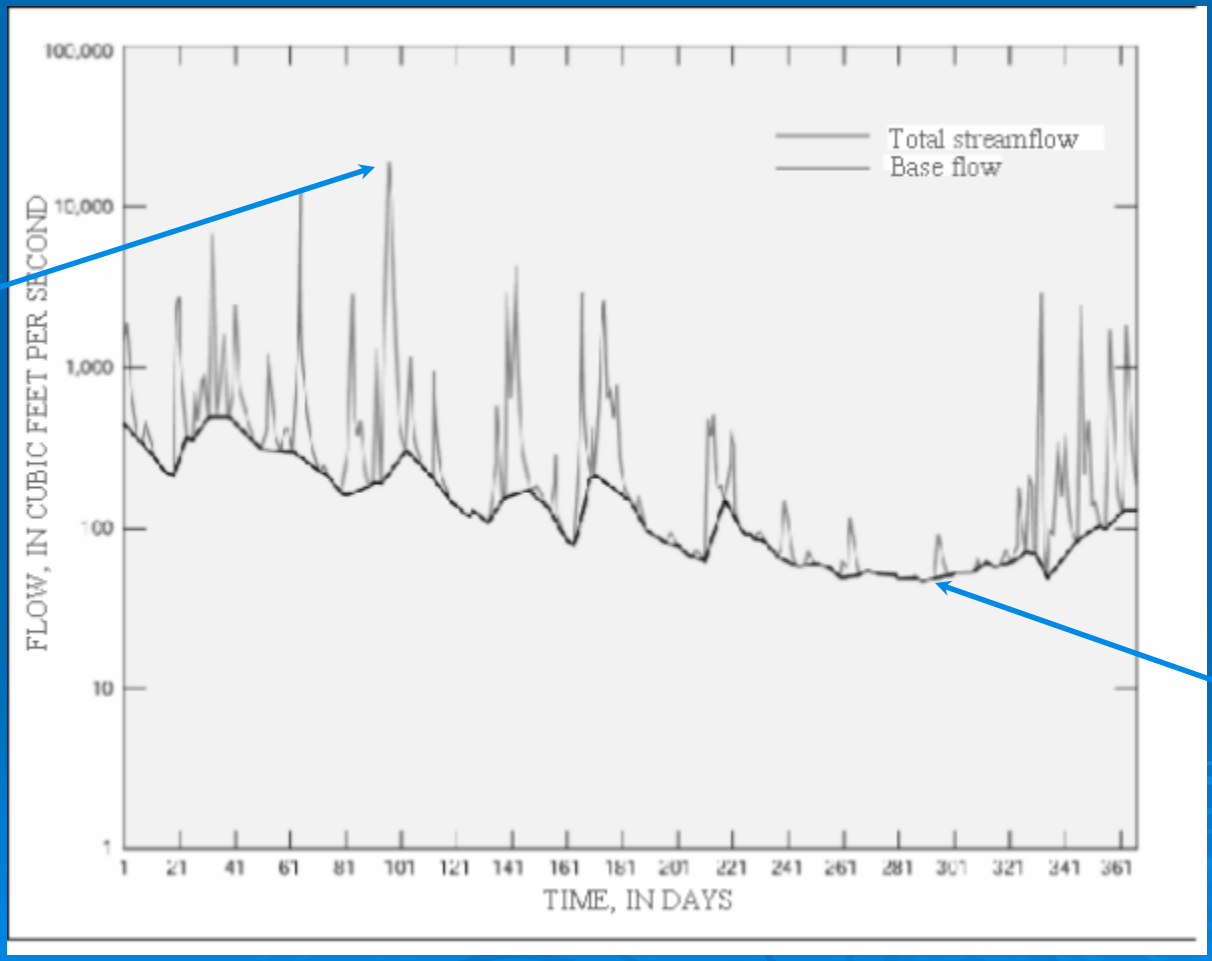
Gages Are Essential:
Stream Flow Rates are Highly Variable



Low flows are critical.

Water Quality Varies with Flow Rates

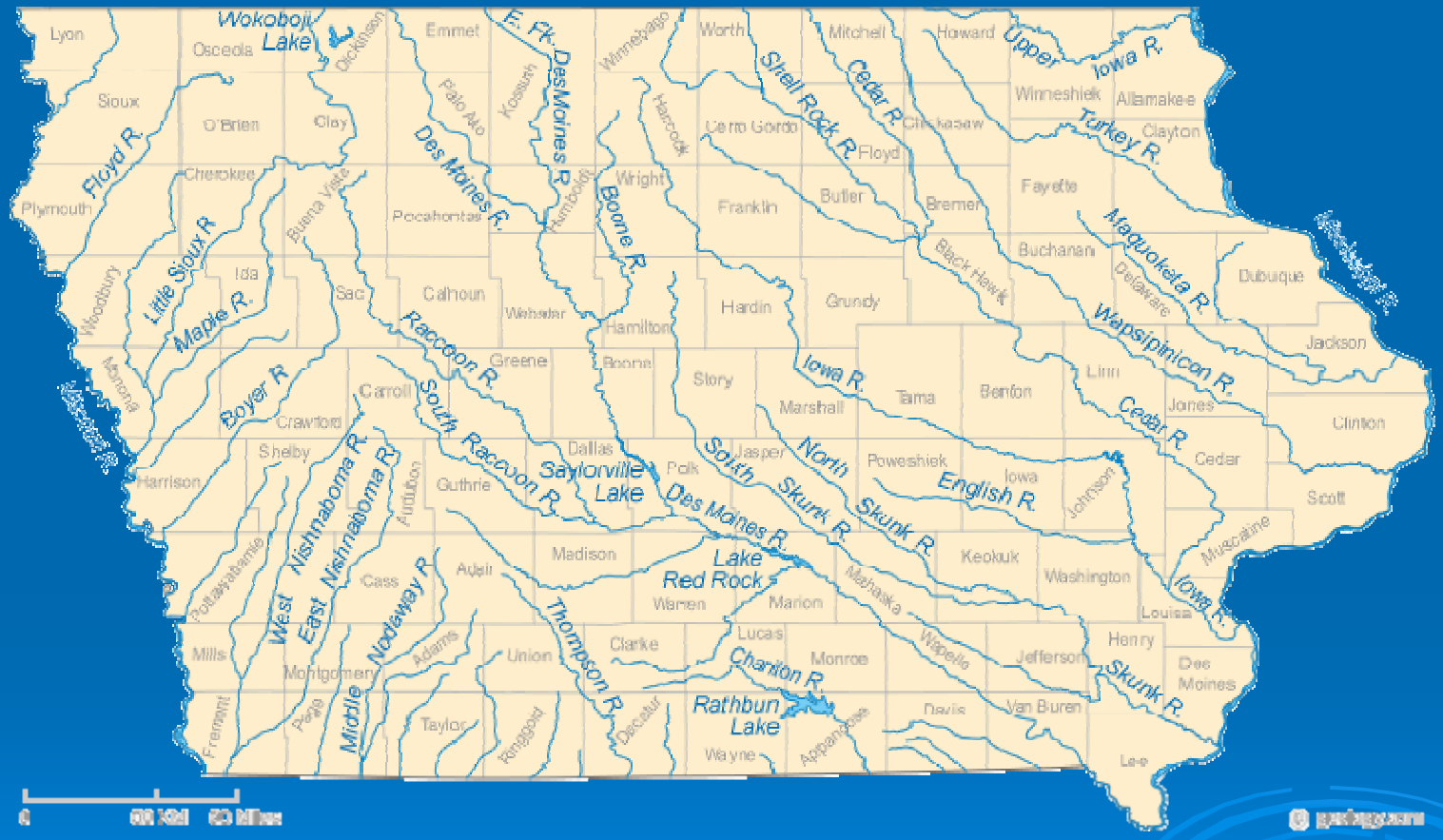
High flows rich in sediment.



