

# Maine's Groundwater Resources Is There Enough ?



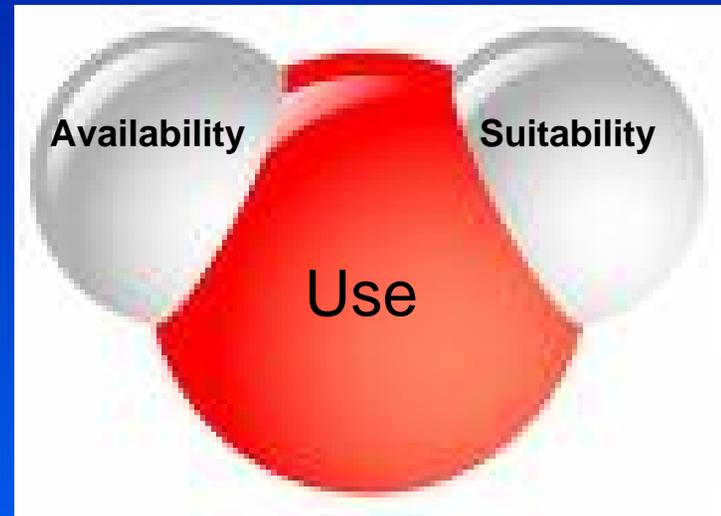
Presentation to the *Citizen Trade Policy Commission*

and *Water Resources Planning Committee*

*Carol White, C. A. White & Associates, LLC*

*September 11, 2009*

# How do we know if there is enough ?



*Sustainability is a balance between meeting the needs of the present without compromising the needs of the future*

# What do we mean by Groundwater Sustainability?

*.....the development and use of groundwater in a manner that can be maintained for indefinite time without causing unacceptable environmental, economic or social consequences.*

*-USGS Circular 1186*

# MAINE'S WATER CYCLE



## SURFACE WATER

Infiltration to groundwater:  
2-5 trillion gallons annually  
**10-20%**



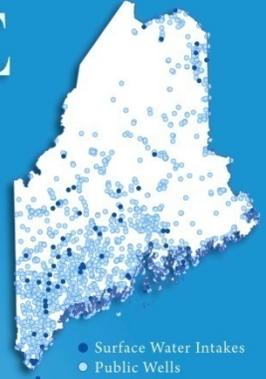
WATER USAGE IN MAINE

Design and cartography  
Bill Duffy  
NORTHERN GEOMATICS

Data Sources:  
Maine Geological Survey  
Maine Drinking Water Program, United States Geological Survey

List of Collaborators:  
Maine Geological Survey, Geological Society of Maine, Northeast Section-Geological Society of America, United States Geological Survey, Maine Water Science Center, National Association of Geoscience Teachers-New England, Geology Department, University of Southern Maine, Geology Department, University of Maine at Farmington, Department Geosciences, University of Maine, Orono, University of New England, C.A. White and Associates, LLC, Walter Anderson, State Geologist, Emeritus, Towhey Associates, Poland Spring Water Company

For more information on Maine's water cycle see:  
Maine Geological Survey (<http://www.maine.gov/dos/nrmc/mps>)  
Maine District Office, US Geological Survey (<http://ma.water.usgs.gov>)

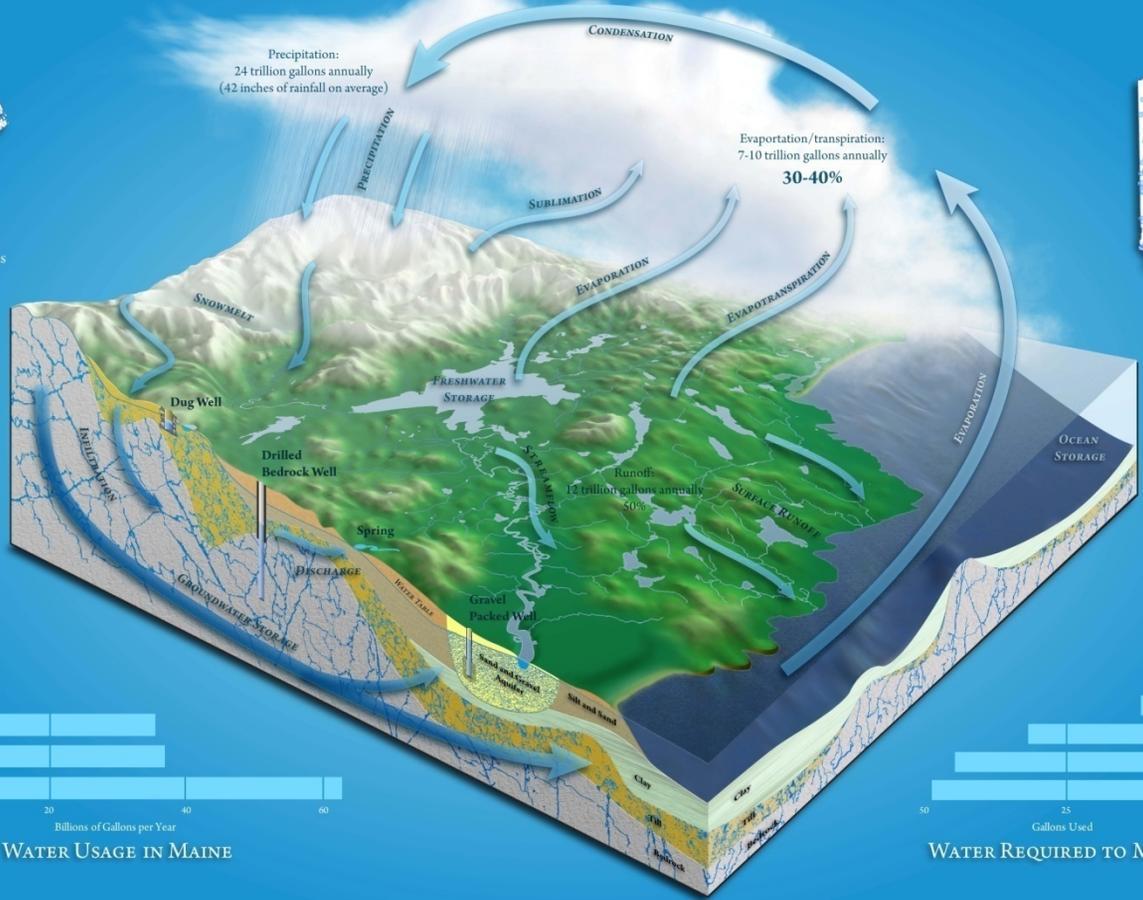


## DRINKING WATER SUPPLIES

The top inch of Maine's  
Sebago Lake contains  
800 million gallons of water

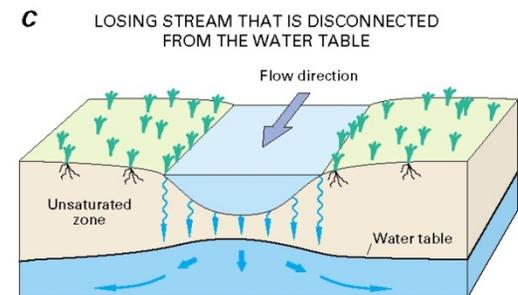
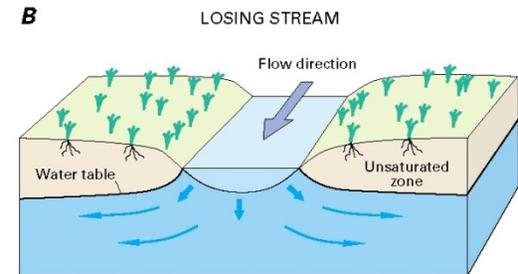
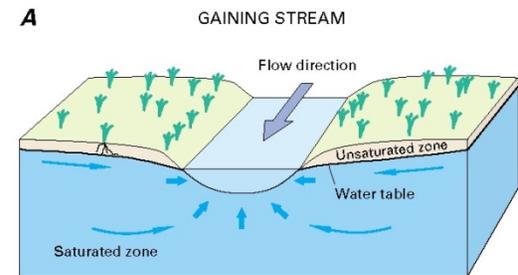
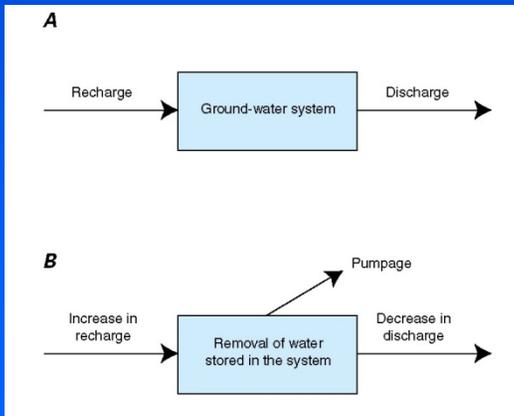


