Maine's Ground Water Monitoring Network, Recharge, and some comparisons with other regions

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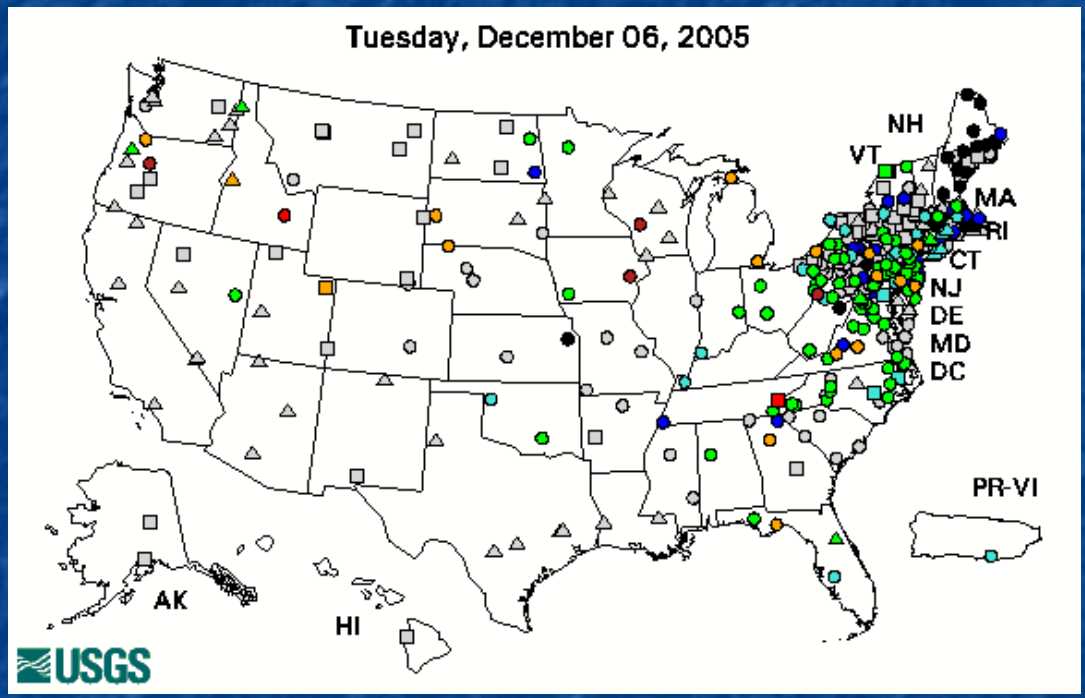
What does a ground-water monitoring network need to have in order to be useful and credible?

- Careful selection of observation wells
- Specified frequency of water level measurements
- Closely followed quality assurance plan
- Easily accessible data

Role of the U.S. Geological Survey in ground water level monitoring

- The USGS operates cooperatively funded ground water level monitoring programs in all 50 states (many thousand wells monitored overall)
- Data are collected and processed following the same QA practices everywhere, and are all accessible online.
- The USGS is working to establish a stable, base network of wells across the nation, with emphasis on local (State) needs.

Climate Response Network (long-term wells without pumping influence)



Possible purposes of a ground water monitoring network

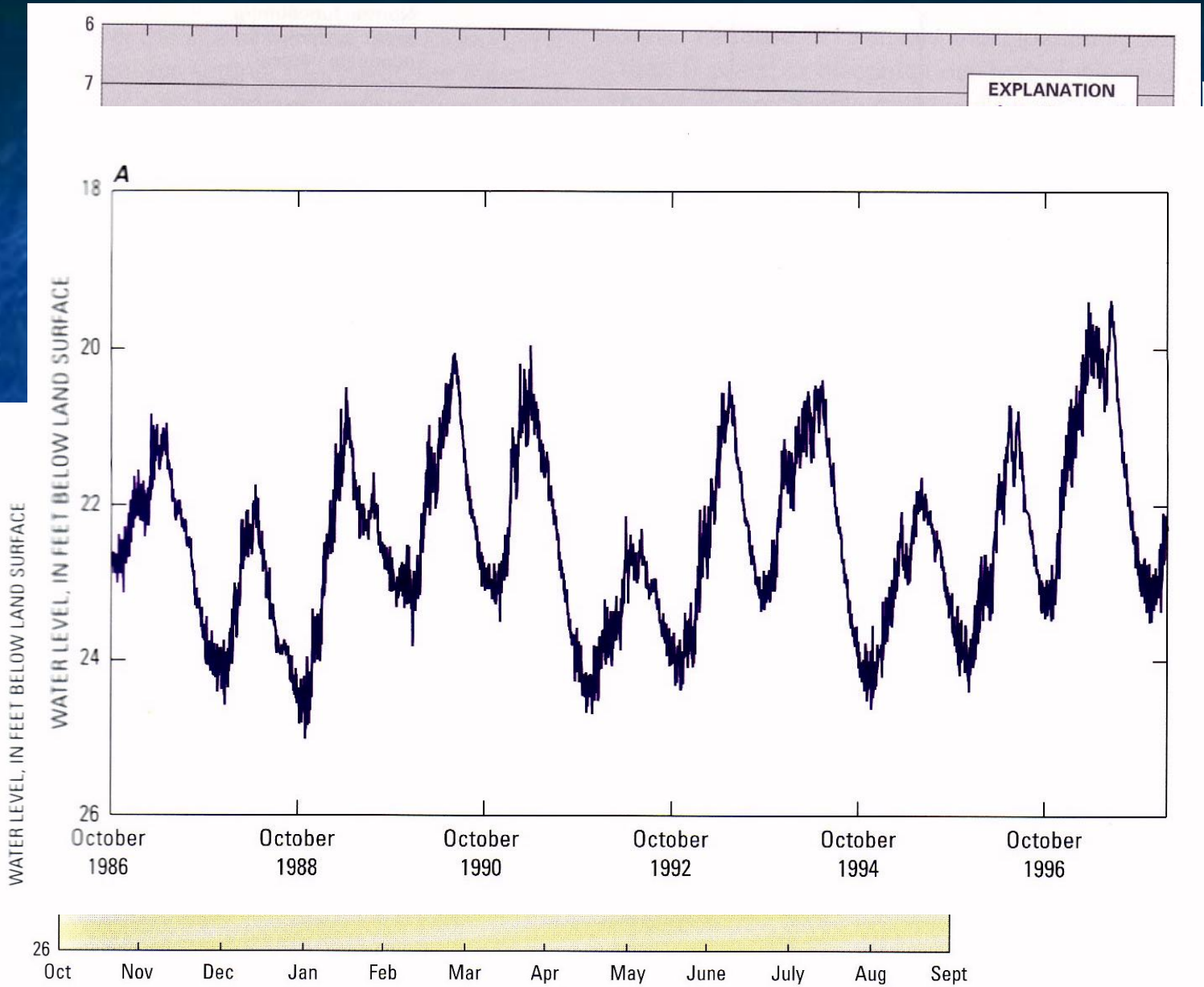
- Mapping ground-water flow paths for a specific site
- Estimating ground-water recharge at a specific site or sites
- Detection of long-term trends in many aquifer types or locations
- Estimating ground-water recharge over large areas
- Detection of drought conditions
- Detection of long-term changes due to pumping or climatic influences

