An Overview of Maine's Ground Water Resources

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Maine Geological Survey

Hancock County Planning Commission

Workshop

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Presentation outline

- Maine water resource statistics, hydrologic cycle
- Maine water use statistics
- Maine aquifer types, distribution
- Annual ground water cycle, long-term statistics
- Ground water / surface water interaction basics
- Some ground water quality issues
- Water Resources Planning Committee
- An outline of ground water withdrawal regulations

How Much Water Is There?

Moosehead is Maine's largest lake.

How much water is in the top inch of this lake?

Answer: 2 Billion Gallons!

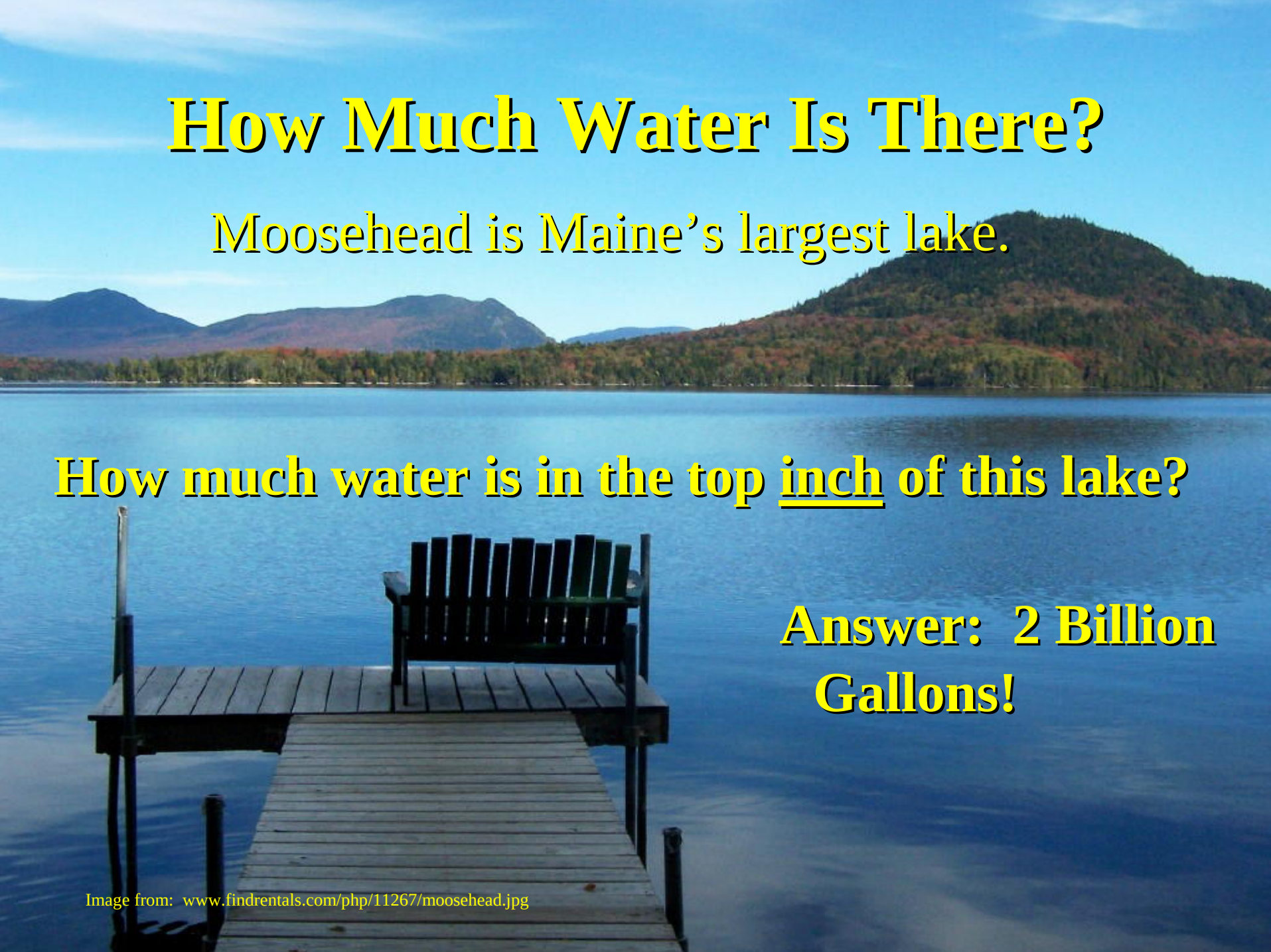
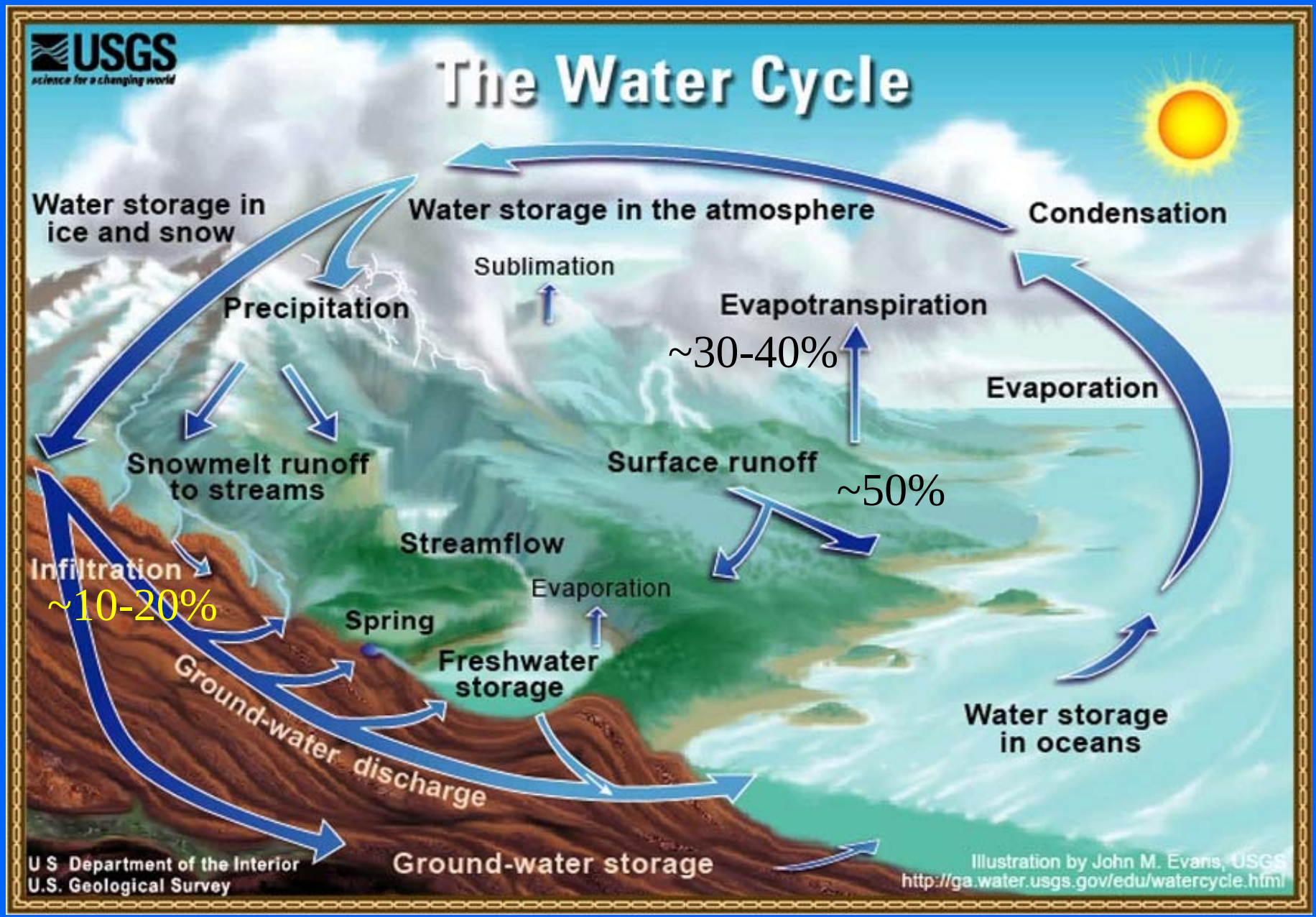