WATER REQUIRED TO MAKE OR PROCESS GOODS



Maine's groundwater is a rapidly renewable resource

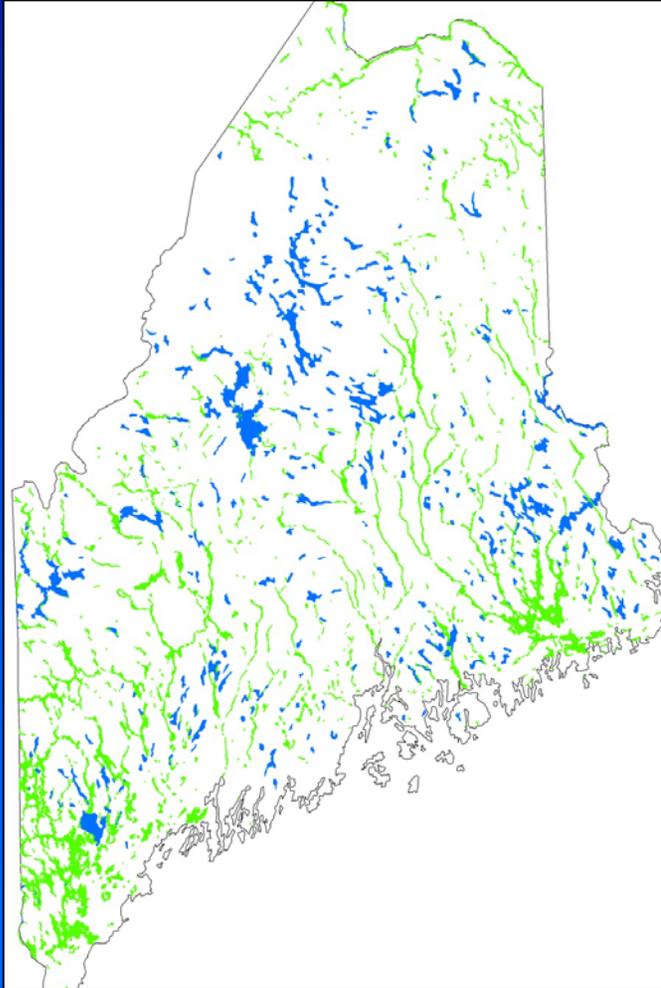
There is no "extra" water in an aquifer. Water captured by pumping will result in some combination of loss of discharge to surface water, an increase in recharge from the surface, or a loss in storage.