round

rought
onitoring

Long-term
water level
changes

Development
of monthly
statistics



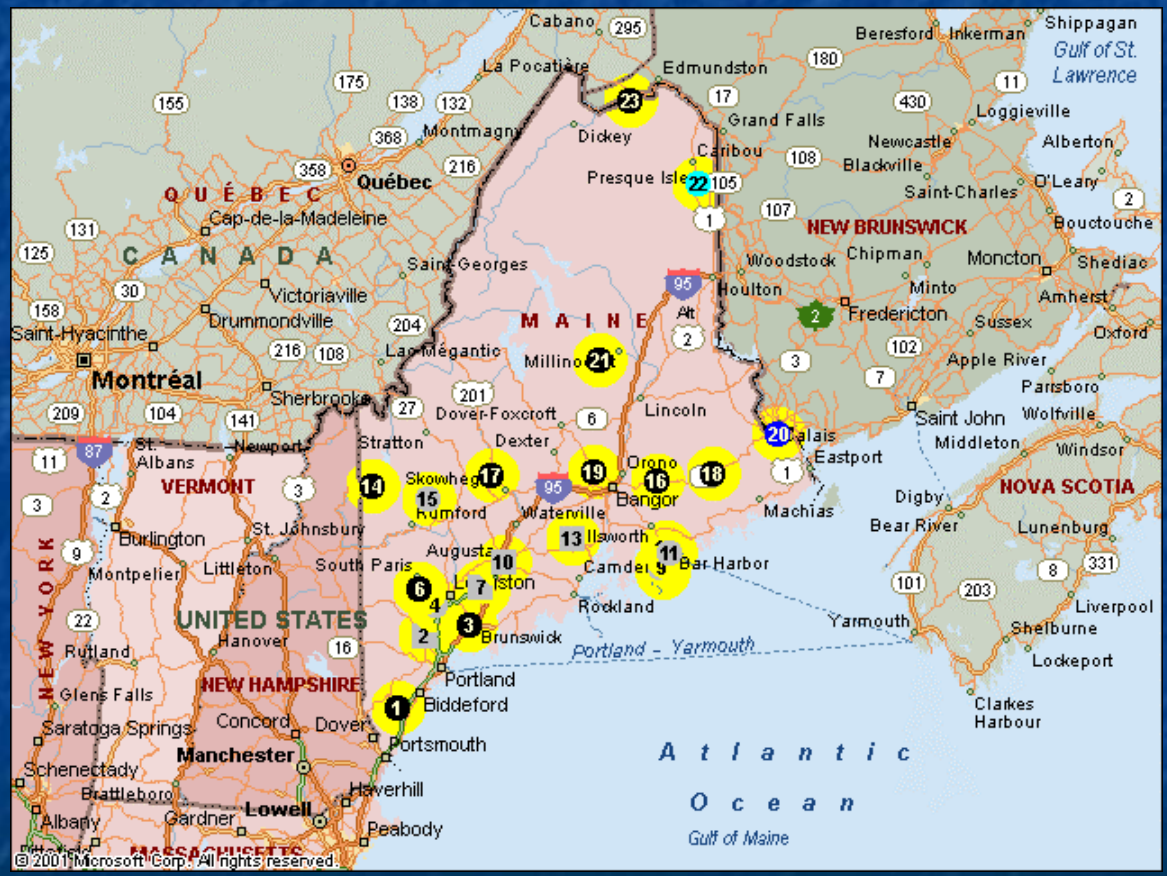
Data need to be publicly available so all can benefit

- How often should new data be made available?
  - Once a year?
  - Quarterly?
  - Daily?

  Depends on purpose, frequency of data collection, and resources

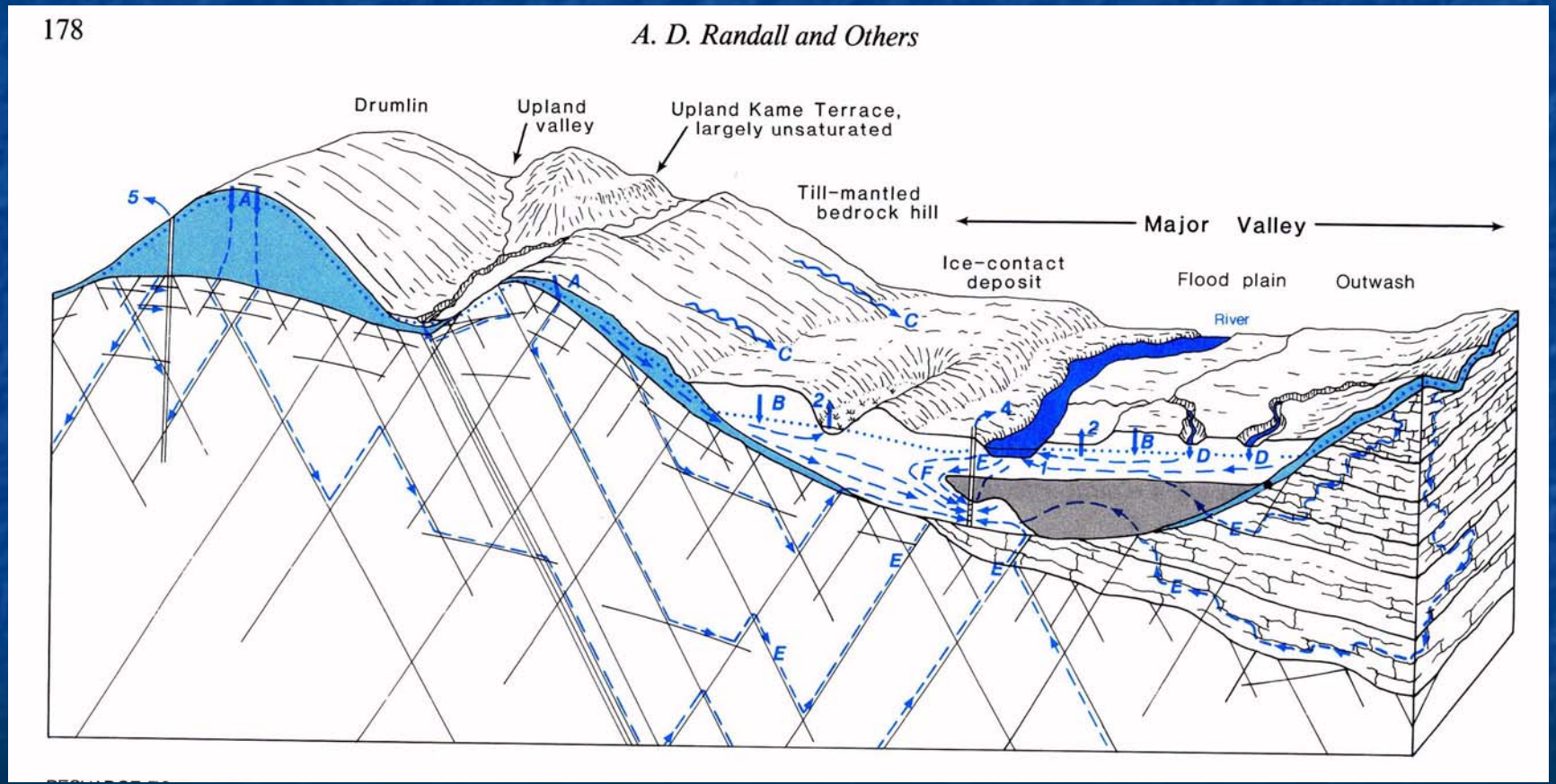
Maine's Ground Water monitoring Network

Purpose: To provide near-real time data on ground water levels in wells representative of Maine's 3 water-bearing units (bedrock, till, and sand and gravel aquifers), over as great a spatial distribution as possible