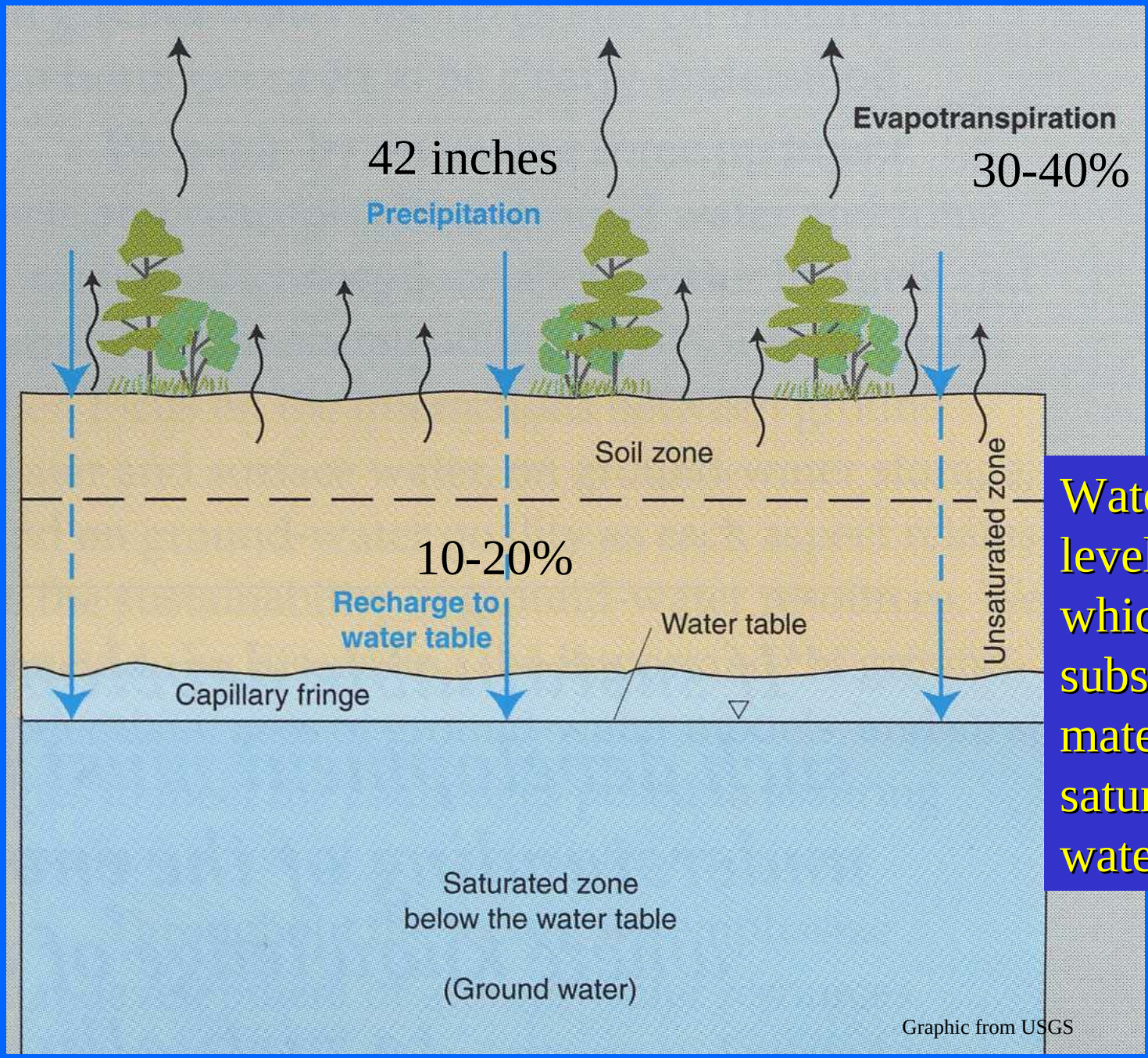
Image from: www.findrentals.com/php/11267/moosehead.jpg

Maine Water Statistics

- Average annual rainfall: 42 inches = 73,500,000 acre-feet, 24 trillion gallons.
- Run-off: ~ 50% of precipitation, 12 trillion gallons
- Evaporation/transpiration: ~ 30-40% evaporates or is transpired through vegetation. 7-10 trillion gallons.
- Infiltration to ground water: ~ 10-20% infiltrates to ground water. ~ 2-5 trillion gallons annually.

Sources: National Weather Service, Maine Ground Water Handbook


USGS
science for a changing world
The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Sublimation
Precipitation
Evapotranspiration
~30-40%
Evaporation
Snowmelt runoff to streams
Surface runoff
~50%
Streamflow
Infiltration
~10-20%
Evaporation
Spring
Freshwater storage
Ground-water discharge
Water storage in oceans
U S Department of the Interior
U.S. Geological Survey
Ground-water storage
Illustration by John M. Evans, USGS
http://ga.water.usgs.gov/edu/watercycle.html



Water table: level below which the subsurface material is fully saturated with water.