**Figure 12.** Interaction of streams and ground water. (Modified from Winter and others, 1998.)

# Where do we find groundwater in Maine ?

## Sand & Gravel Aquifers



Glacial deposits

Approximately 1300 square miles in Maine

Recharge 240 billion gallons of water annually

Typical yields 10-1000's gpm

Vulnerable to contamination

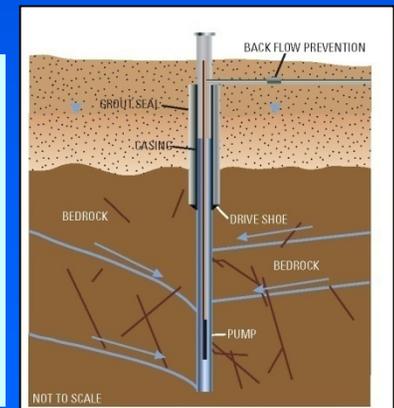
## Bedrock Aquifers

Water from fractures in the rock

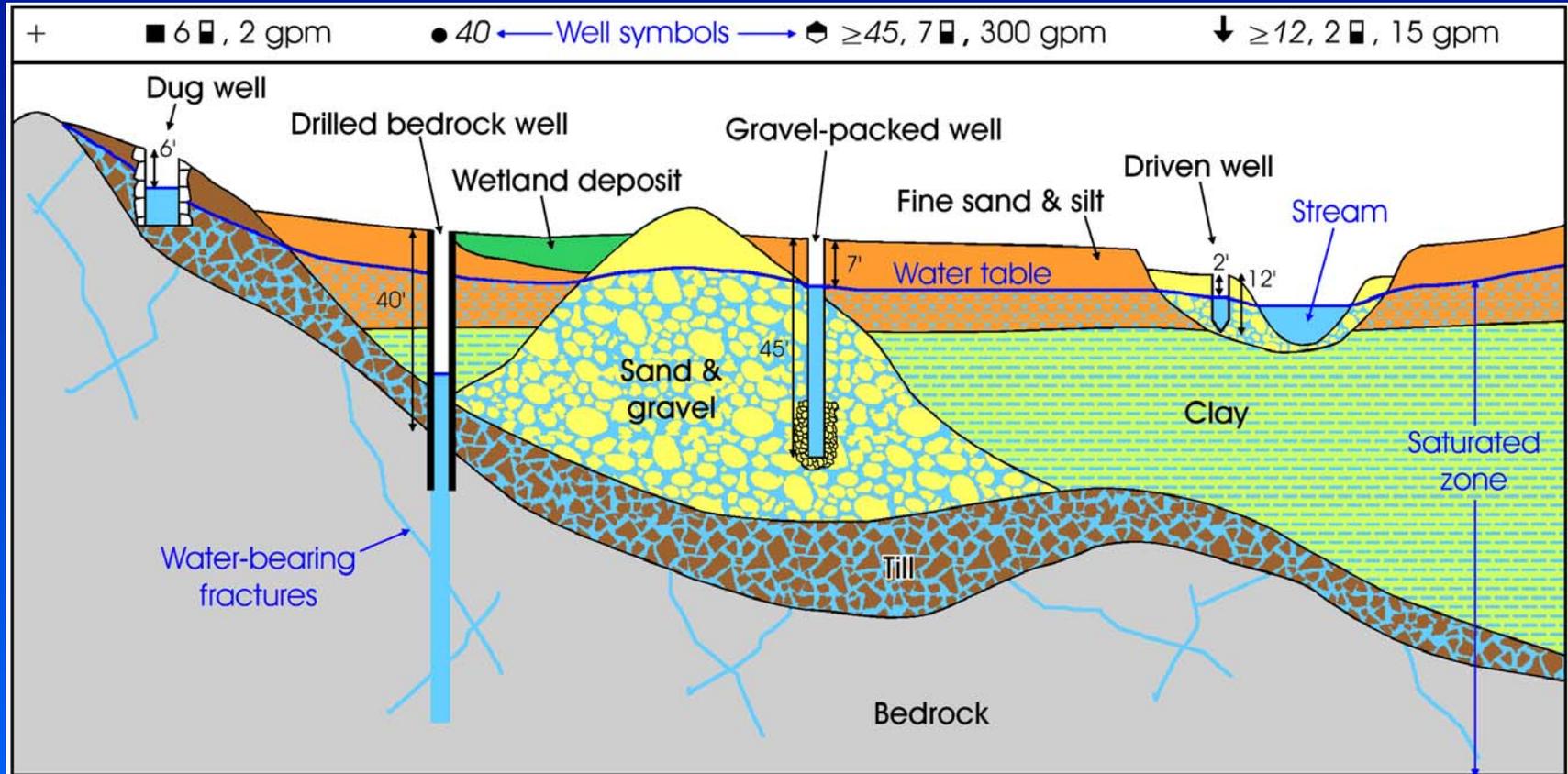
Typically lower yields 1-10 gpm

Individual private wells

More likely to have naturally-occurring water quality issues



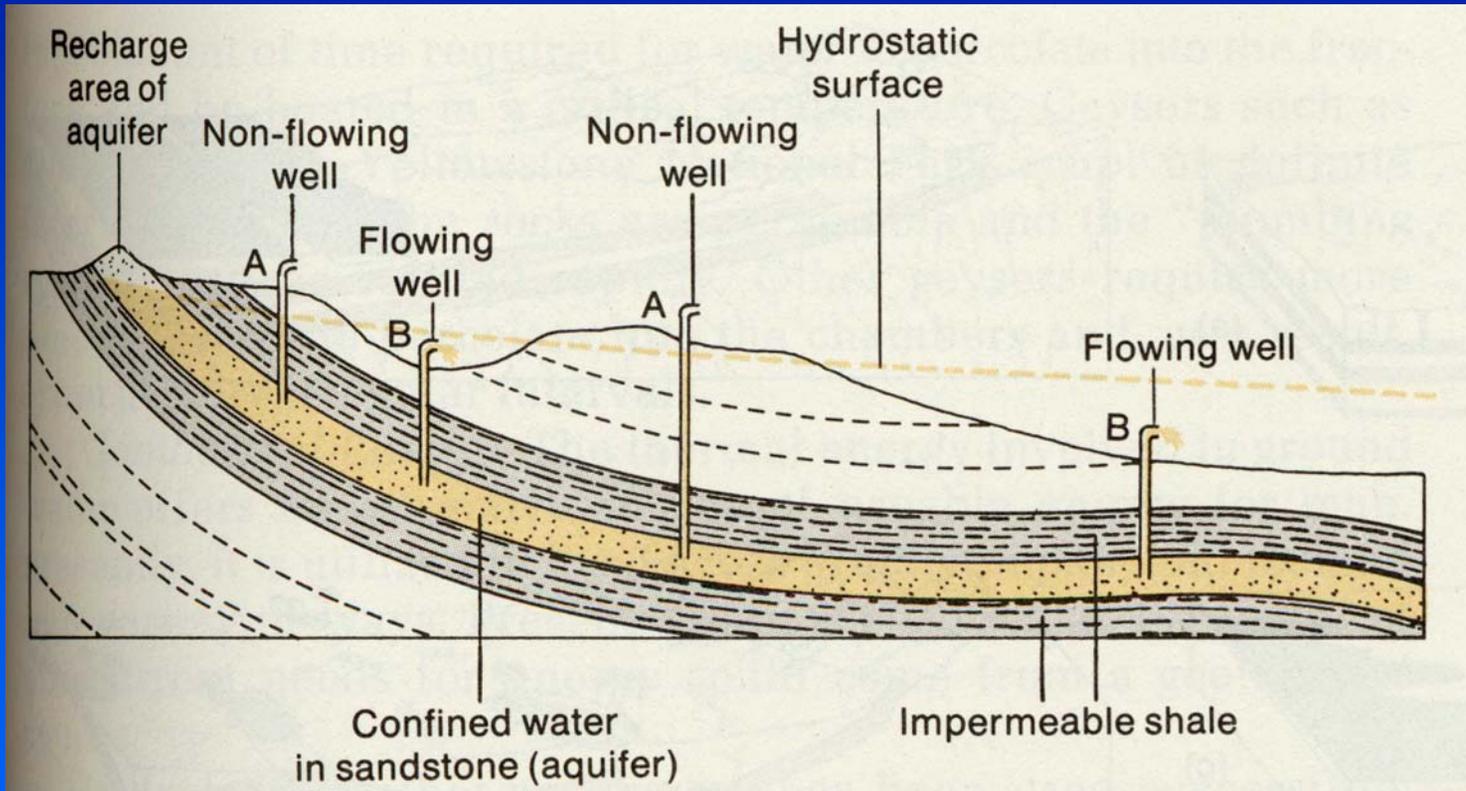
# Maine Aquifers



1 - 5 miles

Maine Geological Survey graphic

# Typical Western United States aquifer

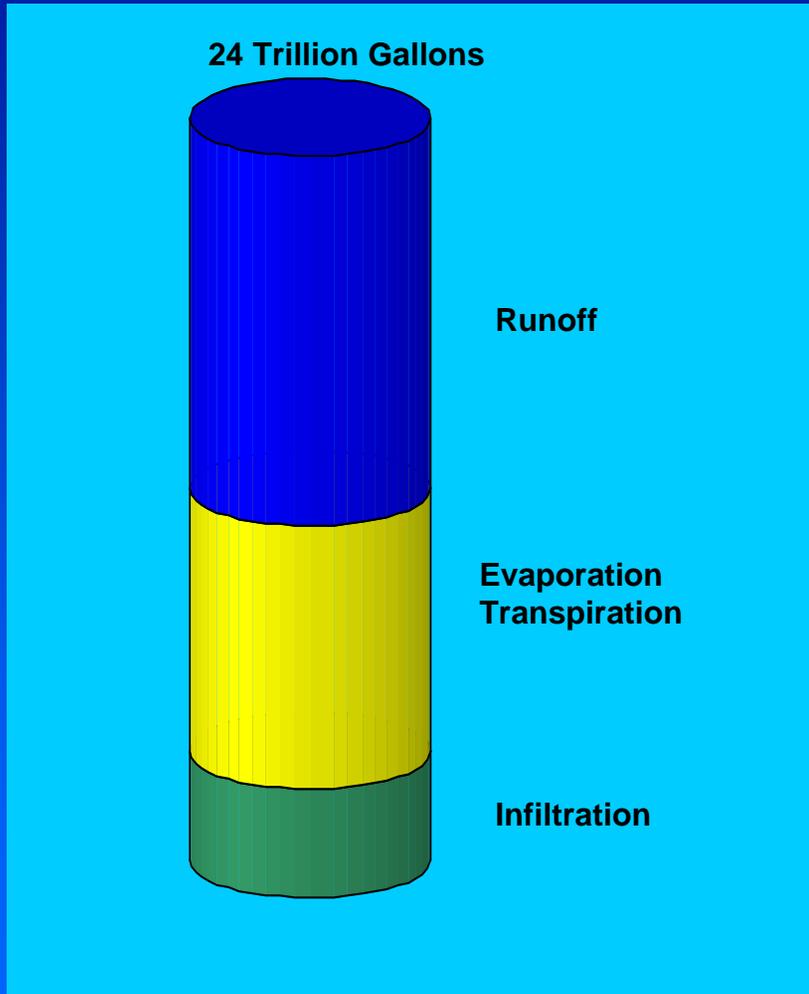


Graphic: Hamblin, 1975,  
Burgess Press

500 – 1,000 miles

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# How much groundwater do we have in Maine ?



42 Inches of precipitation annually equals **24 Trillion gallons per year**

50 %    **Runoff**  
**12 trillion gallons**

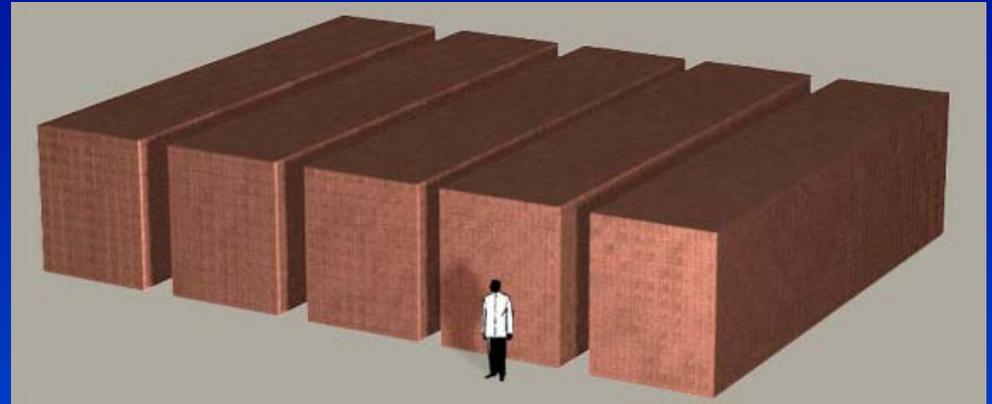
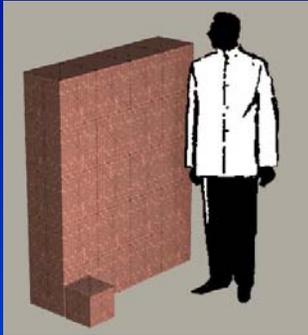
30-40% **Evaporation / Transpiration**  
**7 - 10 trillion gallons**

10-20% **Infiltration**  
**2-5 trillion gallons**

And in **storage** in Maine's aquifers .....