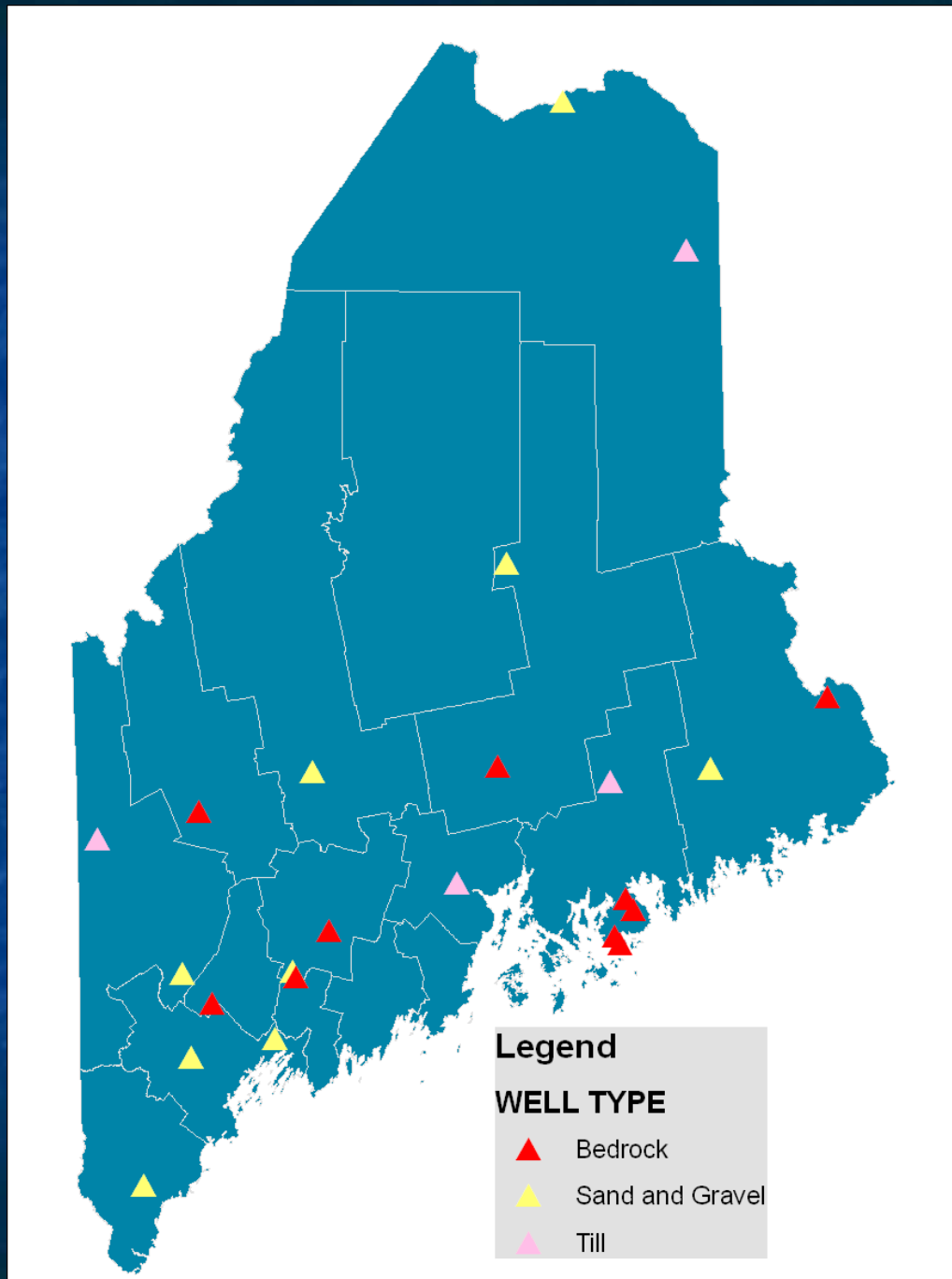


Map at:
http://groundwaterwatch.usgs.gov/StateMaps/ME.html

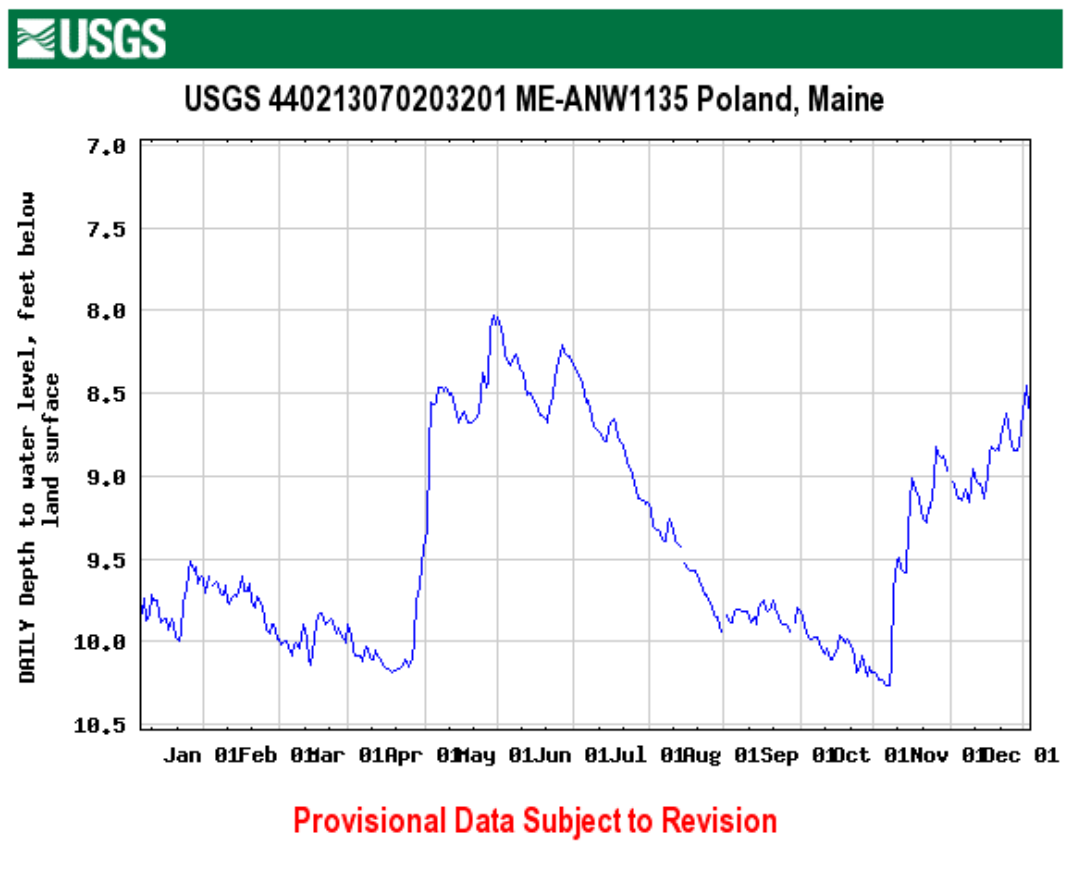
Maine has 10 bedrock wells, 4 till wells, and 9 sand and gravel monitoring wells (23 total, 22 real-time)



Maine's ground-water monitoring network, by aquifer type (2005)



Example water level data



The data are available on the Web at

http://me.water.usgs.gov/

Real-time (hourly) data are shown for the last 31 days. Daily data are available for the last 2 years (730 days) as a graph.