Low flows enriched in dissolved solids.

Temperature varies with flow and seasonally

Lower Reaches of Major Rivers will have the Highest Sustained Flows



Are storage reservoirs needed? Where can they be built?

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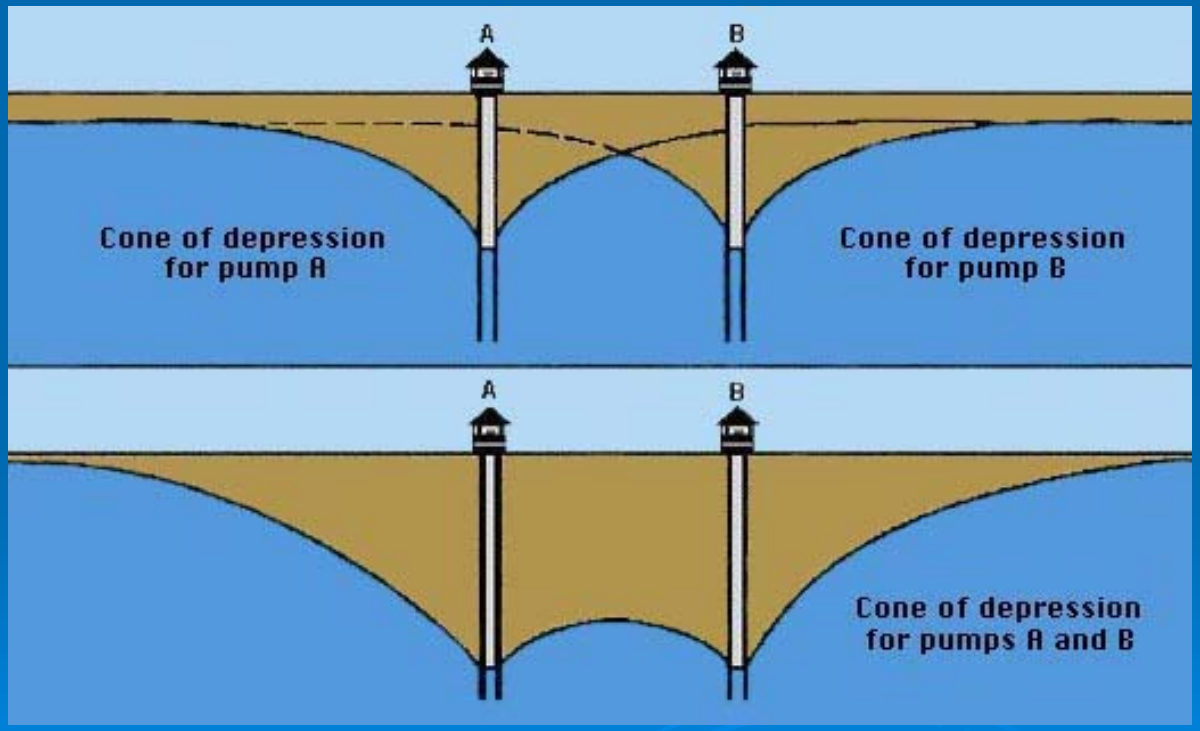
Groundwater is below us everywhere, but…

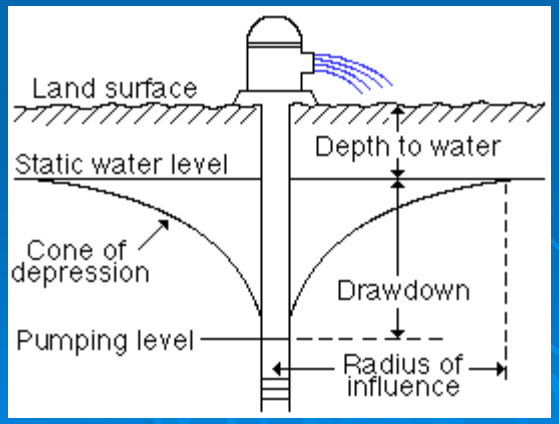
- **Quantity**
  - Is there "enough" for our purpose?
    - Will it impact other users?
- **Quality**
  - Is it "good enough"?
- **Sustainability**
  - Is it dependable for the long haul?
    - **Will there be "enough" in the future?**

Groundwater Quantity — Well Yields

How much can the aquifer supply?

Will that withdrawal of water impact other wells?





What do we know about aquifer yields and well interference?

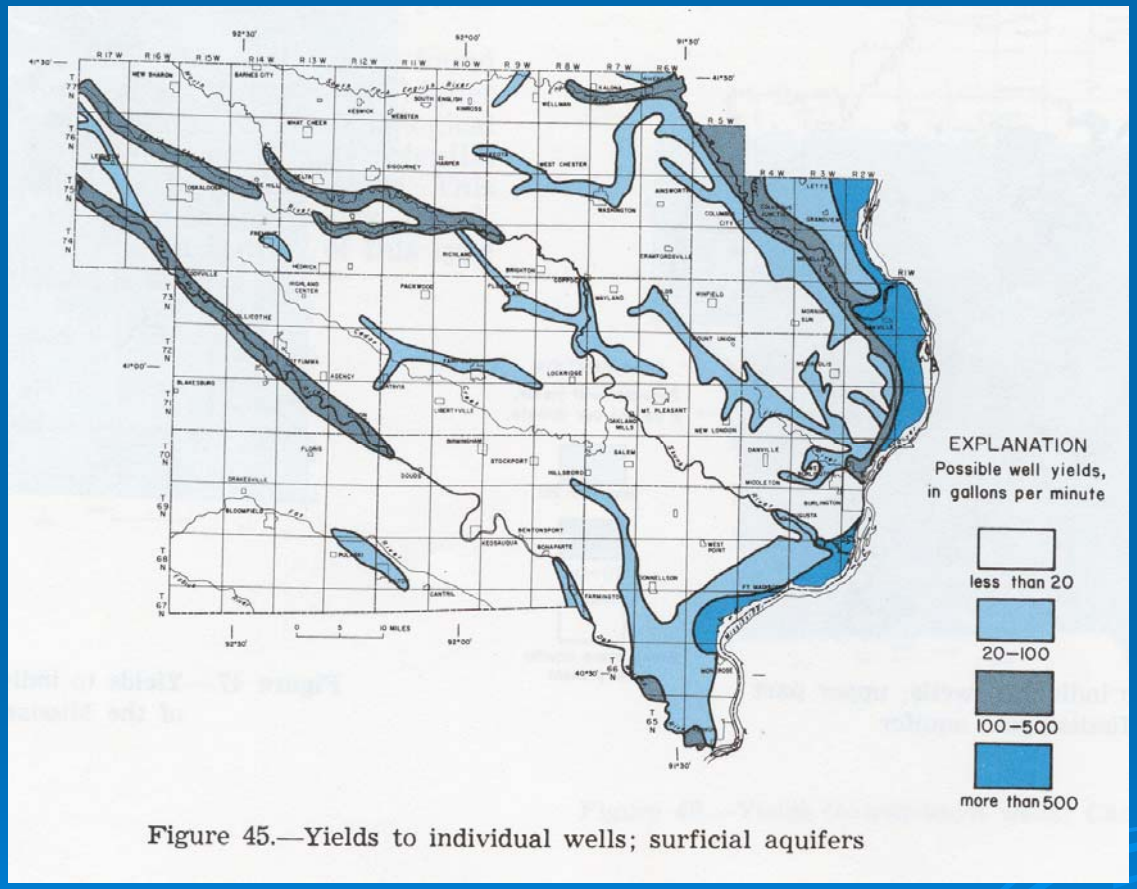
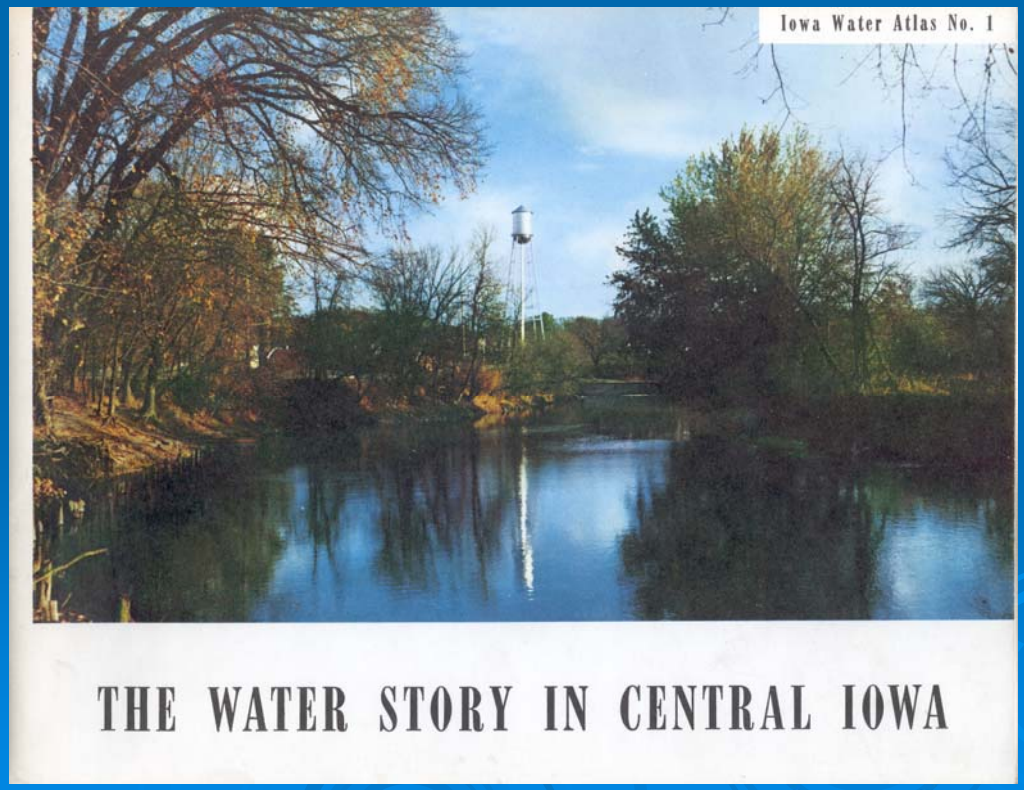