Graphic from USGS

Maine Ground Water Use

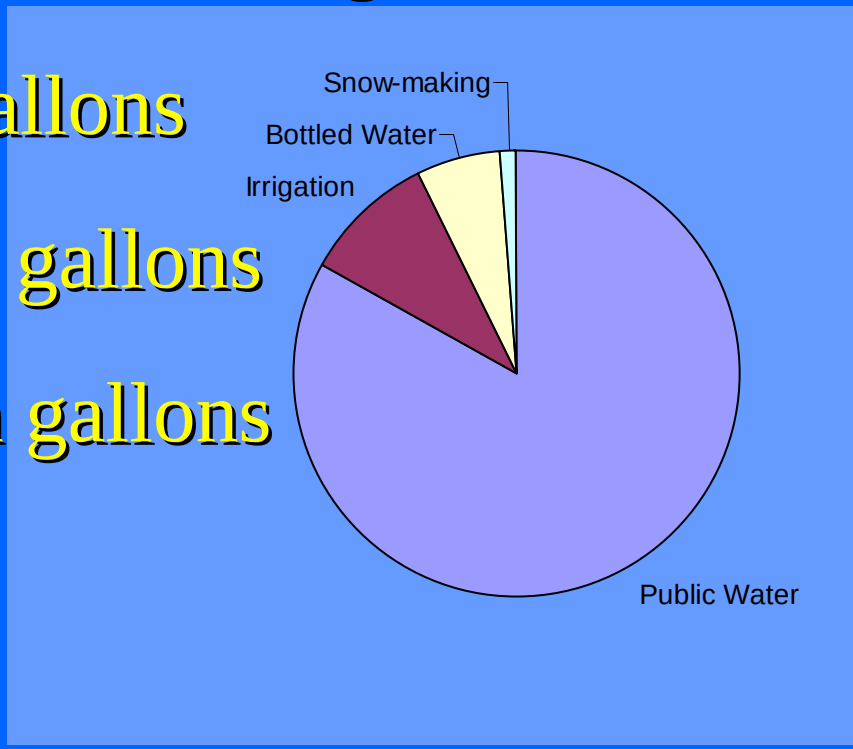
2008

Public water systems – 9,175 million gallons

Irrigation – 1,069 million gallons

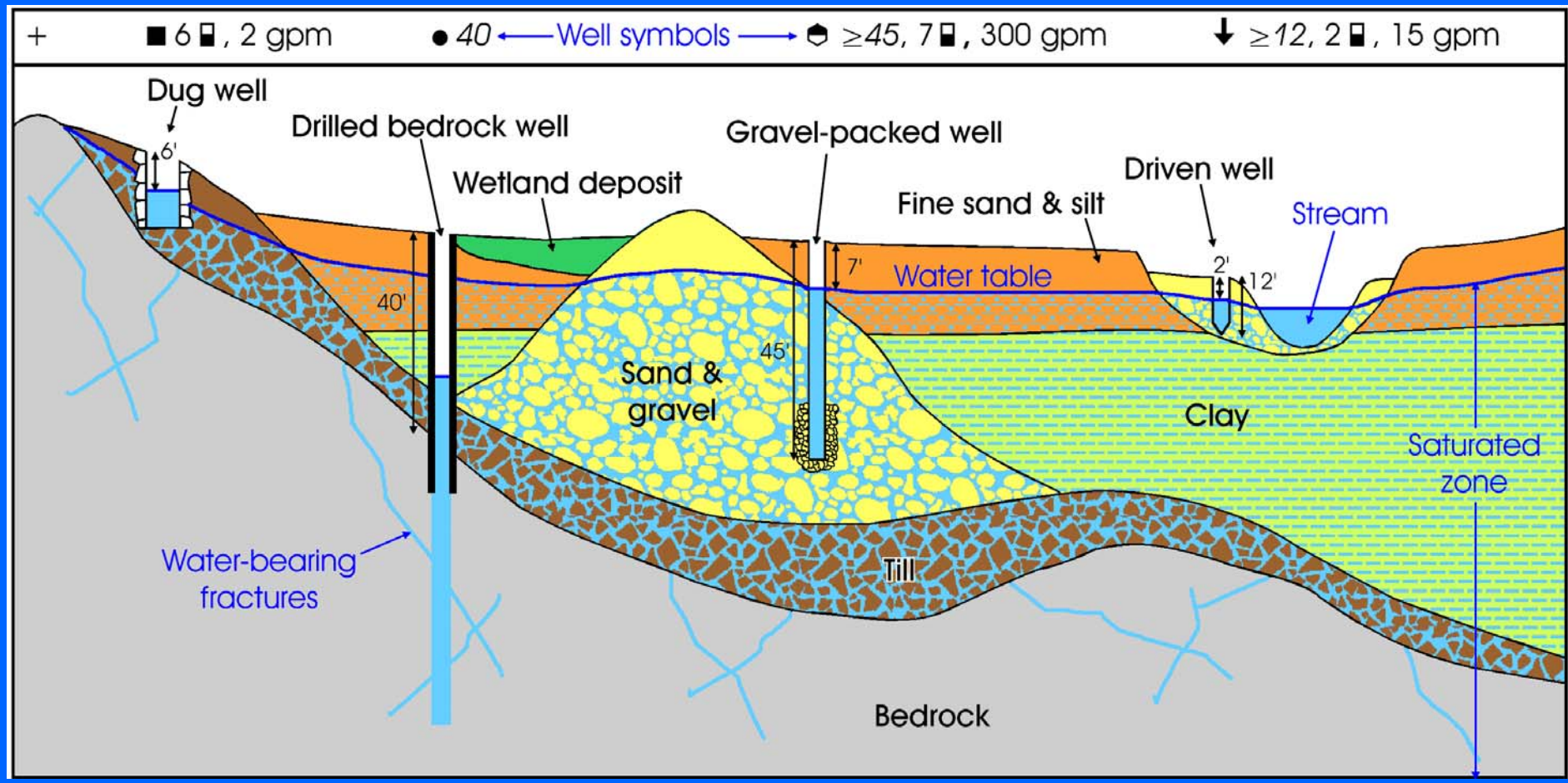
Bottled water – 702 million gallons