Data available for the history of the well in tabular format.

Brunswick – sand and gravel; Poland -- bedrock at Range Pond State Park

What the network can and can't do

Our monitoring network **can**:

- Indicate long-term trends in background water levels at a few specific locations
- Be used to detect drought conditions in various regions of Maine, or historically high water levels
- Show timing of recharge at specific locations
- Give people an up-to-the-hour picture of water levels in specific areas
- Show differences in recharge responses to precipitation/snowmelt by aquifer type

What the network can and can't do

Our monitoring network **cannot**:

- Indicate recharge amounts (without a significant additional investment) many wells respond to more than just recharge
- Indicate water level conditions in all areas of the state water levels can only be extrapolated a short distance
- Indicate water levels where water withdrawls are high we locate wells where we don't expect pumping effects
- Evaluate pumping effects on ground water
- Evaluate ground-water availability it may be used as one of many tools

More on what the network can't do.....

Our monitoring network **cannot**:

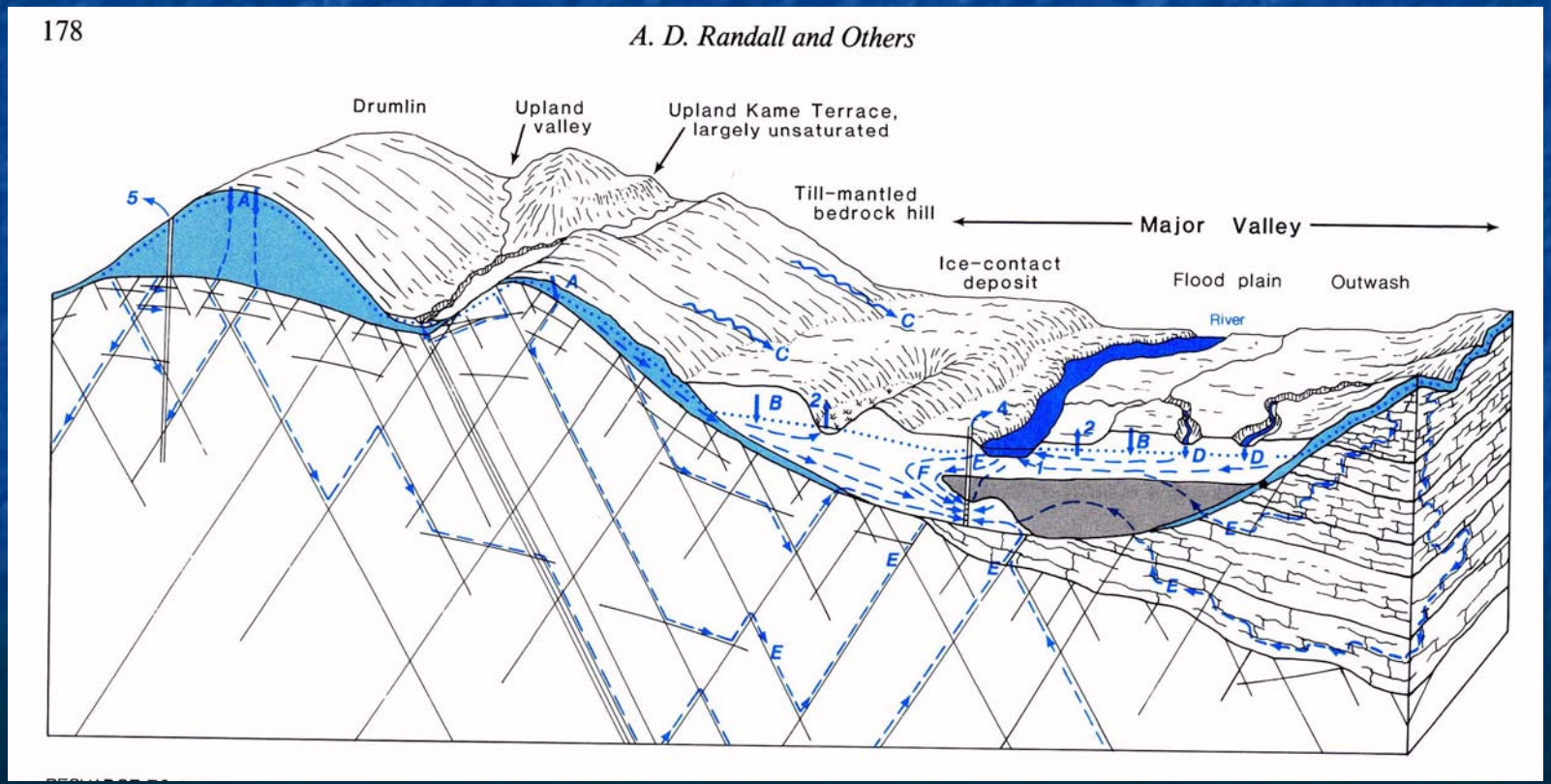
- Indicate ground-water flow directions
- Indicate ground-water hydraulic gradients within aquifers or between aquifers

Funding for the network

- The network is half funded by the USGS (federal money) and half funded by local (primarily state) funding.
- Funding from agencies is channeled through the Maine Emergency Management Agency.
- There is probably little opportunity to increase federal funding for the network.