Figure 45.—Yields to individual wells; surficial aquifers

A fair amount, but aquifer studies are out of date

Major Aquifer Characterization Studies Date from the Mid-'60s to mid-'80s

Data compilations have become incomplete – major improvements in methods for predictive capabilities need to be employed.



Groundwater Quality -- Is it good enough for:

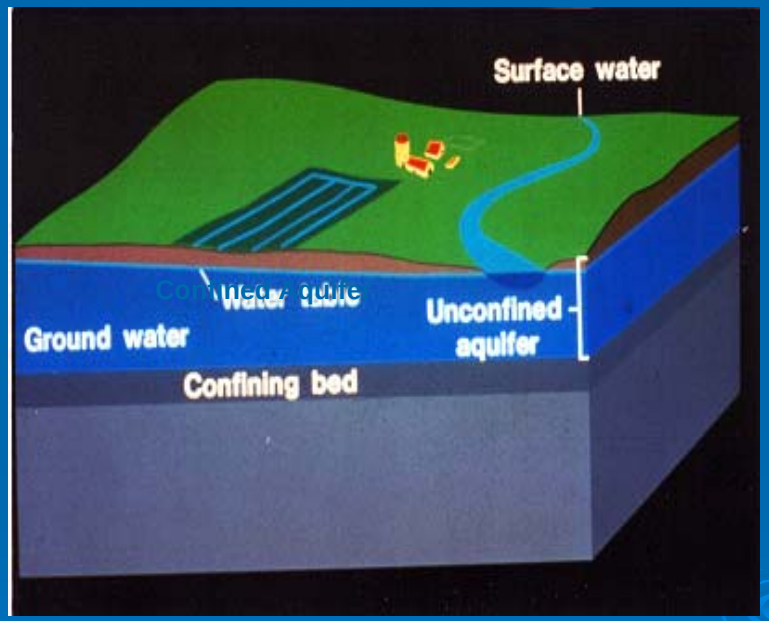
- Human consumption?
- Livestock watering?
- Boilers/cooling water?
- Industrial processes?
- Irrigation?
- Discharge?

Quality affected by both
natural constituents and "contaminants."
Decent database on GW Quality;
Analysis of Data Needed

Is it Sustainable for the Long Term?

Water Table (Unconfined) Aquifers

- Readily replenished and drained
- Susceptible to drought – periodically not sustainable



Confined Aquifers

- Not readily replenished or drained
- Water can be thought of as "in storage"
- Drought Resistant
- Over-use = "Groundwater Mining" = not sustainable

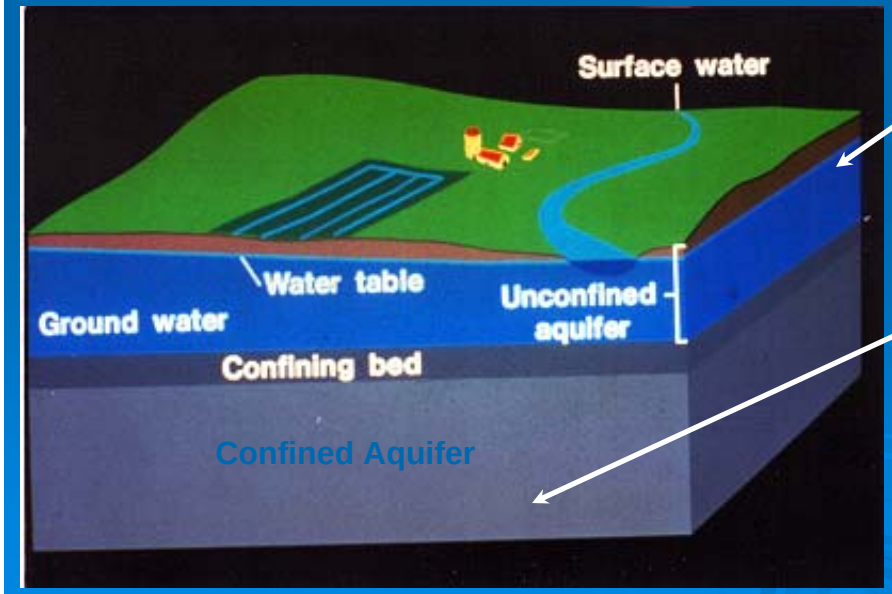
Is it Sustainable for the Long Term?