Snow making – 109 million gallons



Source: DEP Water Use Reporting Program

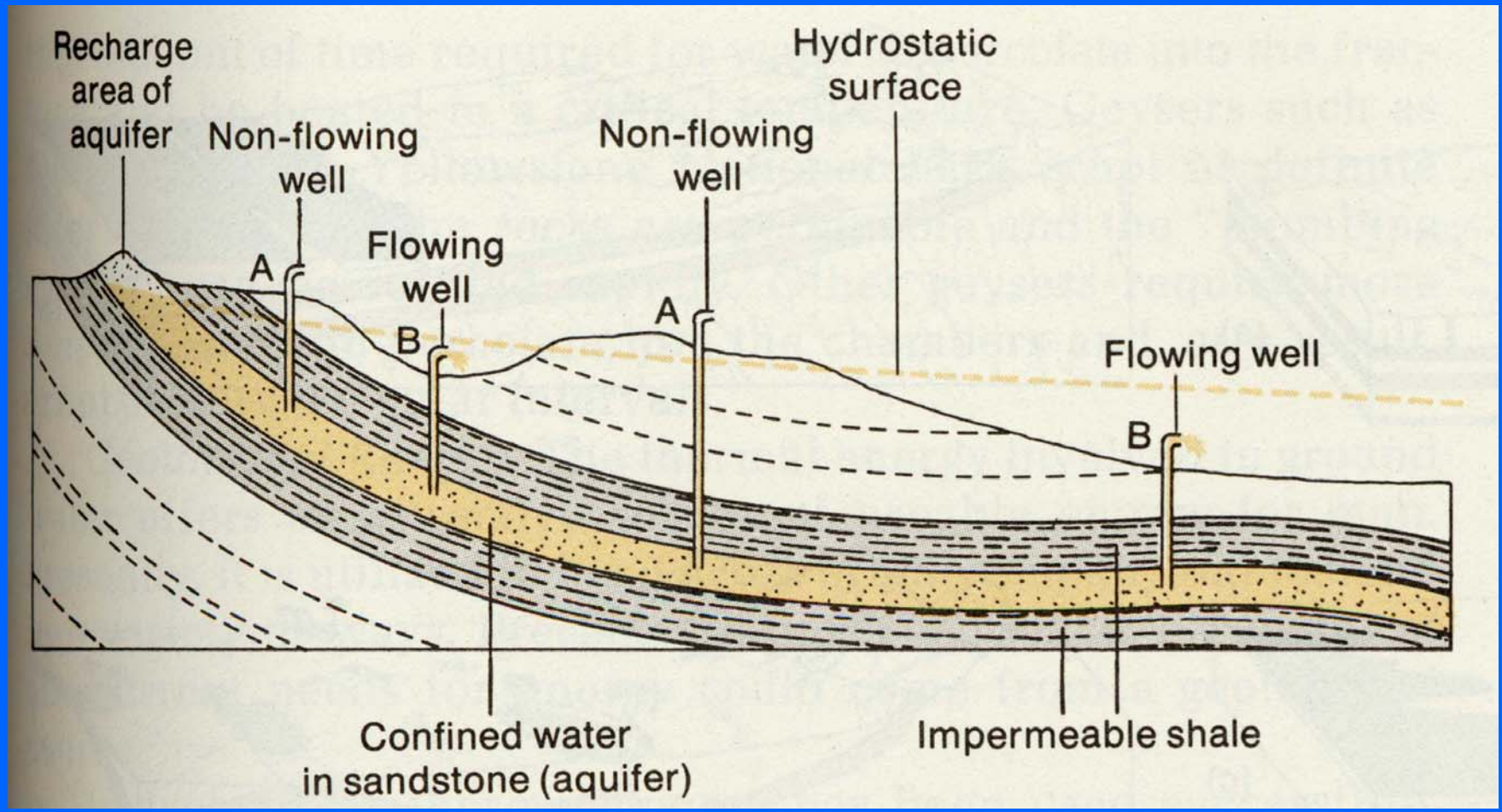
Types of aquifers in Maine



1 – 5 miles

Maine Geological Survey graphic

Typical Western United States aquifer

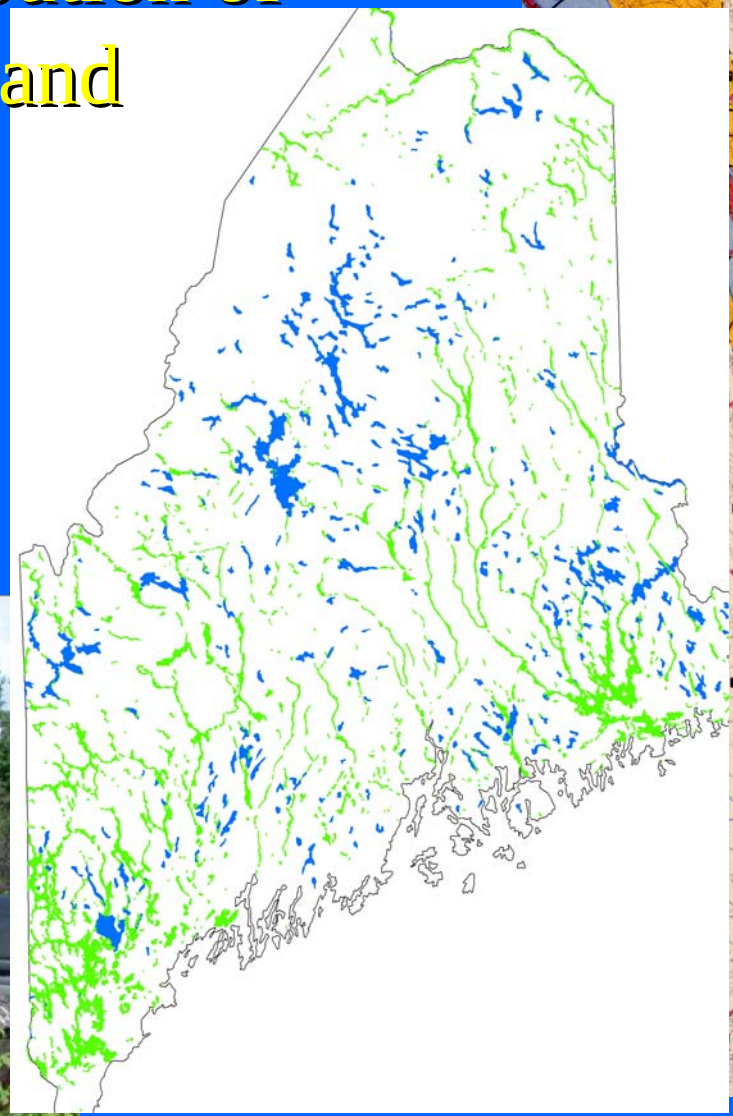