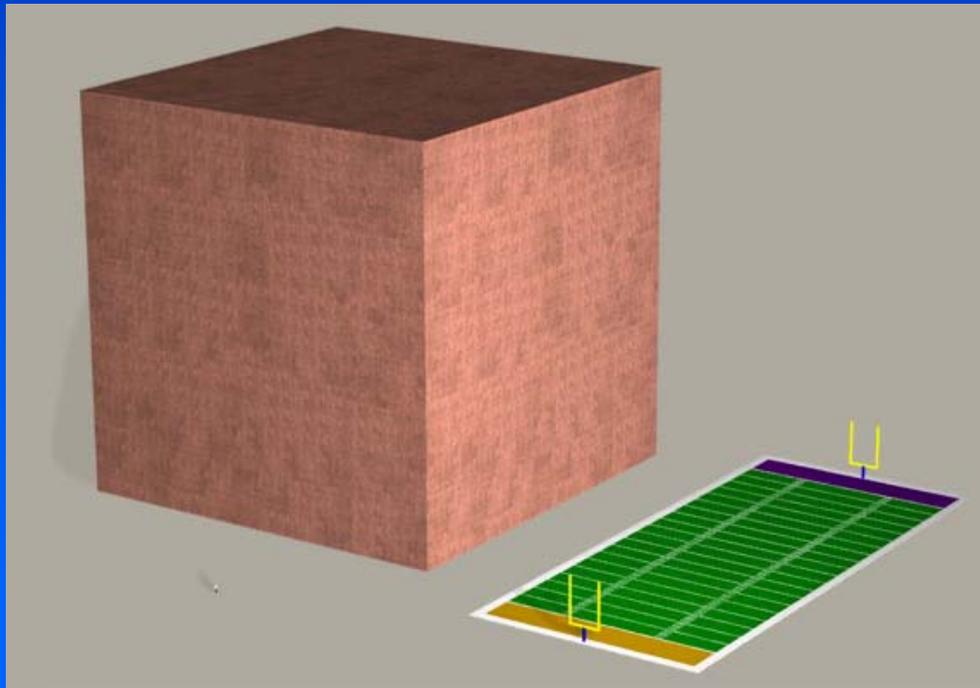
# So how much is a trillion anyway ?

One Million



One Billion

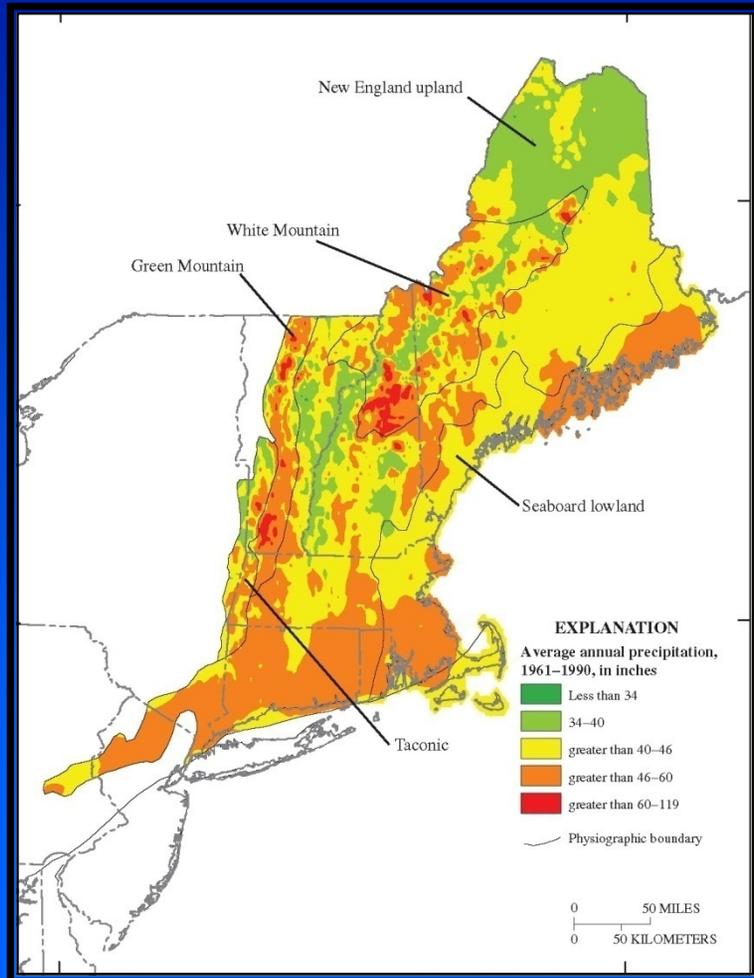
One Trillion



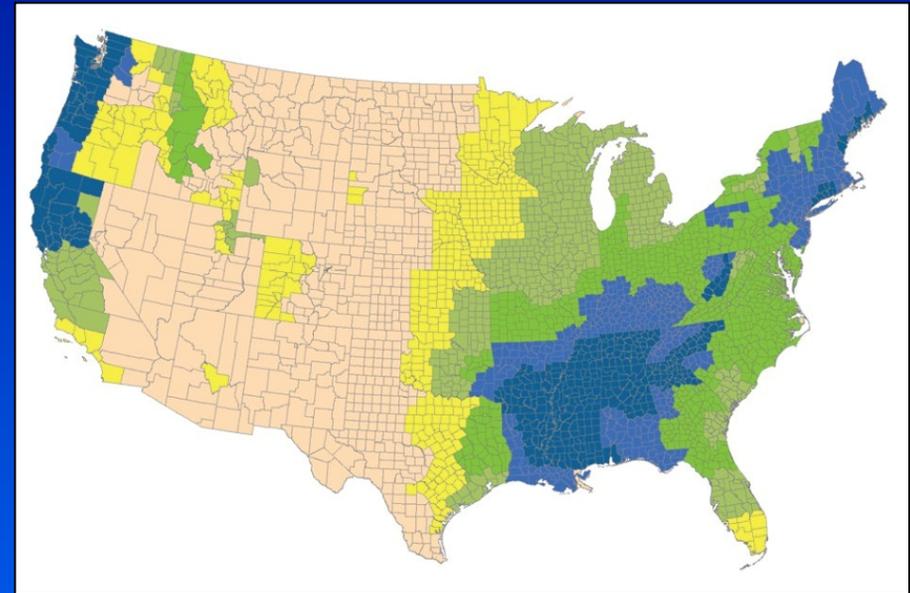
# more on the numbers

- The US receives about **1 trillion** gallons of recharge per day
- An estimated **200 - 400 billion** stars in the Milky Way
- U.S. population is about **303 million**
- Maine's population is about **1.3 million**
- *What could you do with a trillion gallons of water ?*
  - shower non-stop for **300,000 years**
  - supply **3,000,000 people** with a lifetime of drinking water
  - produce **20,000,000,000** -- that's billions - bottles of beer