Water Table Aquifers

- Think checking account
- Streams are part of this account

Confined Aquifers

- Think one-time windfall investment

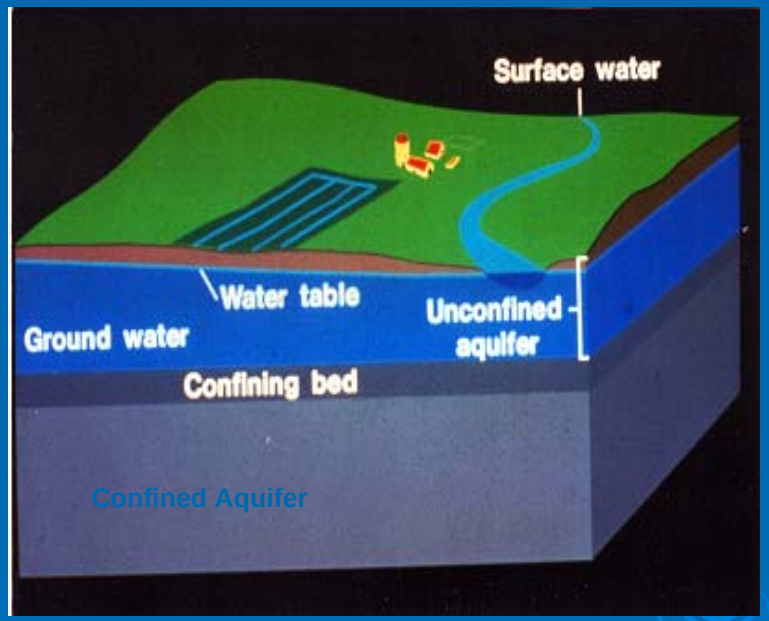


Checking –
Not much stored there, it goes fast, but okay if the paychecks keeps coming.

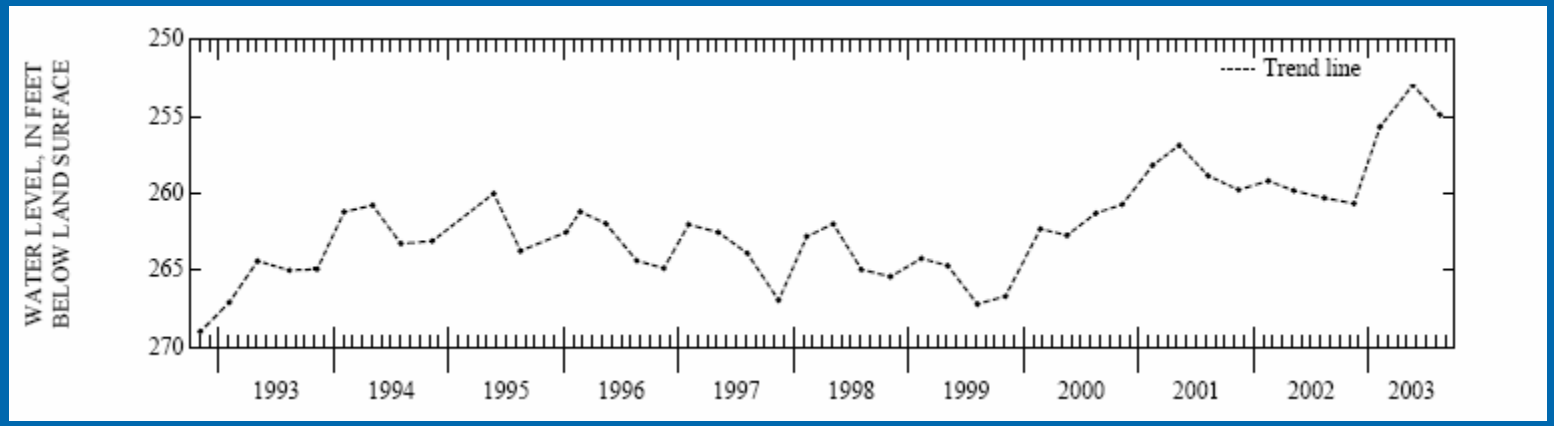
Investment –
Plenty stored there, but once withdrawn, it will be replaced slowly.

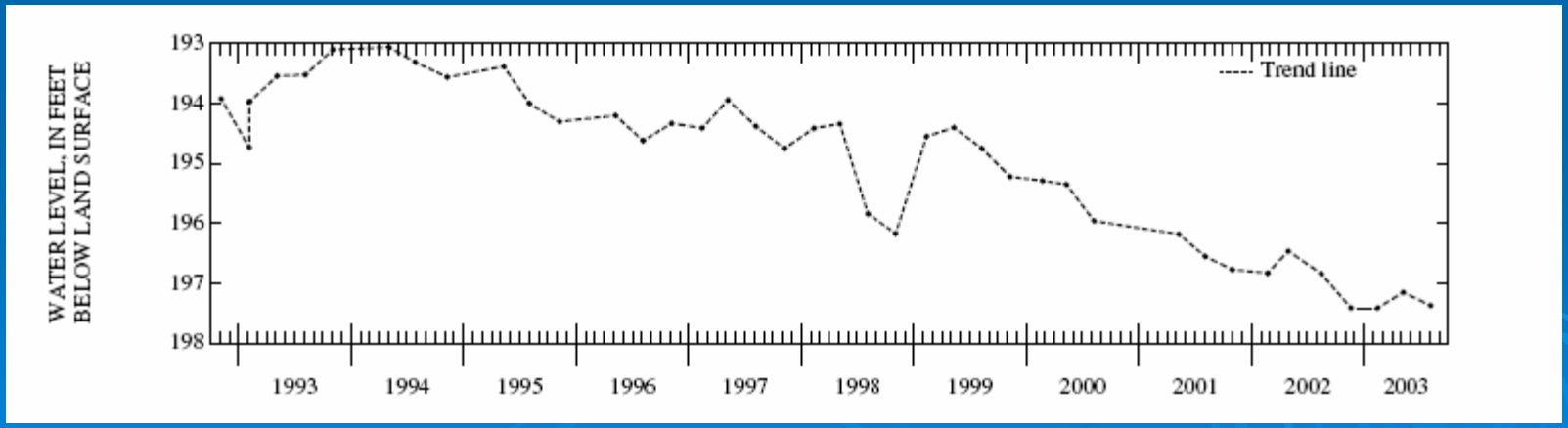
Is it Sustainable for the Long Term?

- Sustainability assessments largely lacking.
- Information and analysis needed.
- Drought known to affect water table aquifers and streamflows.
- Declines in confined aquifers are known in a variety of locales.
- Deep Jordan aquifer—regional declines of about 3 feet/year but varying locally with use.
- Groundwater level monitoring is analog to stream gauging --discontinued in 2004.