Recharge – watershed scale

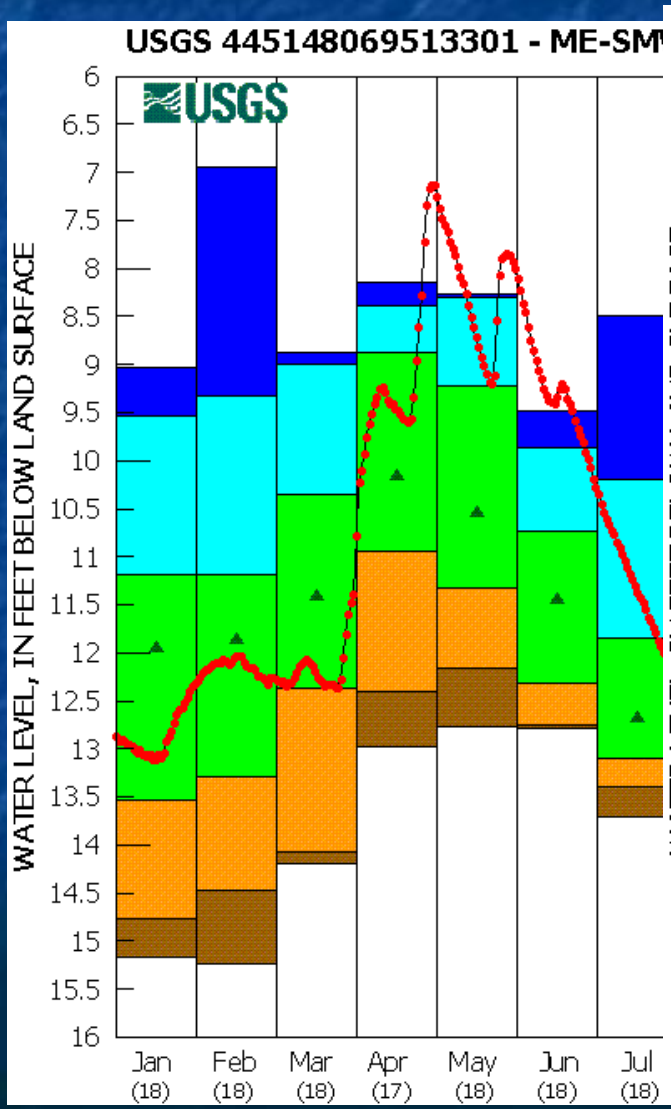
- Ground-water flow paths are generally short; recharge generally occurs locally.
- Ages of ground water:
  - Bedrock aquifer: 25 yrs old, on average (3-50 yr span) 58 wells sampled by USGS
  - Surficial aquifers: 5 yrs old, on average (0-15 yr span) 30 wells sampled by USGS