# Groundwater availability



Average Annual Precipitation



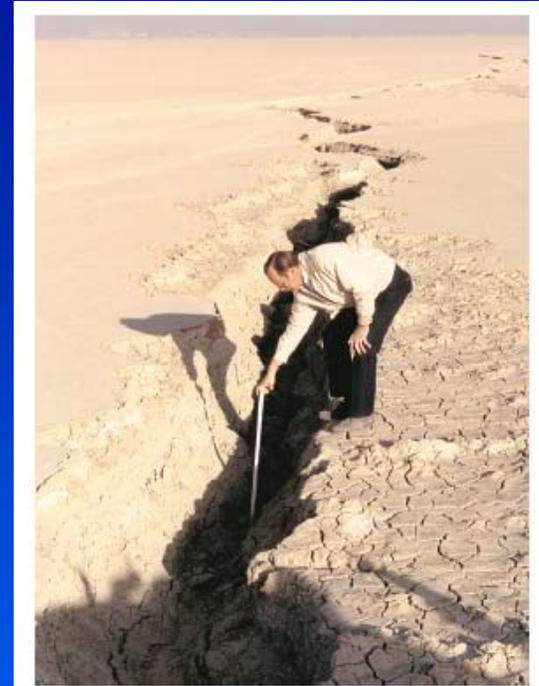
Available Precipitation

Source: USGS Circular 1186

# Groundwater Depletion



Areas of the US where the water table has dropped over 40 feet

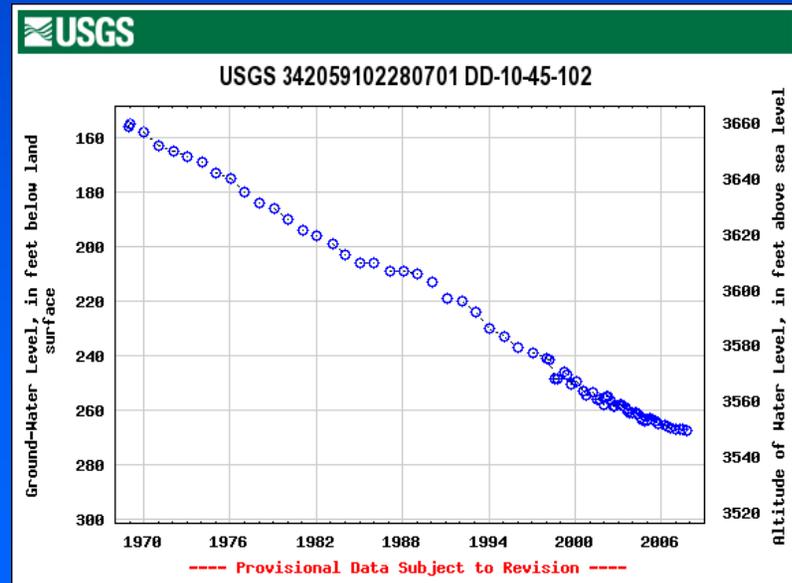
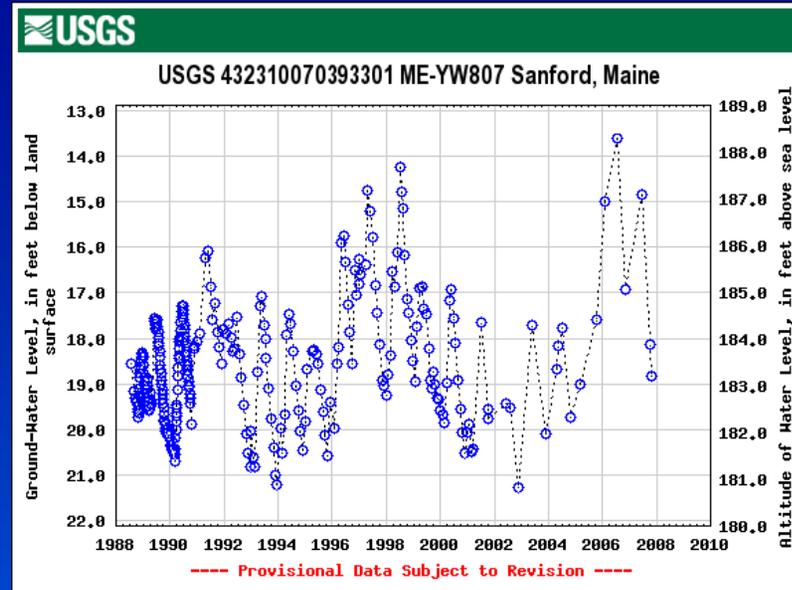


This earth fissure formed on Rogers Lake at Edwards Air Force Base, California, in January 1991, and forced the closure of one of the space shuttle's alternative runways. The fissure has been attributed to land subsidence related to ground-water pumping in the Antelope Valley area (Galloway and others, 2003).

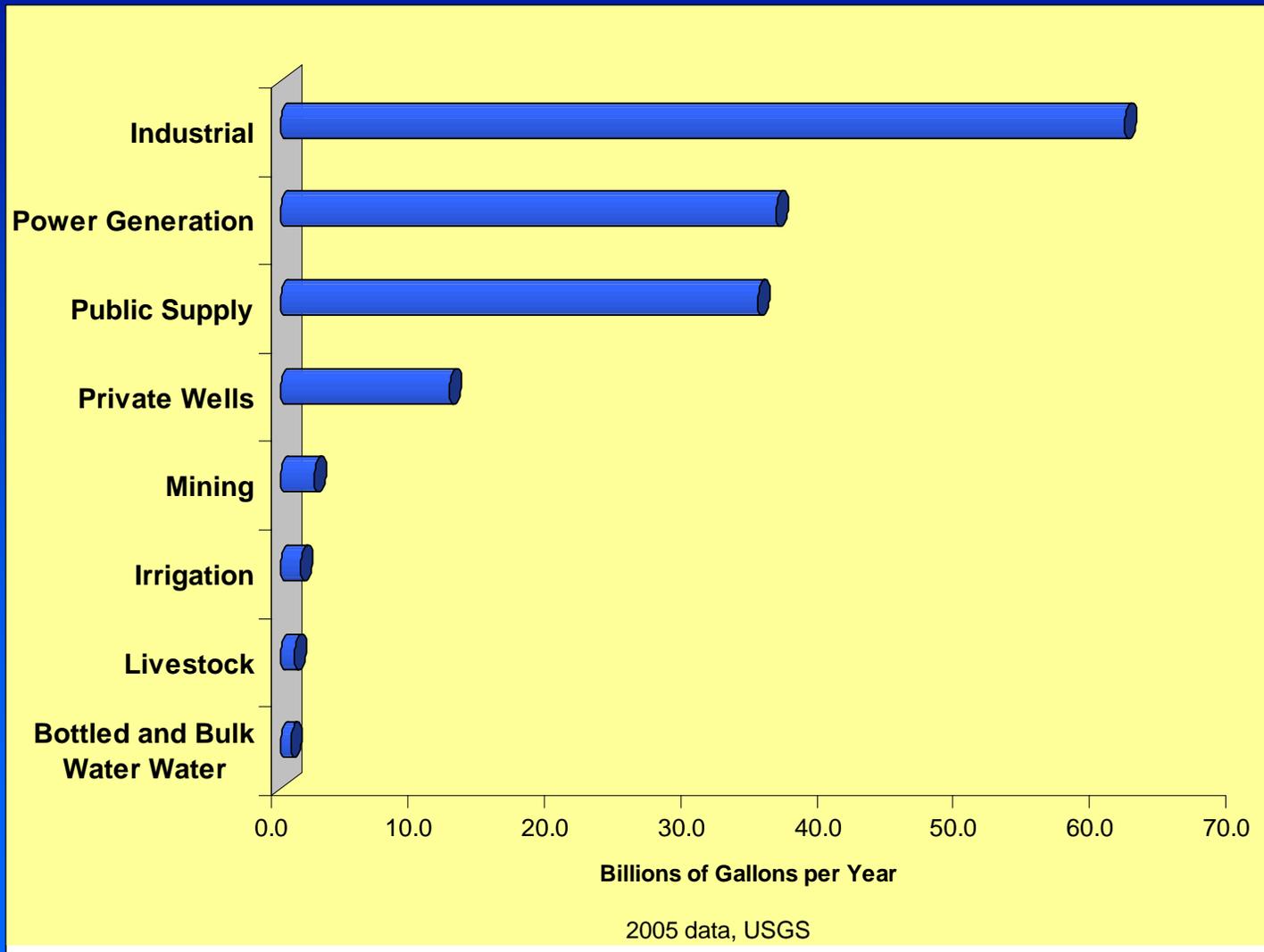
Long-term water levels for a well in southern Maine (top) and a well in west Texas (bottom).

The Maine well shows a variation in water level of ~ 8 feet and the graph is an example of sustainable groundwater use.