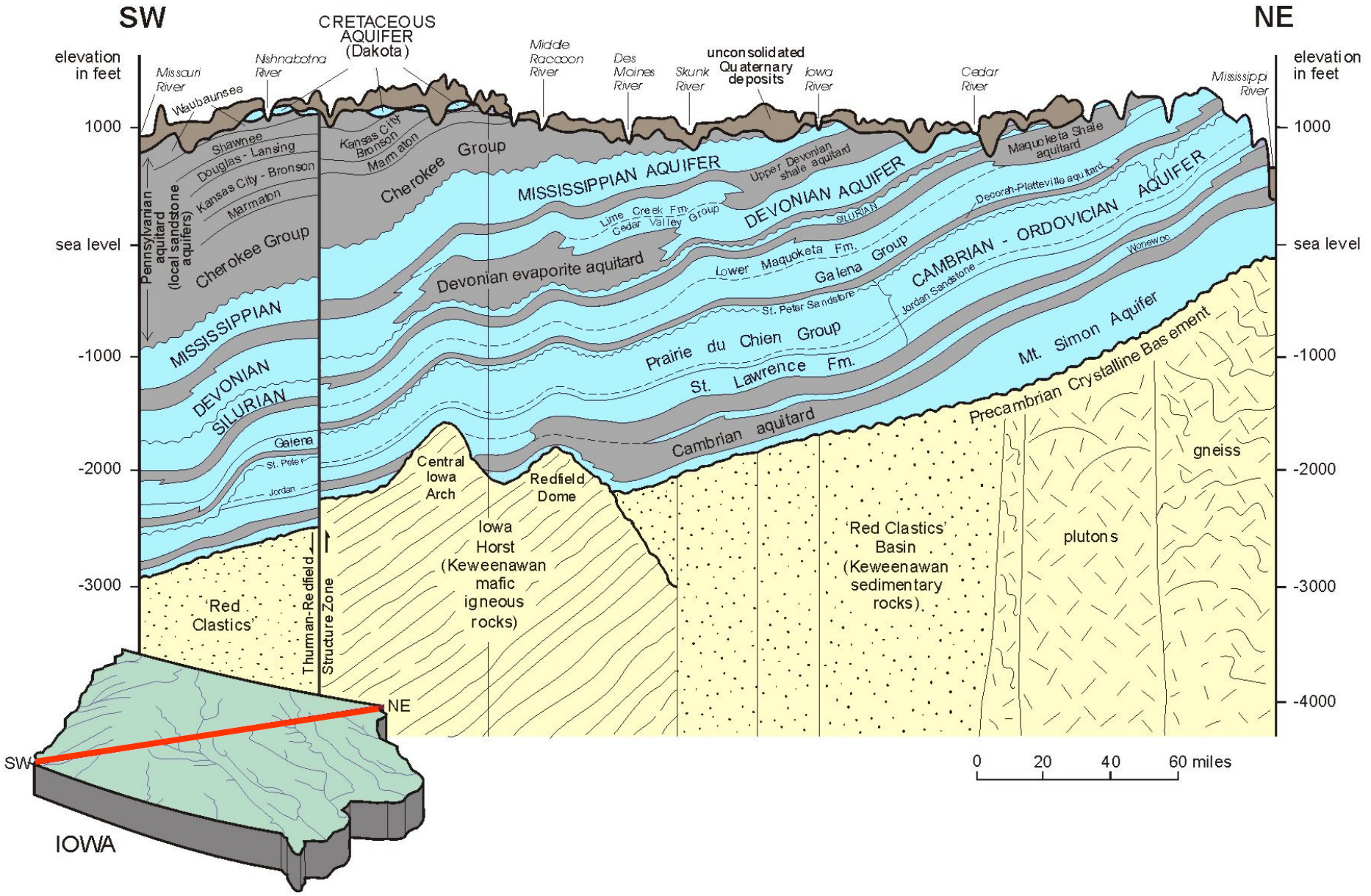
Water Level Monitoring Essential to Assess Trends For Good Decisions