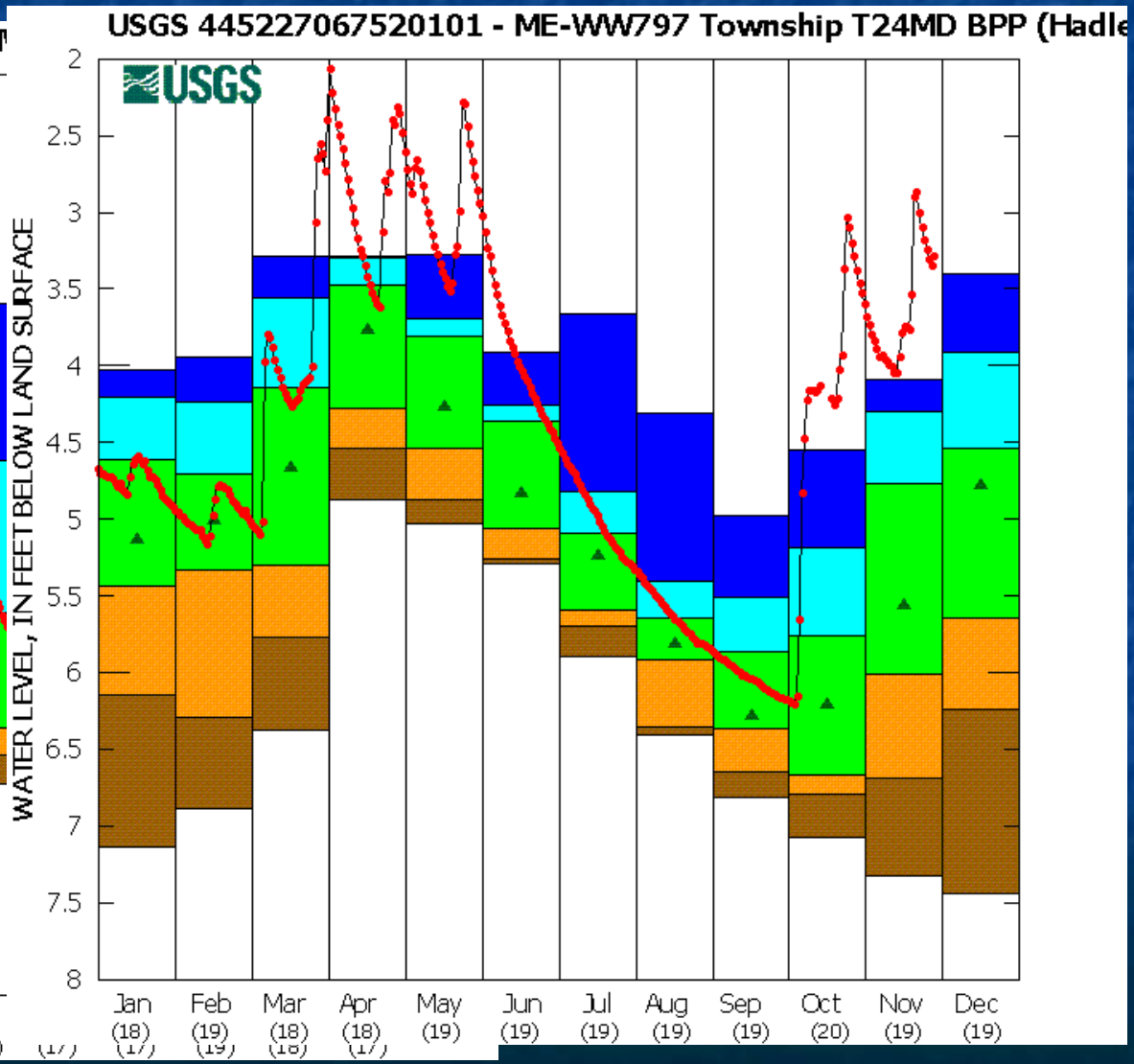


Recharge to ground water - timing

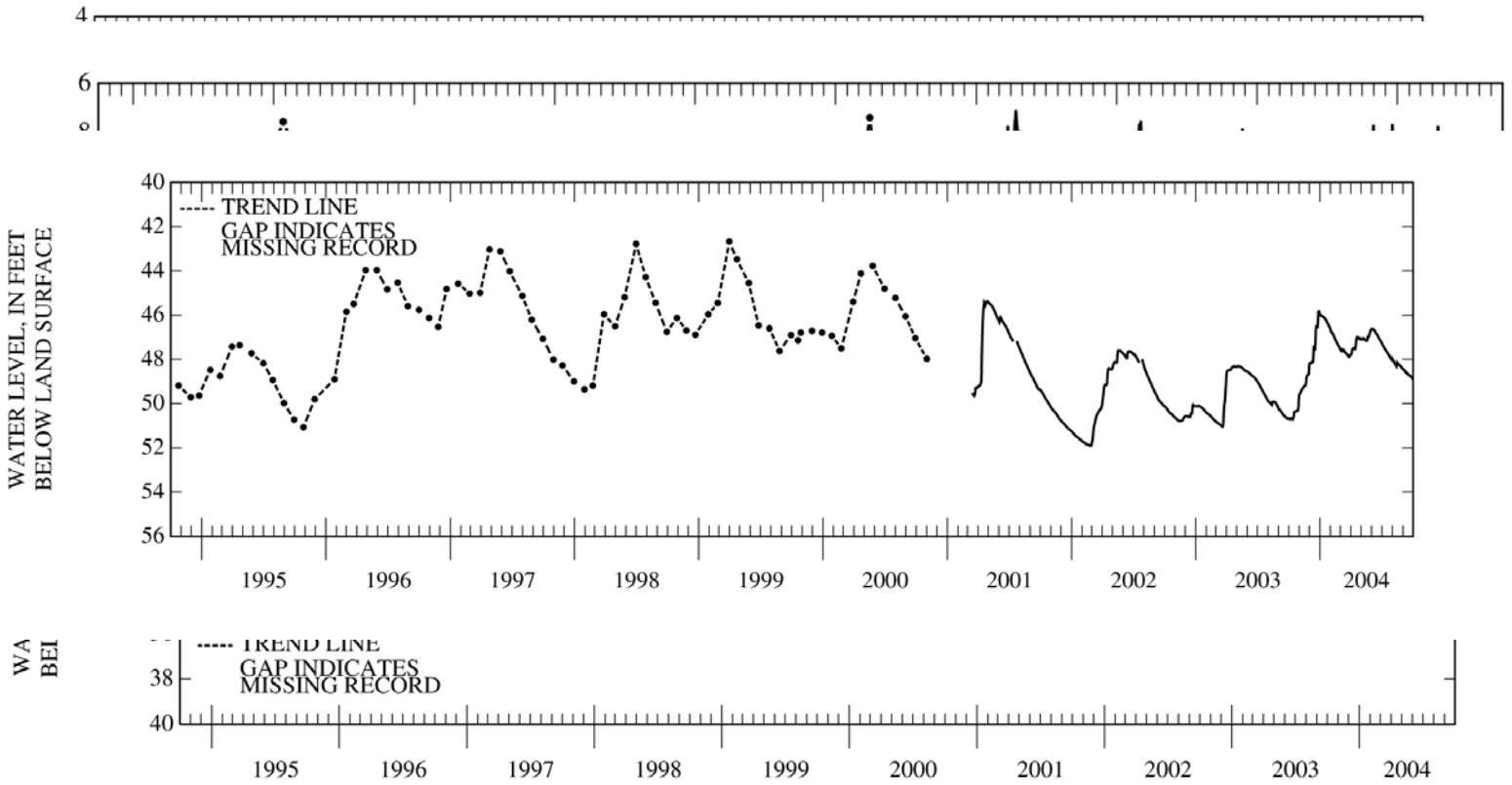
- Maine has 2 periods of concentrated recharge: spring and fall
- Recharge can (and does) occur thoroughout the year, though recharge is minor in winter and summer.
- Recharge varies according to depth to water table, soil type, and slope of land surface

Recharge cycle examples





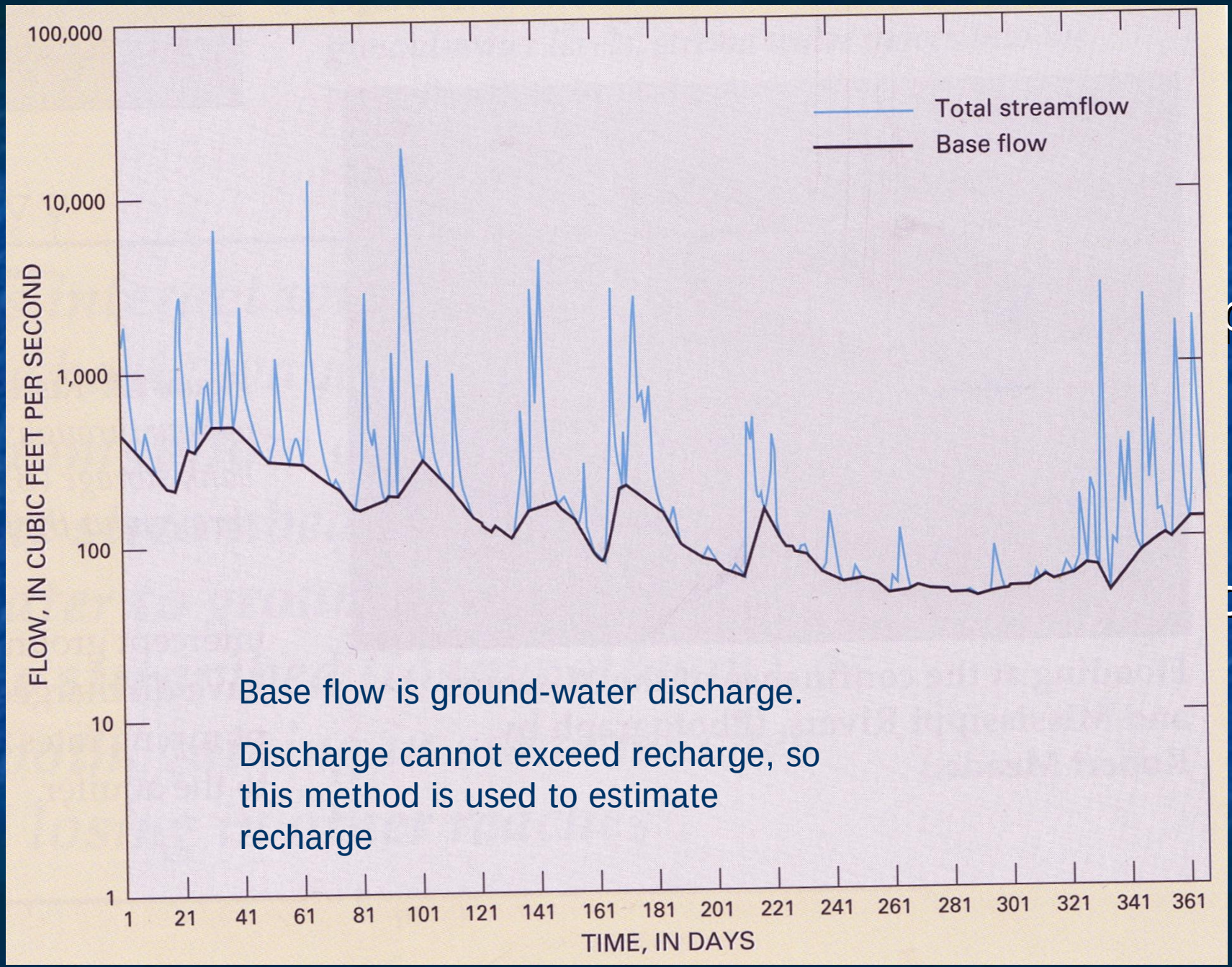
(Long-term) records



Fort Kent (S&G); Litchfield (bedrock); Litchfield (S&G); Brunswick (S&G)

More recharge variables

- Soil type:
  - Permeable soils allow the most recharge
  - Thick clay layers inhibit recharge
  - Recharge to bedrock aquifers and till is intermediate between these two types
  - Recharge on hilltops and at edges of sand & gravel deposits; discharge generally in low-lying areas and valleys
- Slope of land surface:
  - Recharge occurs best where slopes are low. Steep slopes inhibit recharge
- Depth to water table:
  - Very deep water tables receive recharge more slowly, and usually not in summer
  - When the soil is saturated, recharge generally does not occur