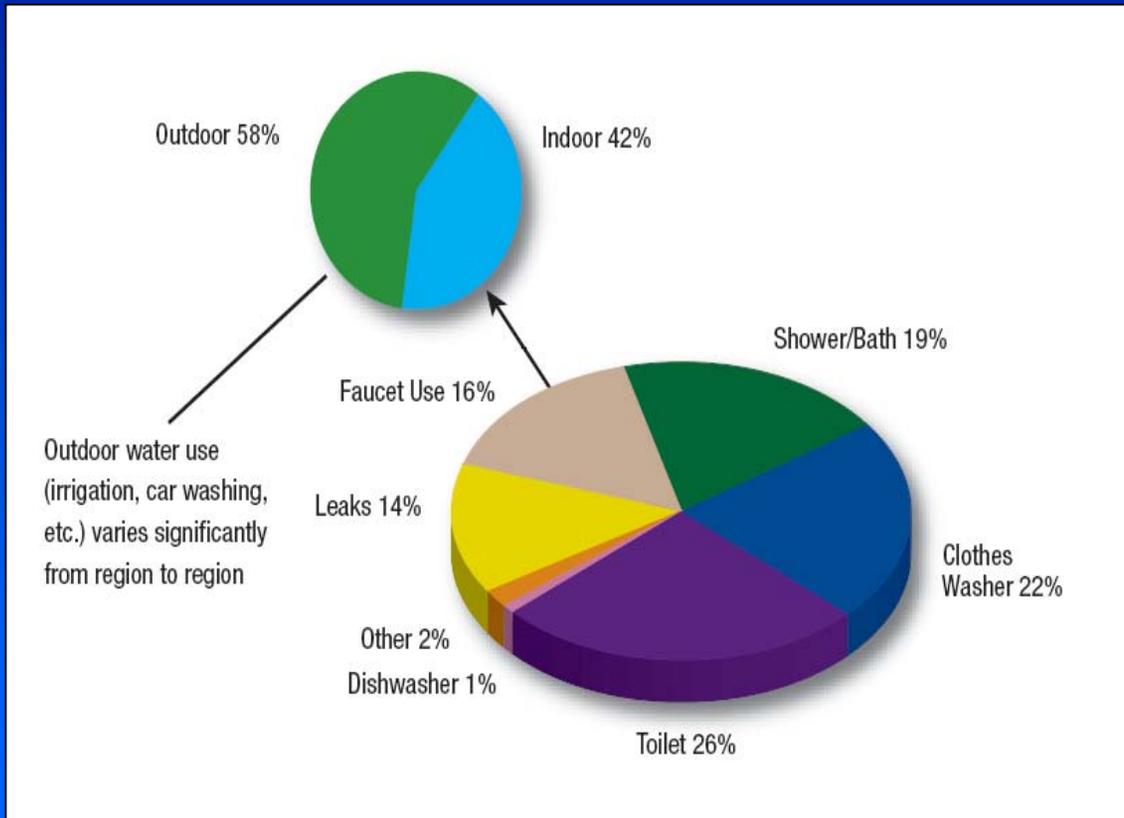
The Texas well shows a recession of more than 100 feet and is an example of unsustainable groundwater use - "groundwater mining".



# How do we use water in Maine



# Household water use



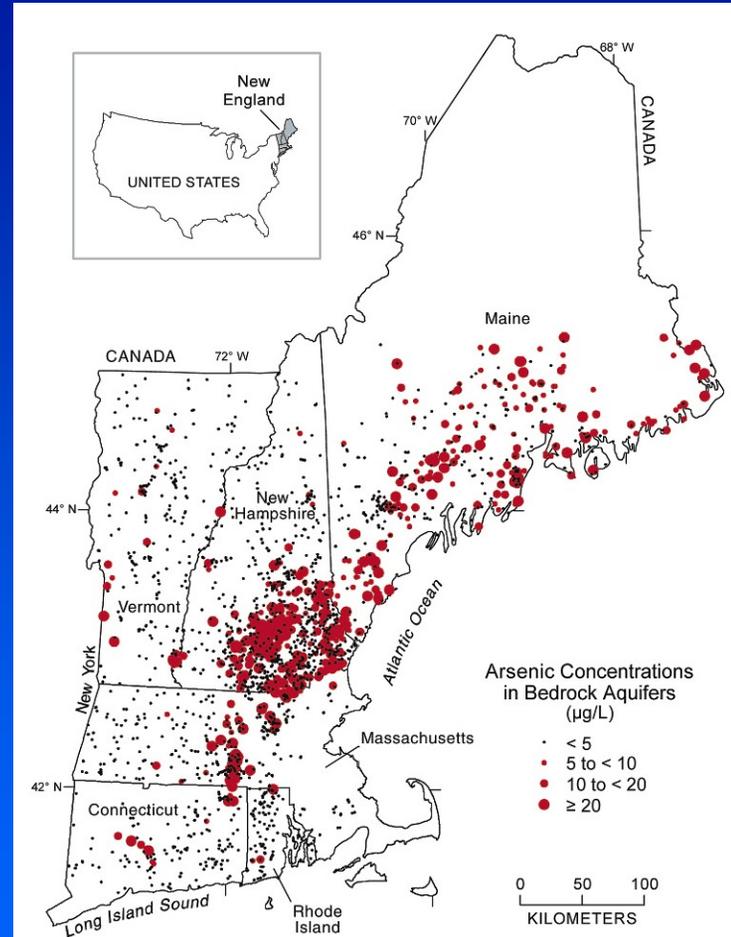
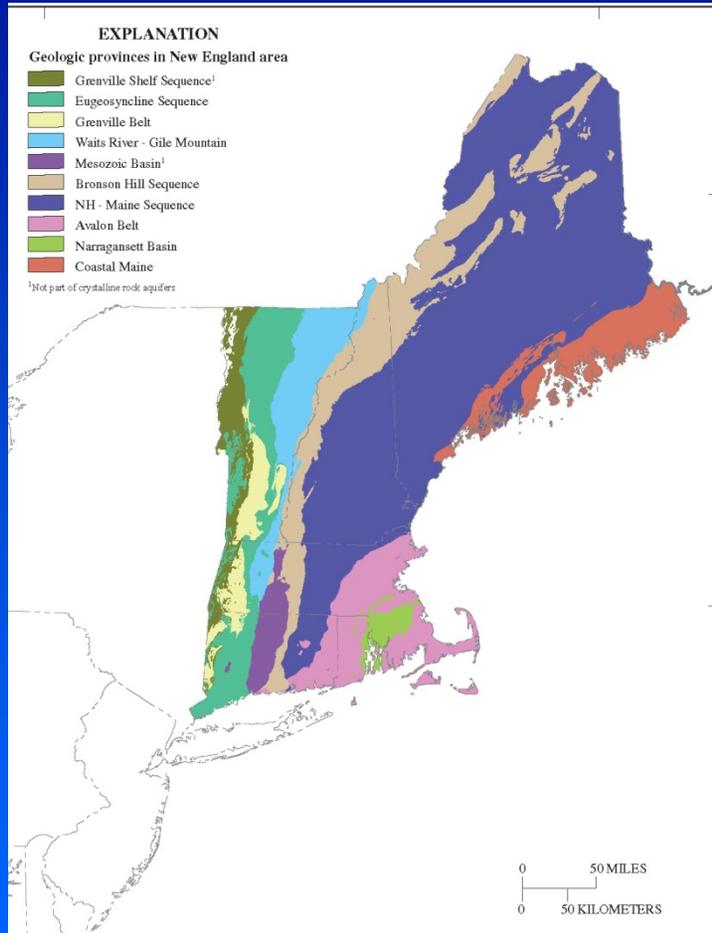
The average American uses about 100 gallons per day