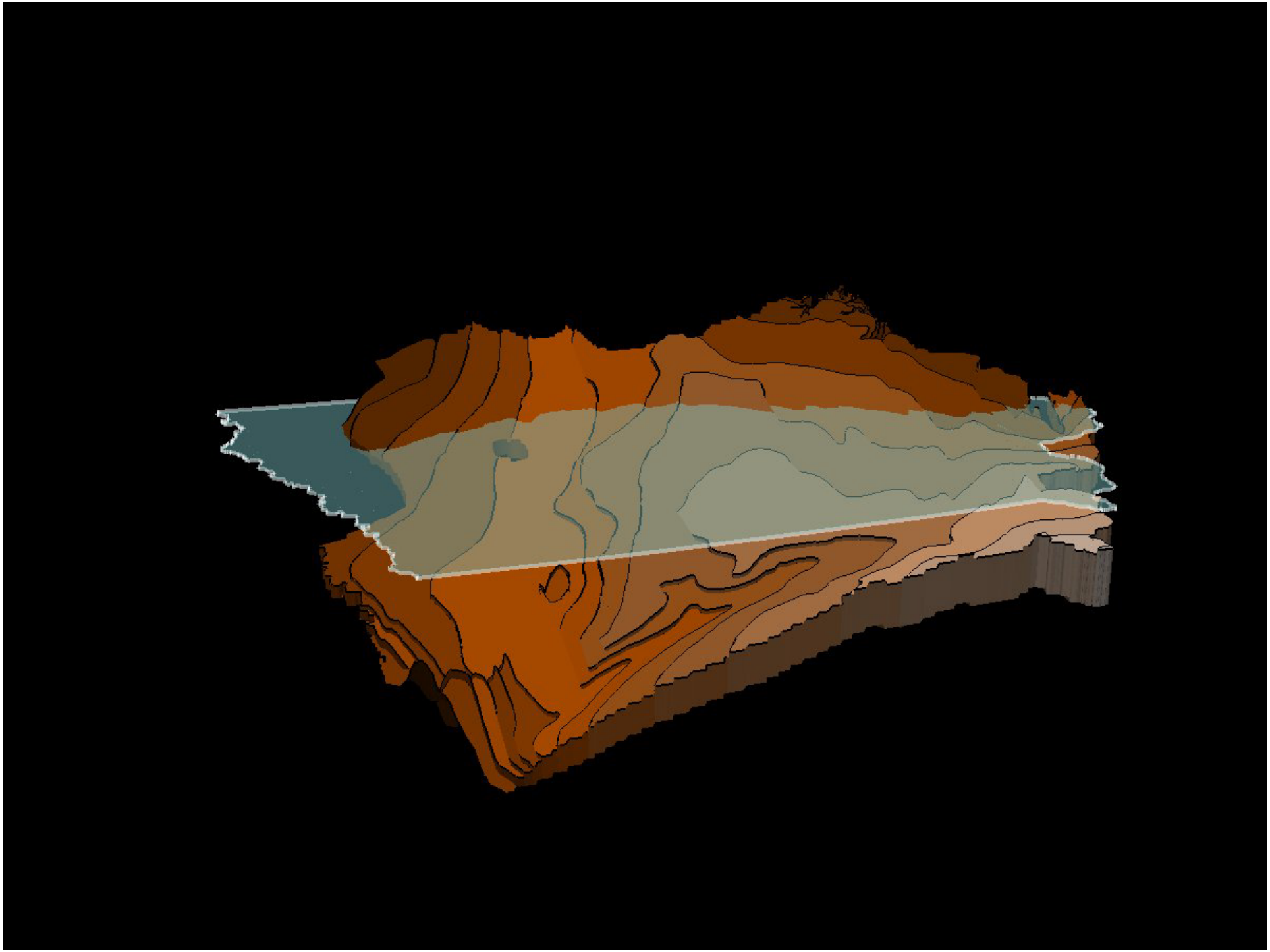


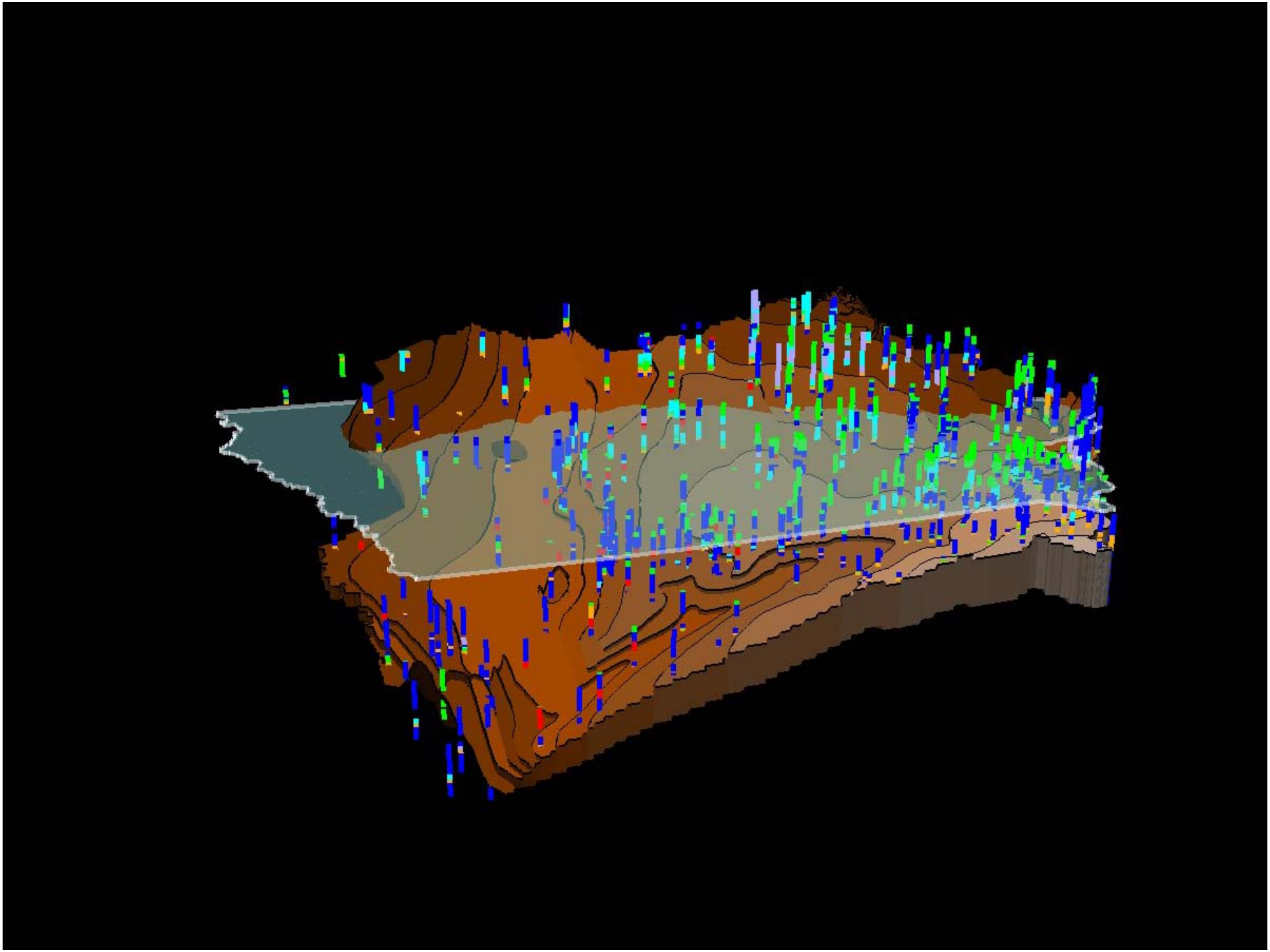


Bedrock Aquifer Systems across Iowa

Southwest to Northeast







How Much Water Do We Use?

Consumed vs. Withdrawn

•Consumptive Use is the water that is evaporated, transpired, or incorporated into a product. Water that is not returned to a source that can readily be used again. Typically discharged to a stream.

•Withdrawn means how much is actually removed from a stream or aquifer.

•Total maximum permitted withdrawals are known, but estimates by source are more than 10 years out of date.

•Actual withdrawals by source not adequately tracked.

Water Withdrawn in Iowa

Purpose	Groundwater withdrawals (Mgal/d)	Surface water withdrawals (Mgal/d)	Total withdrawals (Mgal/d)
Agriculture (livestock)	82	27	110
Commercial	18	25	43
Domestic	45	0	45
Industrial	74	184	258
Irrigation	35	4	39
Mining	1	42	43
Power generation	15	2110	2120
Public water supplies	257	116	373
Total water withdrawn	528	2510	3030

Mgal/d = million gallons per day

Source: *Estimated Use of Water in the United States in 1995*. U.S. Geological Survey Circular 1200, 1998.

Water Consumed in Iowa

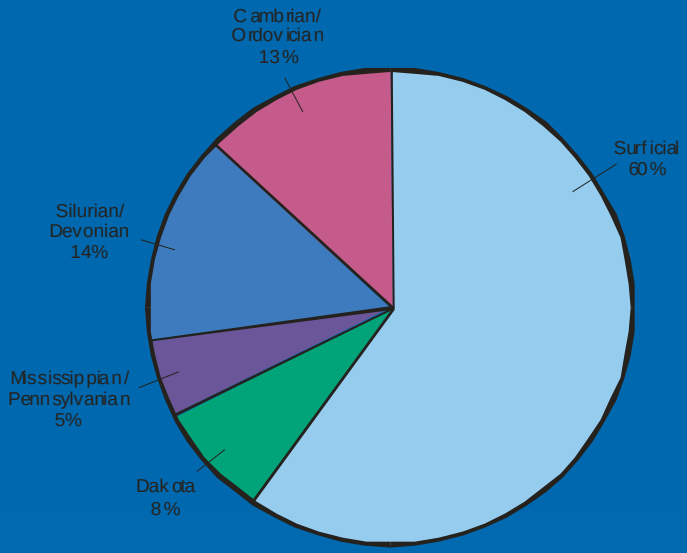
Purpose	Groundwater consumed (Mgal/d)	Surface water consumed (Mgal/d)	Total consumed (Mgal/d)
Agriculture (livestock)	82	27	110
Commercial	6	8	14
Domestic	73	0	73
Industrial	12	41	53
Irrigation	35	4	39
Mining	<1	<1	<1
Power generation	<1	10	10
Public water supplies	52	36	89
Total consumptive use	261	127	388

Mgal/d = million gallons per day

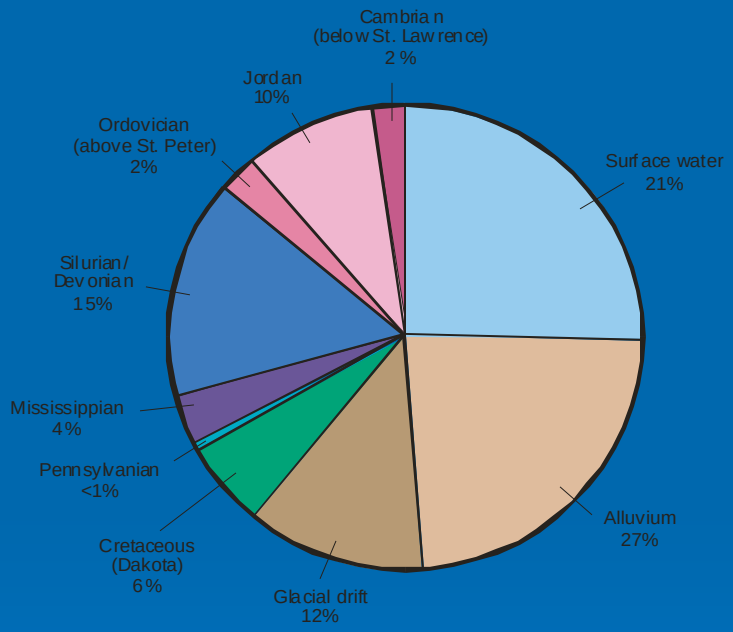
Source: U.S. Geological Survey estimated water use in Iowa, 1995, unpublished data.

Estimates are from 1995.