100,000
10,000
1,000
100
10
1
FLOW, IN CUBIC FEET PER SECOND
Total streamflow
Base flow
1
21
41
61
81
101
121
141
161
181
201
221
241
261
281
301
321
341
361
TIME, IN DAYS
Base flow is ground-water discharge.
Discharge cannot exceed recharge, so this method is used to estimate recharge

Some comparisons to other regions

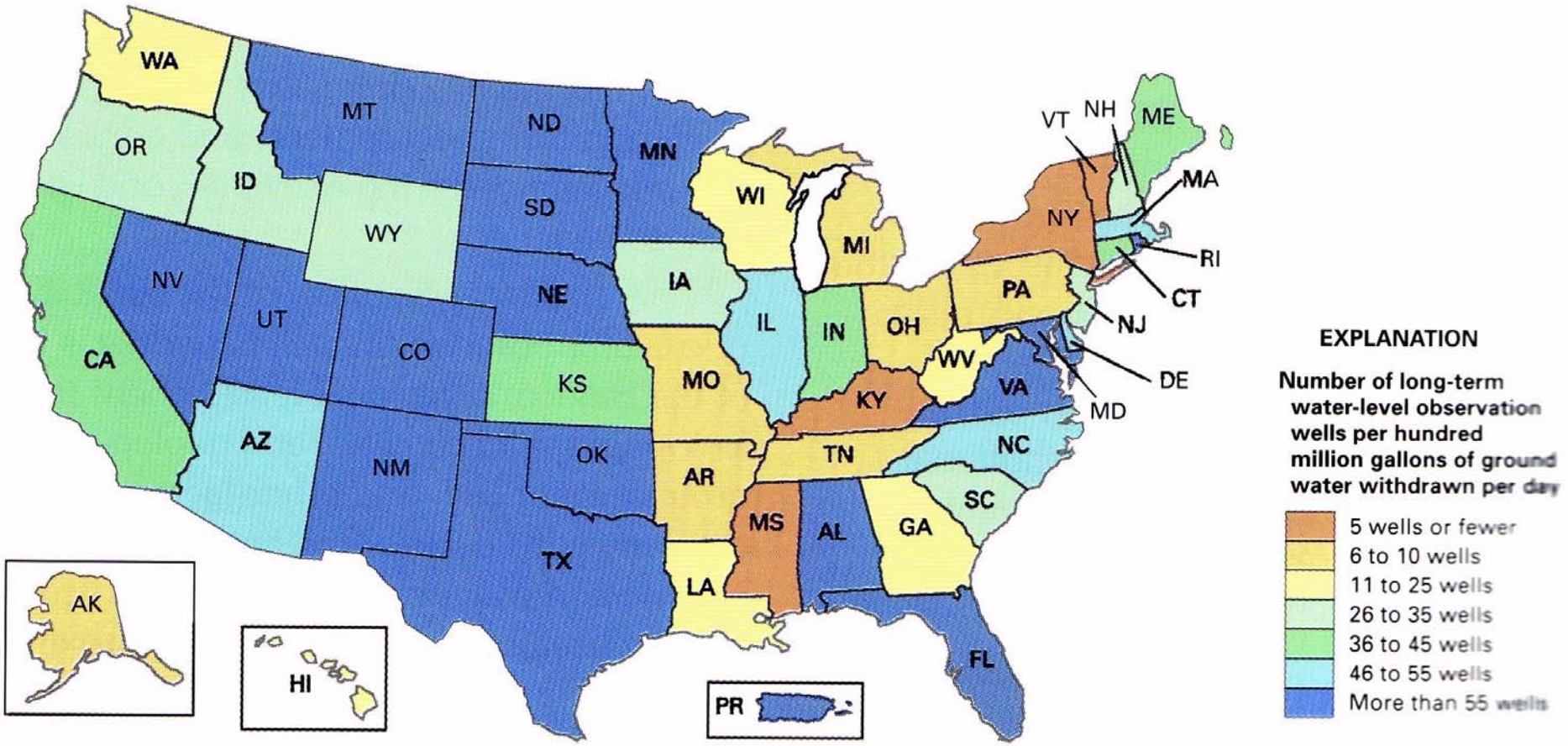
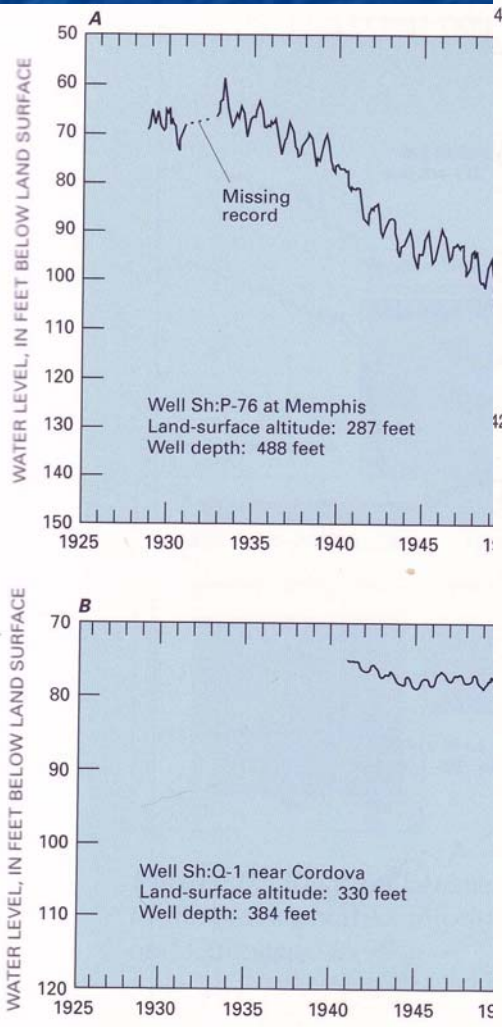
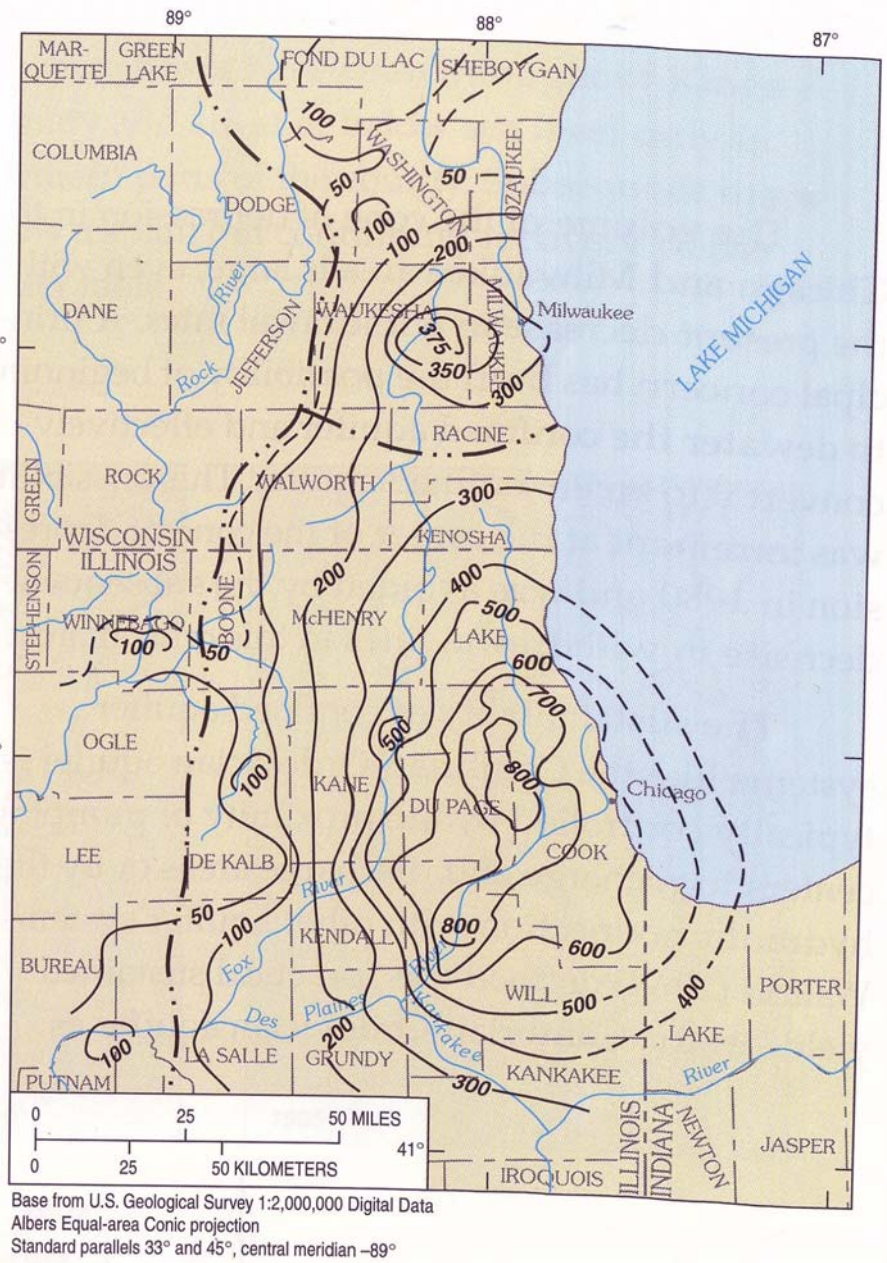