# Not all groundwater is the same

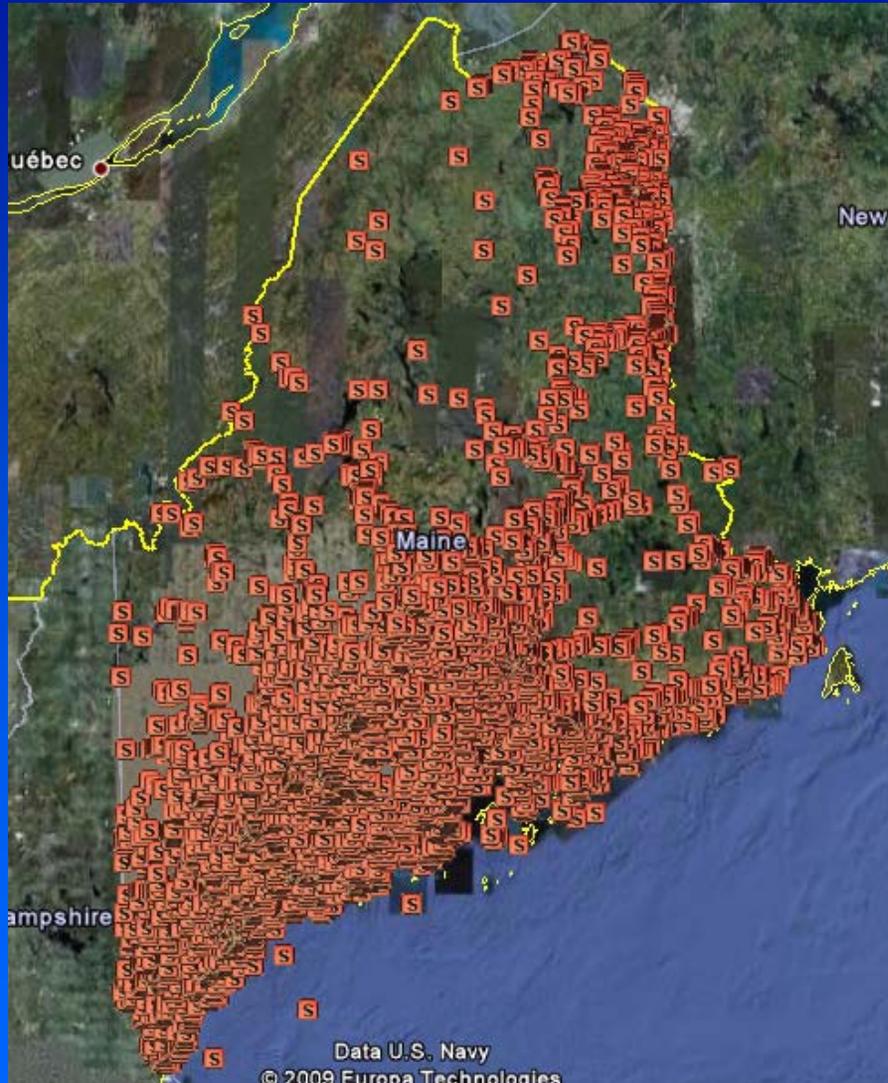
Groundwater quality affects suitability



# Naturally-occurring contaminants



....the other kind



Petroleum Spill Sites in Maine

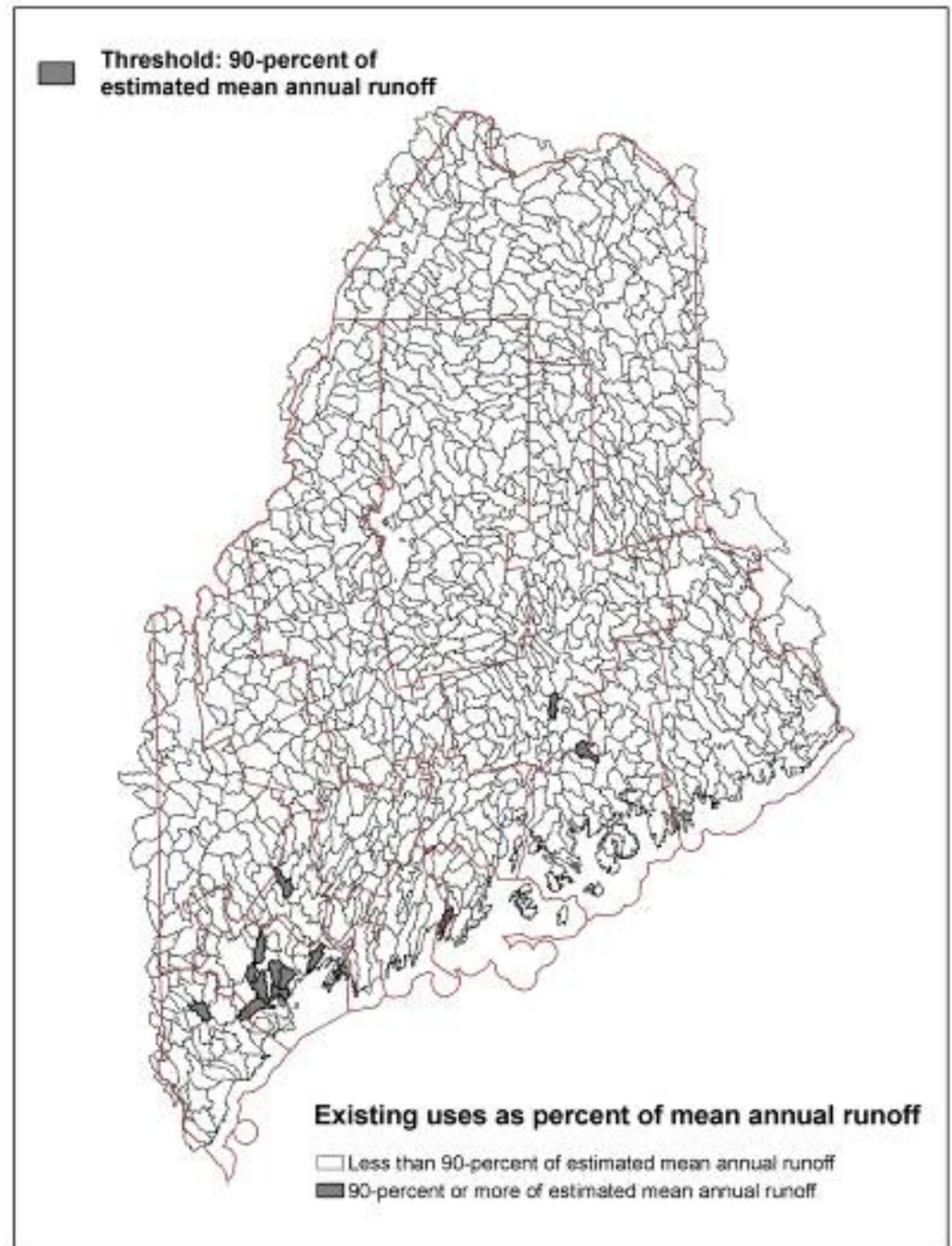
source: Maine Department of Environmental Protection  
[www.maine.gov/dep/gis/datamaps/](http://www.maine.gov/dep/gis/datamaps/)

Where are we having problems now ?