GW Withdrawals By Source Aquifer



Drinking Water By Source



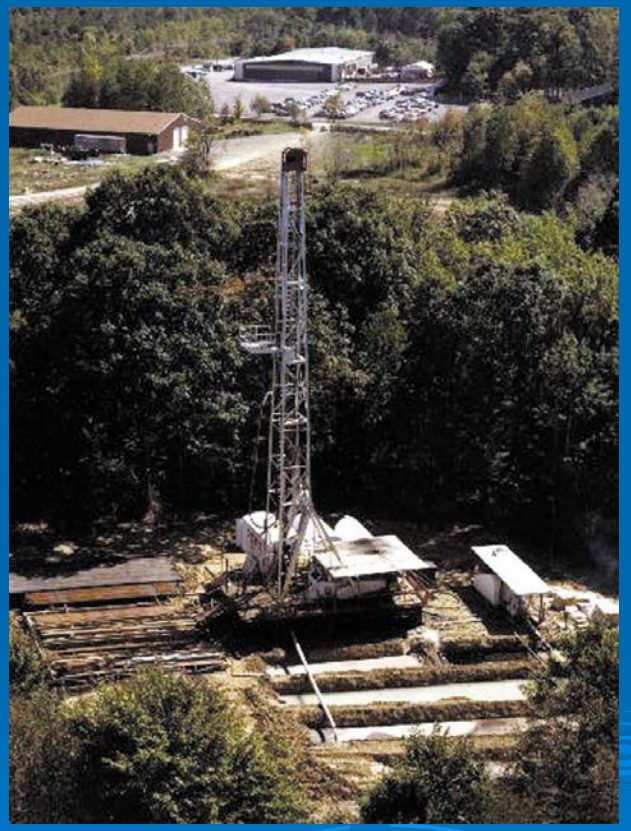
1995 Estimates

How Do We Allocate Water?

IA Code -- All waters are **"public waters and public wealth"** of Iowa citizens. Iowa statute provides an allocation system based on **"beneficial use".** Waste, unreasonable use, and unreasonable methods of water use are prevented.

Permit System -- Withdrawals in excess of 25,000 gallons/day (from streams or aquifers) require a permit from the state.

Permit Reviews and Evaluations – Cursory in many cases. **Are we getting it right for the long term?**



Who Gets It? From 1985 Water Plan: Permitting and Drought Allocation Priorities

1. **Self-supplied domestic**:
   non-regulated, self-supplied withdrawals with limited ability to seek water elsewhere.

2. **Domestic fraction** of regional **rural water and municipal systems**:
   water for the preservation of human life and welfare.

3. **Livestock**: water for the preservation of animal life.

4. **Power**: water used incidental to the generation of power.

5. **Industrial**: water used by commercial and industrial facilities.

6. **Non-traditional irrigation**: water for fruit, vegetables and other newly introduced crops.

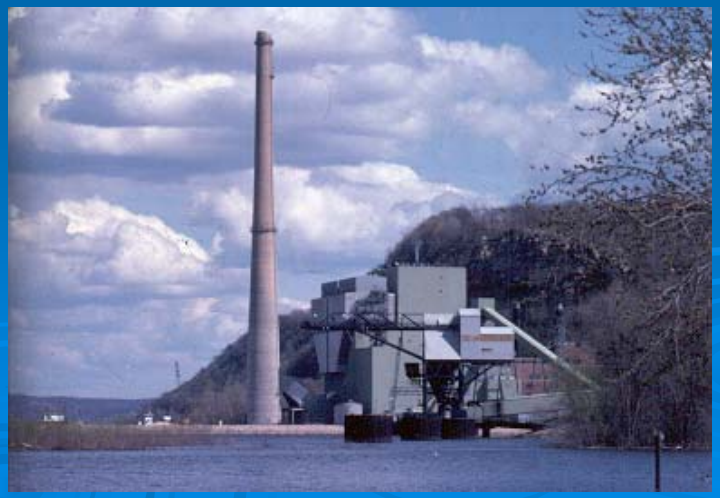
7. **Irrigation** of traditional Iowa crops: water for soybeans, corn, alfalfa and others.

8. **Recreation and leisure**:
   water for lawn and golf course watering, car washing and other incidental uses.

9. **Out of state export**: water exported to another state for use.

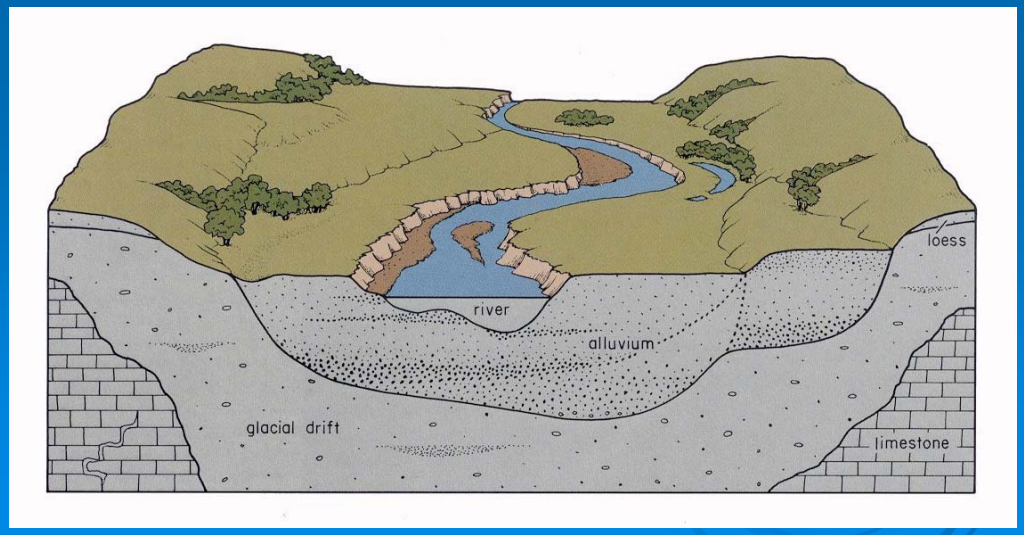
Developing Issues--Water Supply

- Energy – water connections
- Sustainable allocations
- Water and climate
- Water supply – water management program needs