500 – 1,000 miles

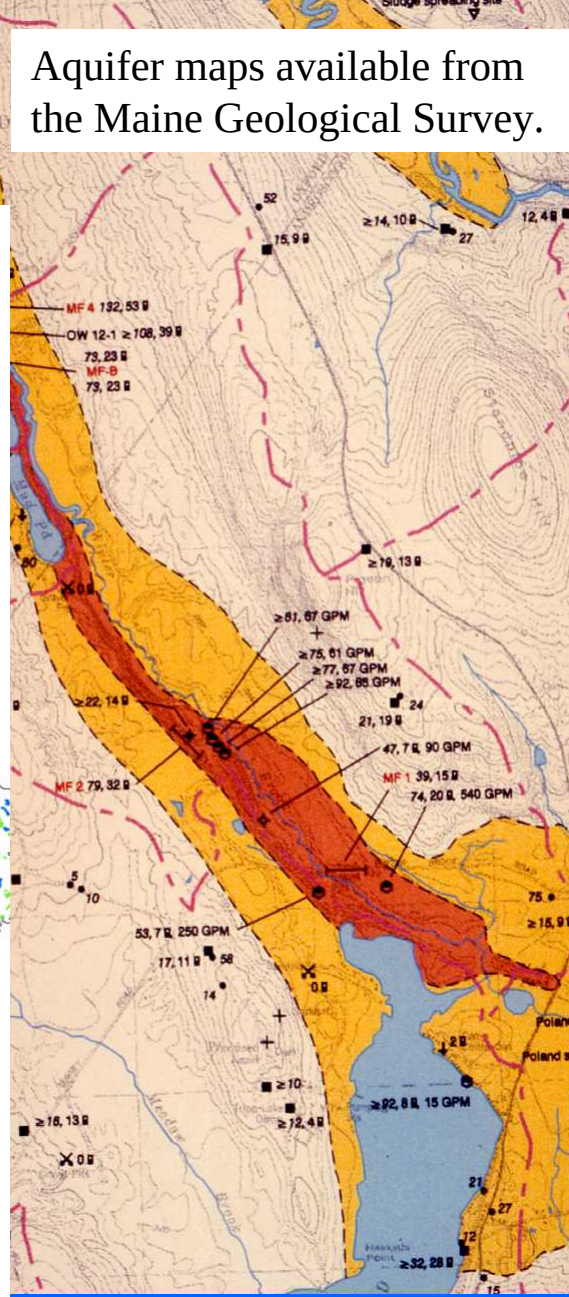
Graphic: Hamblin, 1975, Burgess Press

Statewide distribution of significant sand and gravel aquifers

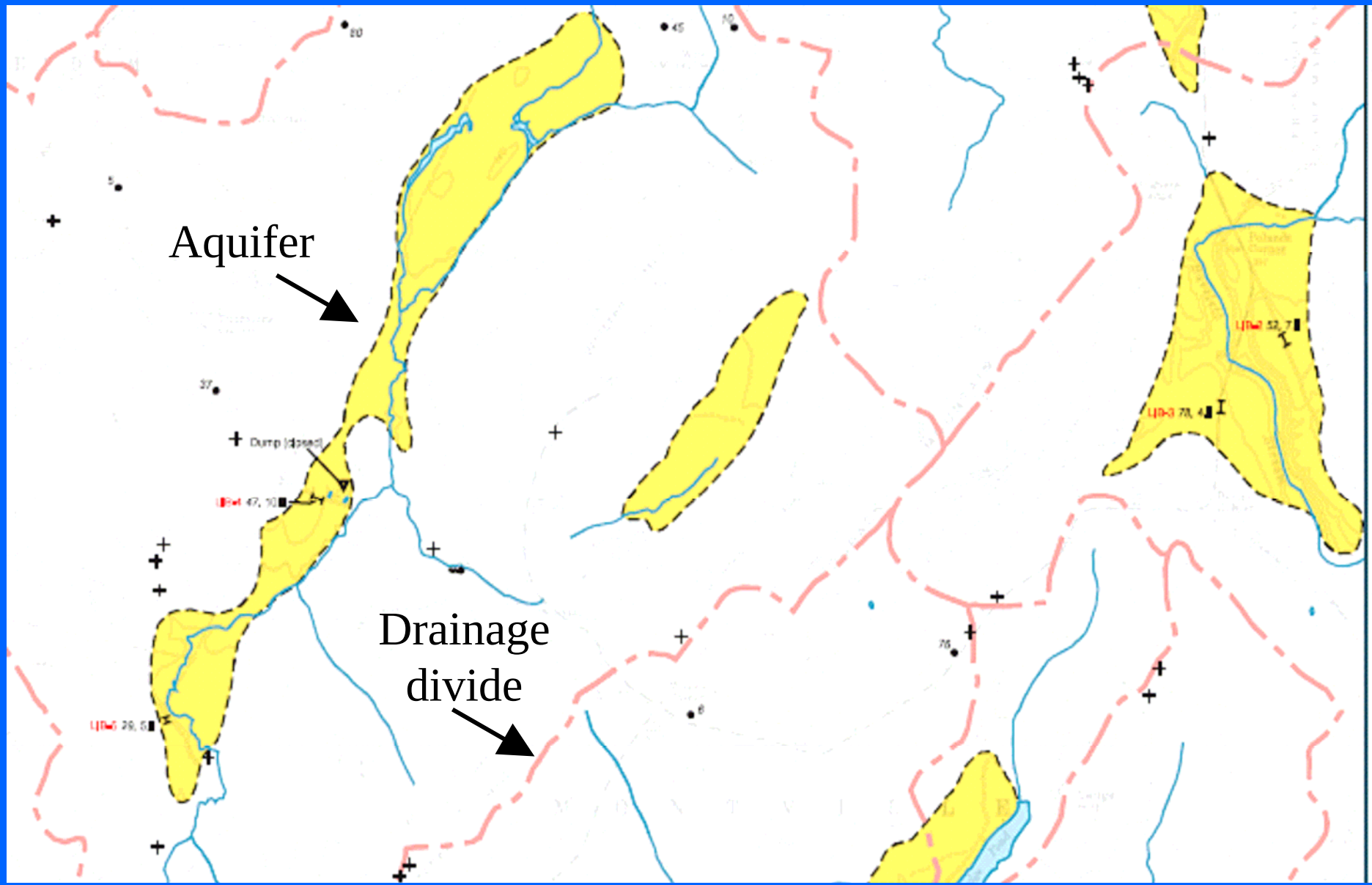
1,300 square miles of mapped sand and gravel aquifers.