Figure 28. *Number of long-term water-level observation wells per hundred million gallons of ground water withdrawn per day in each State and in Puerto Rico.*

Large-s d water supplies sn't have





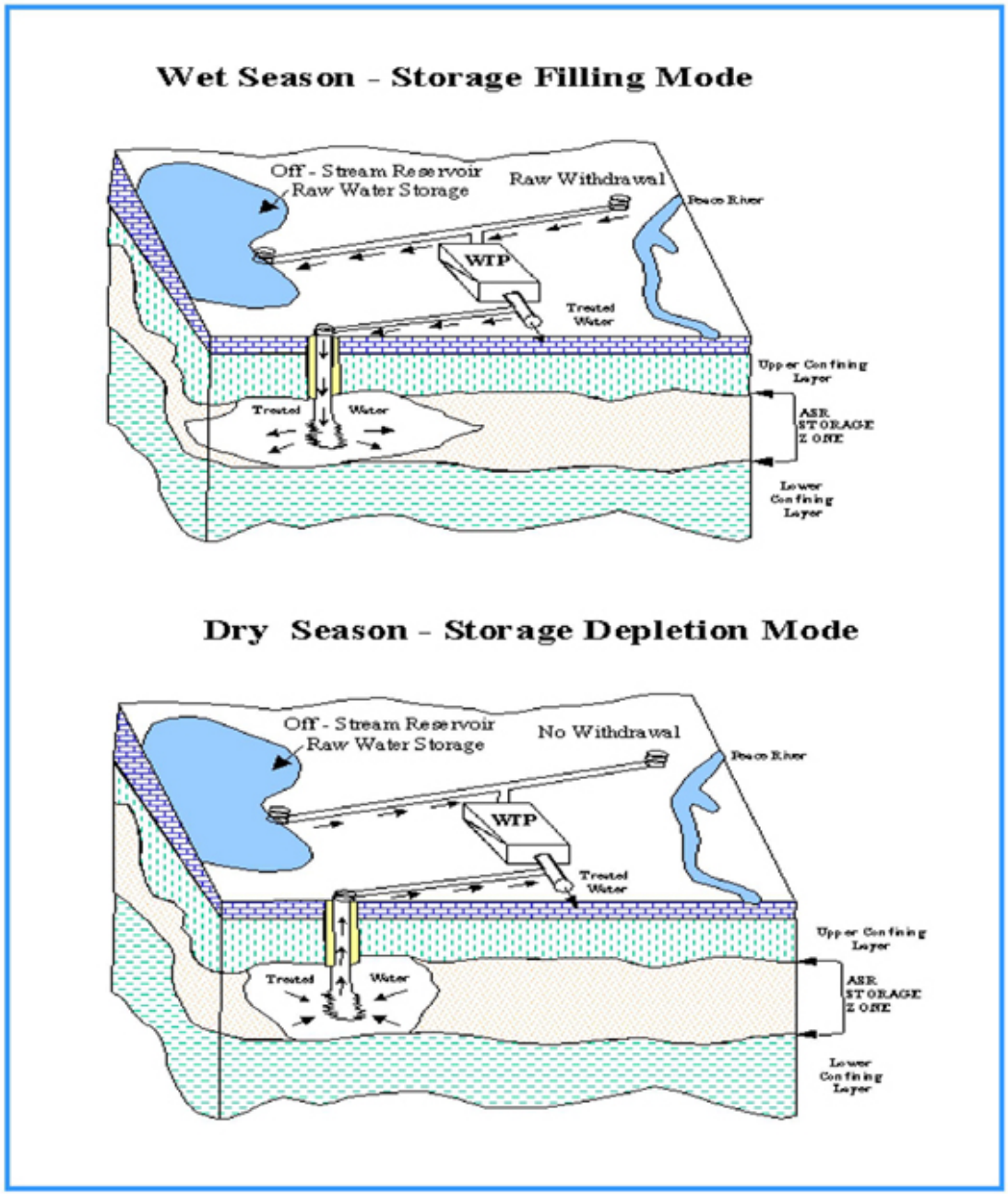
Base from U.S. Geological Survey 1:2,000,000 Digital Data
Albers Equal-area Conic projection
Standard parallels 33° and 45°, central meridian –89°

EXPLANATION

—— 700 —— **Line of equal water-level decline, 1864–1980**—Dashed where approximate. Interval, in feet, is variable

—— · · —— **Major ground-water divide**

Figure 7. *Declining water-level trend*



Another issue Maine doesn't have

Could Maine ever have this problem? Ipswich River, Mass.

New Hampshire is addressing this issue by requiring that ground water withdrawls be permitted after consideration of all other pumping in the watershed.

Resources

- Handout of USGS web sites
- Map of USGS monitoring wells
- USGS Circulars
- Index of Ground-water level data by state