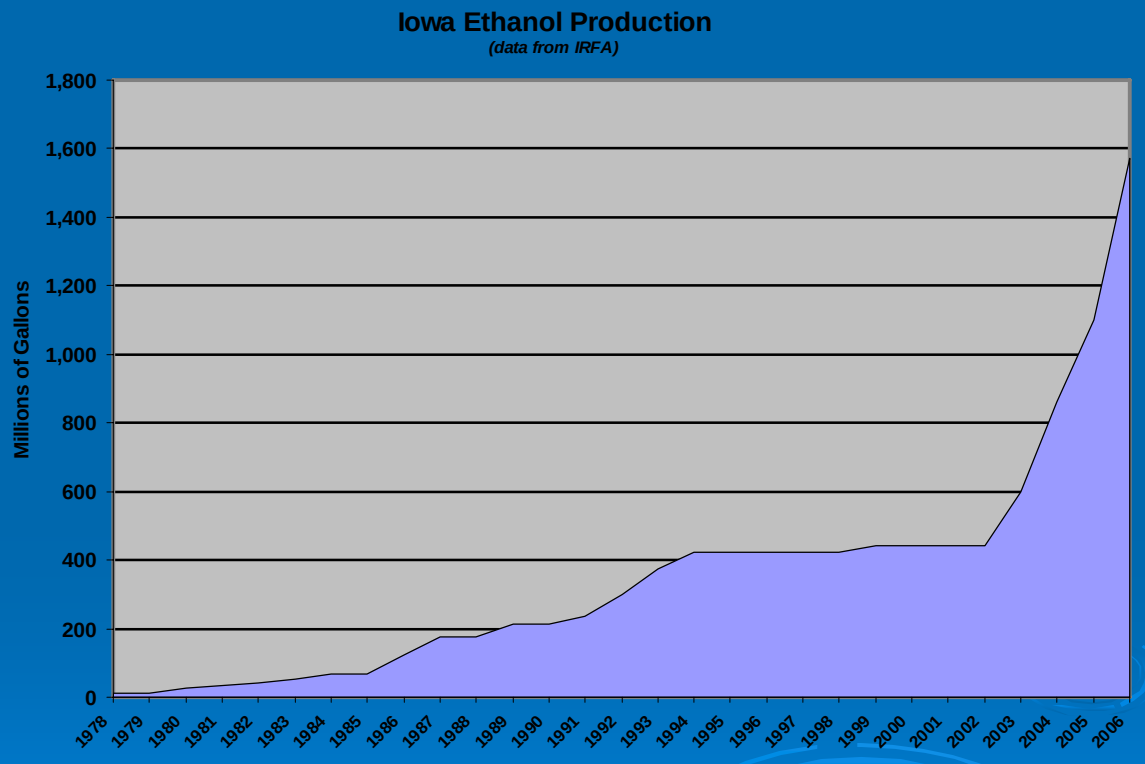
Energy and Water

- Traditionally cooling water for power plants, supplied by surface water
- Growing demands for ethanol and geothermal, supplied by groundwater
- High energy prices will impact water demand in ways we don't yet fully appreciate. Same can be said for other natural resource and environmental issues.

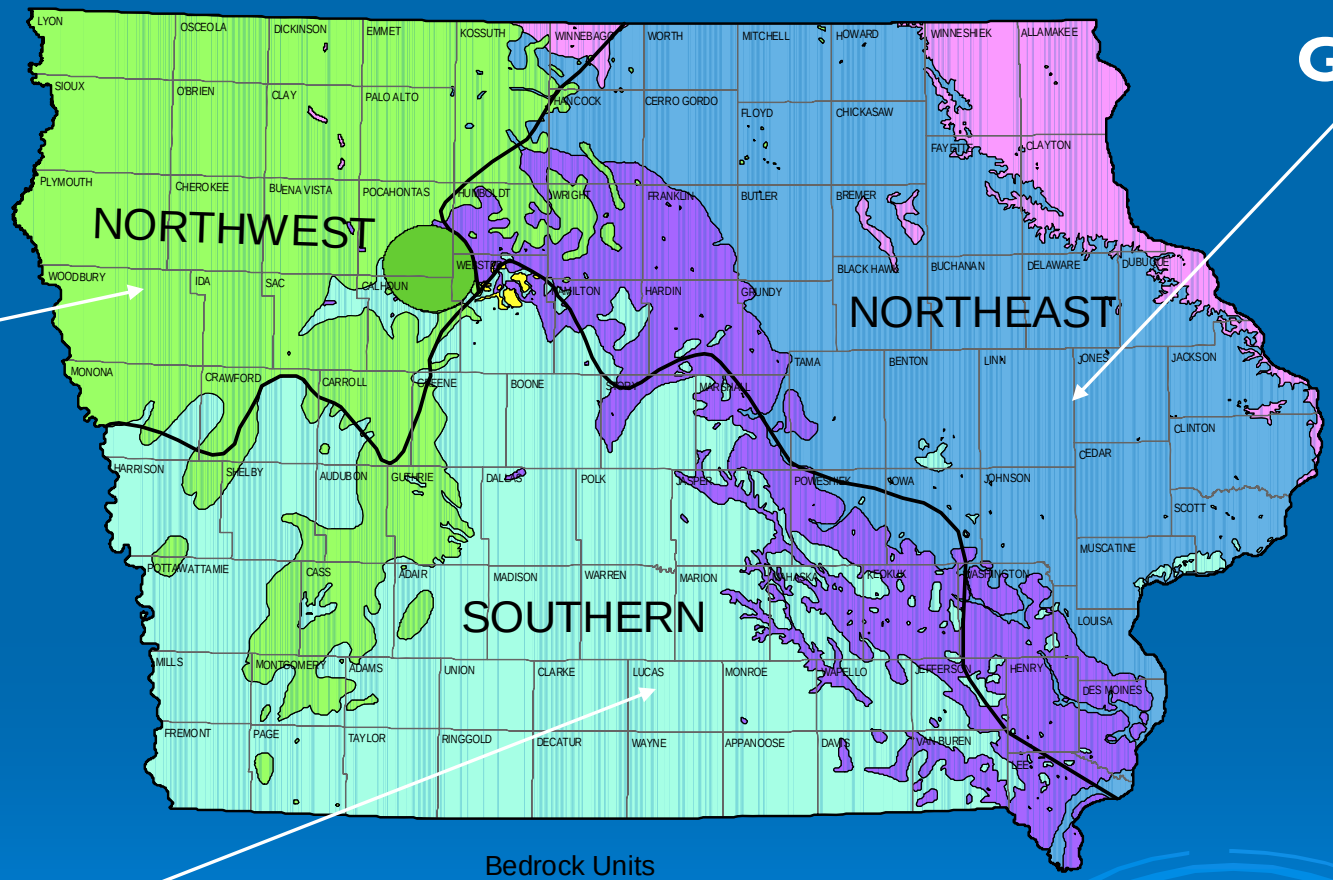


Ethanol Production

- Current capacity 1.6B gallons/year with much more planned
- ~ 4 gallons water per gallon ethanol
- Development breeds development: ethanol plants + cattle operations + ?
- Today, a small part of groundwater demand, but a growing one



Groundwater Supply and Demand are *not* Equally Distributed



Good

Fair

Poor

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Ethanol and other energy-related water demands won't "dry up" the state

But they are raising questions regarding sustainability and our water management system.

Climate Change – What's Happening?

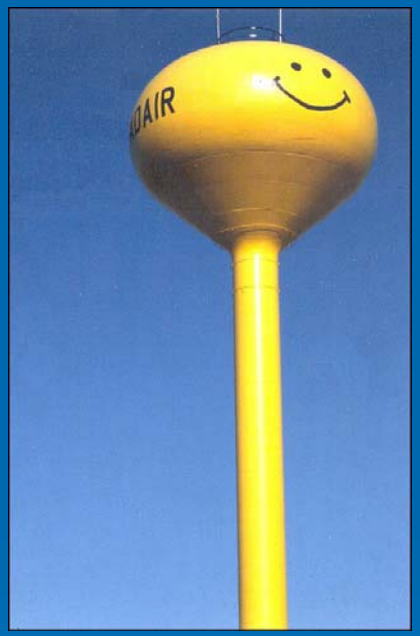
- Questions about what it means in the middle of a continent.

- Wetter……..Drier…
  Warmer……Colder?

- And what that means regarding future water supplies.

Water Management- What's Needed to Do It Right

- **Updated assessment of current demand:**
  Last major use assessments, by aquifer and watershed, in 1995
- **Resume and enhance groundwater level monitoring:**
  Regional aquifer trends and local hotspots
- **Add and maintain additional stream gages:**
  Gages needed for accurate water allocation.
- **Updated assessments of aquifer distribution and properties:**
  last major efforts in the 1980s
- **Upgraded assessment techniques:**
  Need to utilize modern modeling and predictive analysis
- **More thorough hydrogeologic reviews of permits:**
  Well interference and sustainability questions
- **Update the state water plan:**
  Last update in 1985.



Questions?

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www.iowadnr.gov/water/quantity.html

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