Aquifer maps available from the Maine Geological Survey.



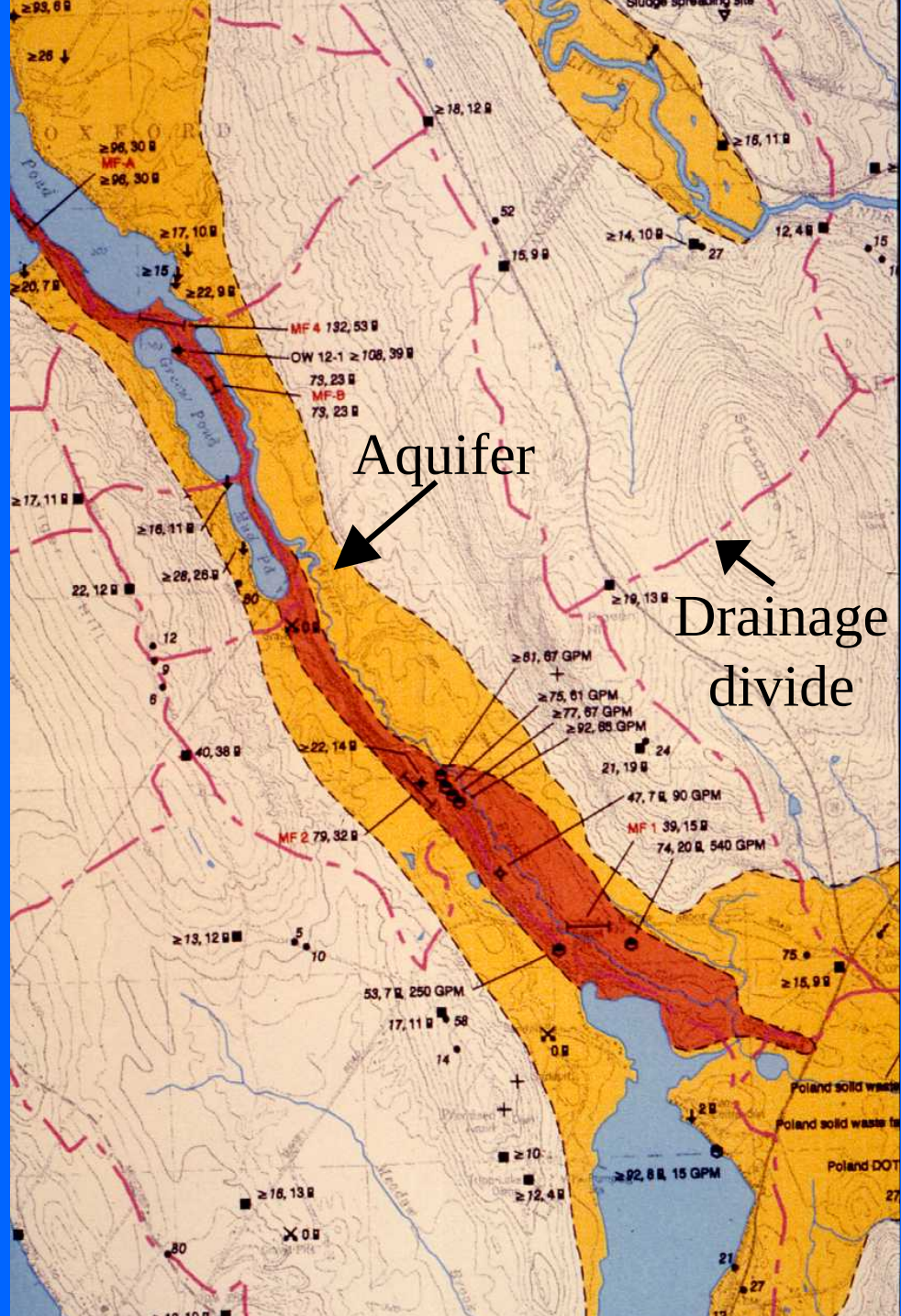
Only northwestern-most Maine remains unmapped.



Examples of sand and gravel aquifer units entirely within single watersheds.

Maine Geological Survey graphic

Example of a sand and gravel aquifer that crosses watershed boundaries. A high-yield portion of the aquifer is shown in red (> 50 gpm).