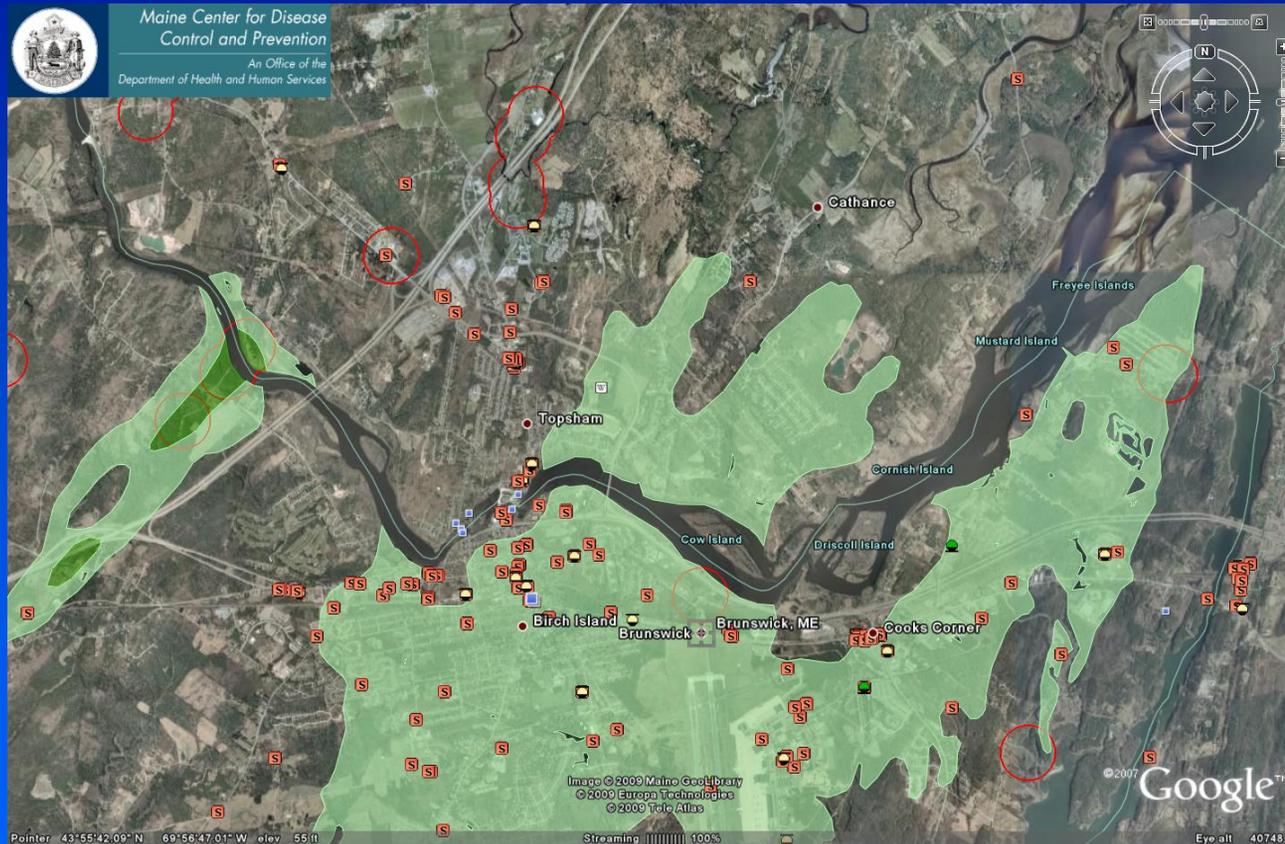
## Maine Water Resources Planning Committee

Does Maine have a statewide problem with water resources, or are there select areas where we should focus additional effort?

Areas with *potential* quantity concerns



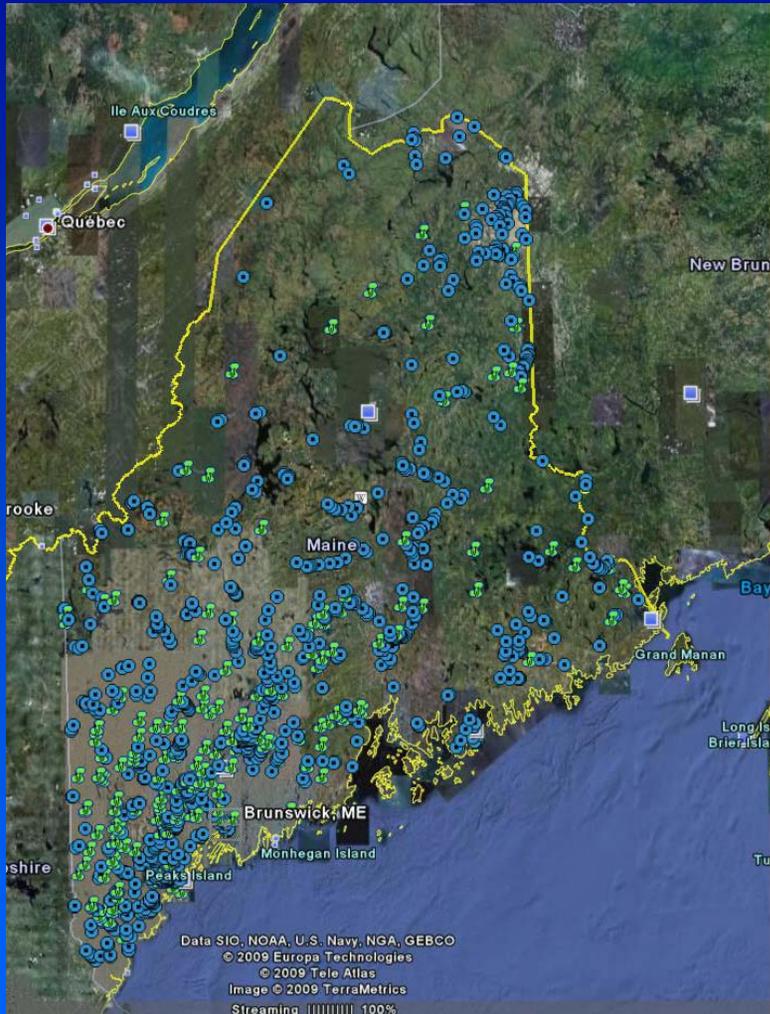
# Potential and known **quality** concerns



source: Maine Department of Environmental Protection  
[www.maine.gov/dep/gis/datamaps/](http://www.maine.gov/dep/gis/datamaps/)



Maine has  
abundant,  
good quality  
water.

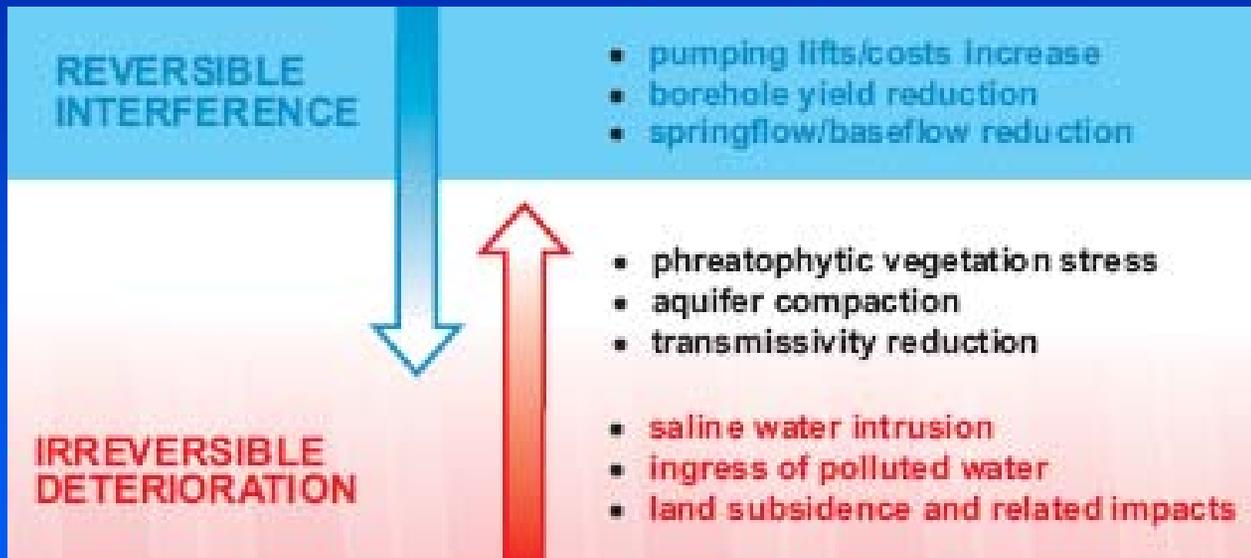


Effective groundwater management policies are based on **Science** which requires *accurate & adequate data.*

Stream biomonitors and wetlands monitoring sites in Maine

source: Maine Department of Environmental Protection  
[www.maine.gov/dep/gis/datamaps/](http://www.maine.gov/dep/gis/datamaps/)

..... and the system is dynamic



## References

Alley, Franke, Reilly, *Sustainability of Groundwater Resources*, USGS Circular 1186, 1999

Marvinney, R, 2004, *An Overview of Water Resources in Maine*, Maine Geological Survey, Department of Conservation, Augusta, Maine

## Websites

Maine Geological Survey

[www.maine.gov/doc/nrimc/mgs](http://www.maine.gov/doc/nrimc/mgs)

Maine Department of Environmental Protection

[www.maine.gov/dep/gis/datamaps](http://www.maine.gov/dep/gis/datamaps)

USGS Groundwater information

[www.water.usgs.gov/ogw](http://www.water.usgs.gov/ogw)