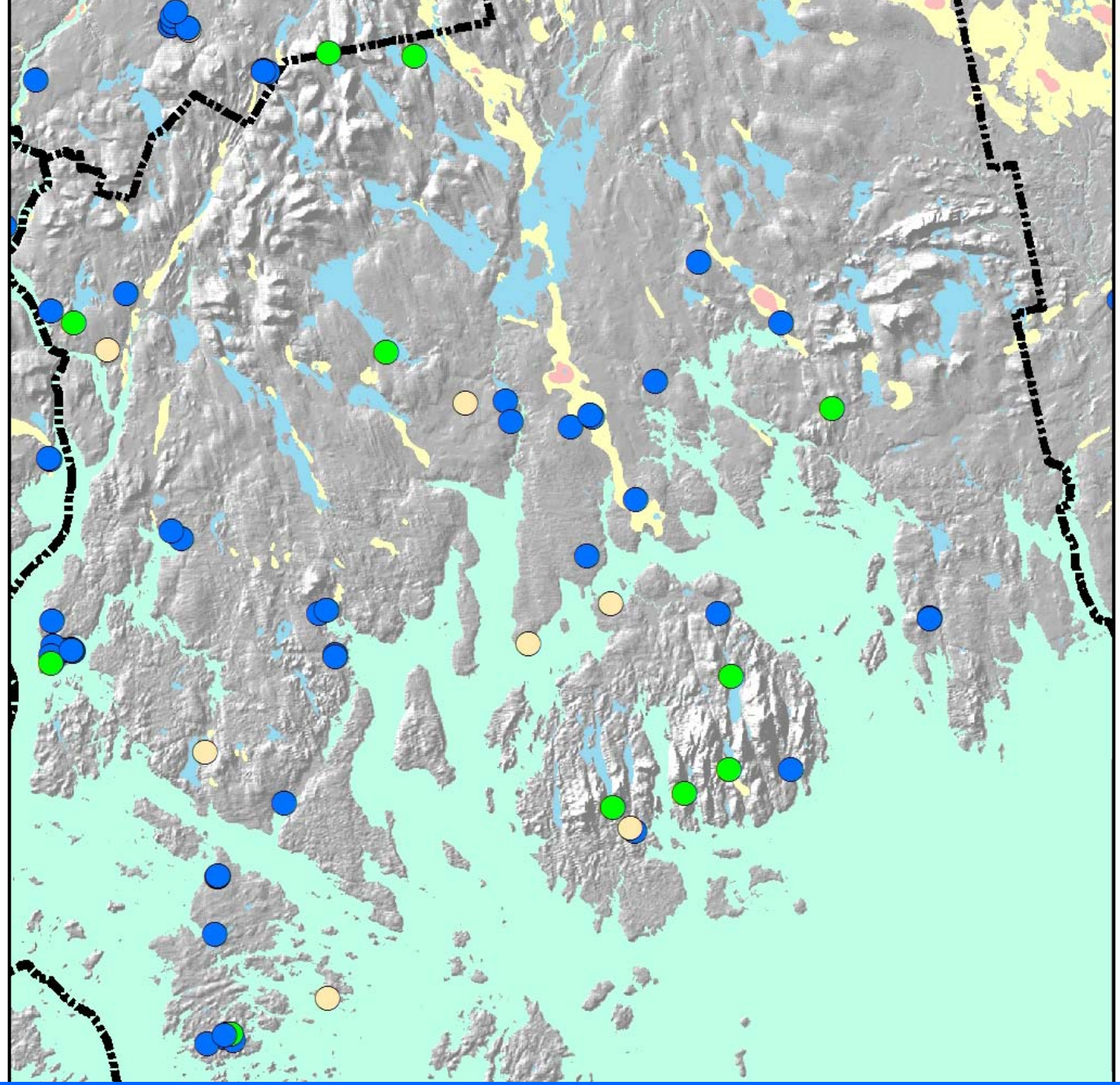
Maine Geological Survey graphic

Hancock County Sand and Gravel Aquifers

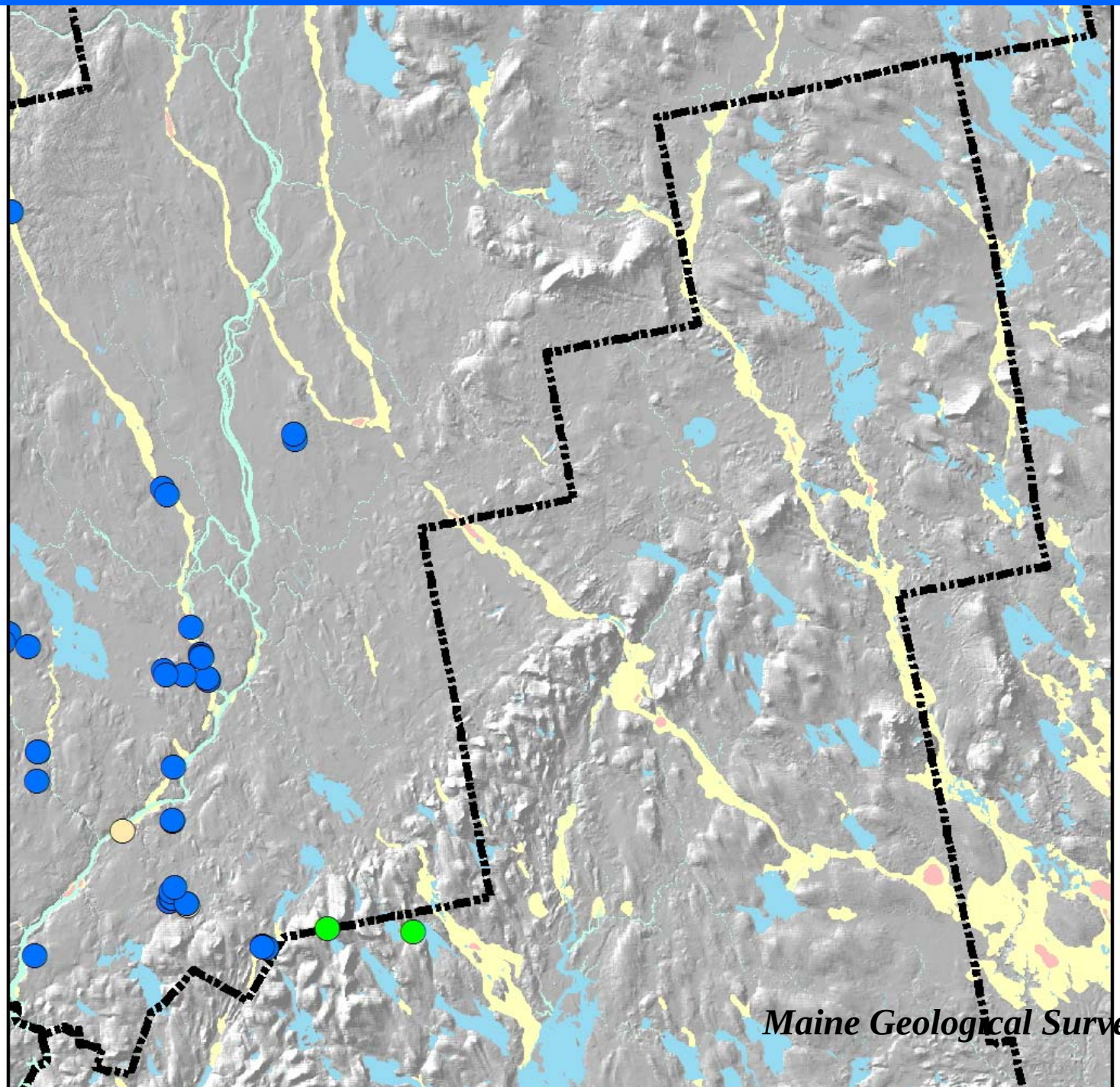
Blue- community water systems

Green – surface intakes

Beige - other



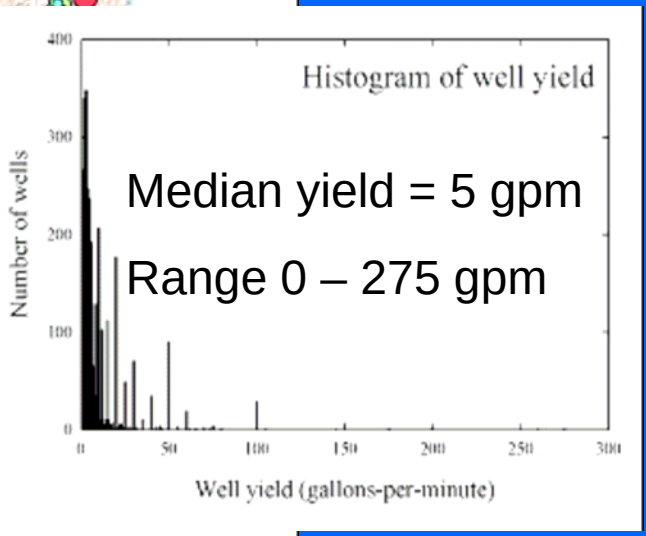
Maine Geological Survey graphic



Maine Geological Survey graphic

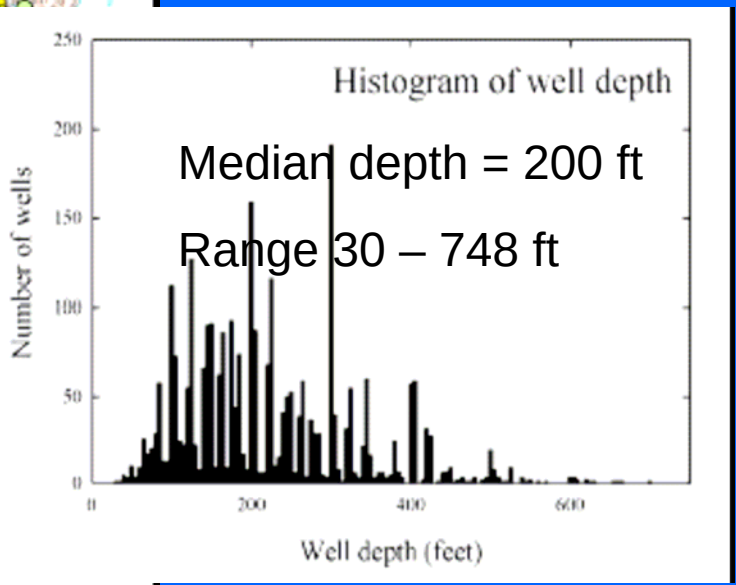
Bedrock Wells Yield

Portion of Open-File Map 07-116, Bar Harbor 1:100,000 quad



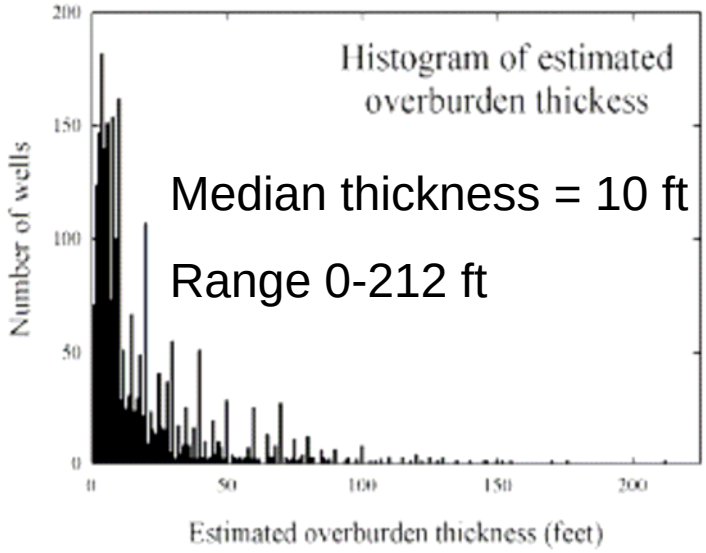
Bedrock Wells Depth

Portion of Open-File Map 07-117, Bar Harbor 1:100,000 quad



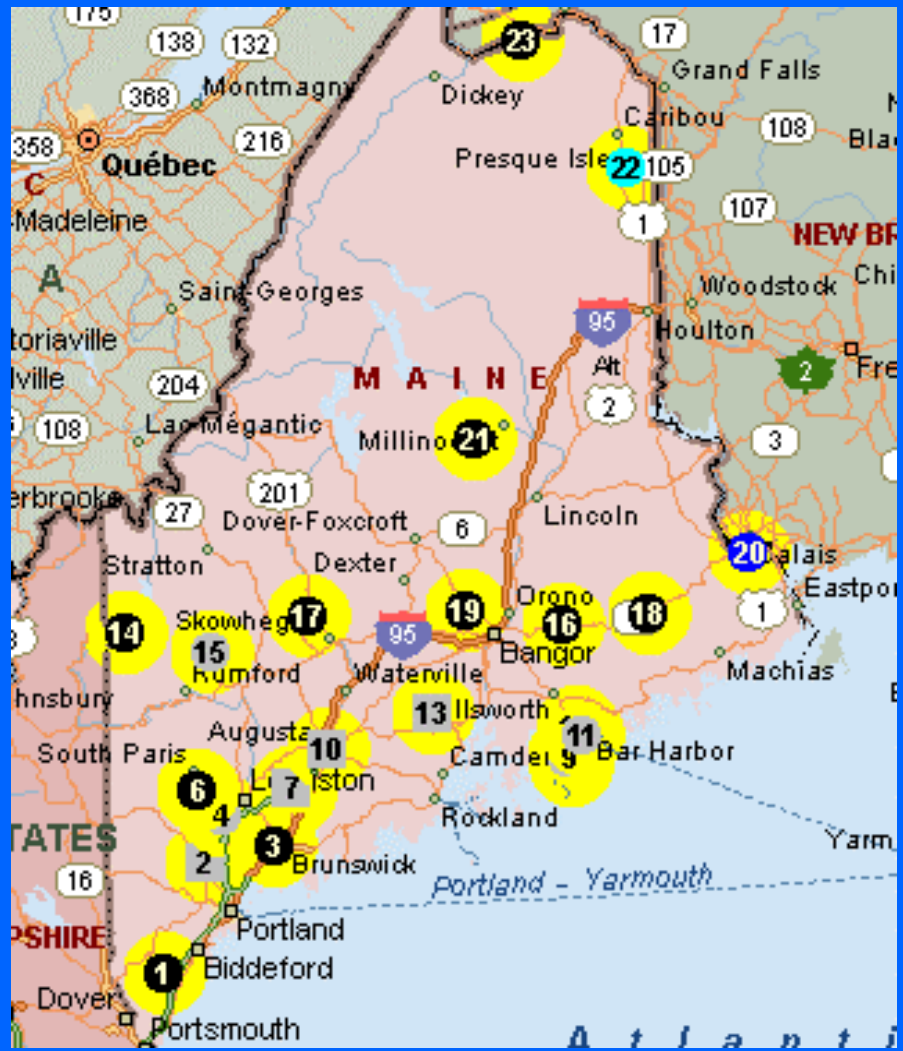
Bedrock Wells Overburden thickness

Portion of Open-File Map 07-118, Bar Harbor 1:100,000 quad



Maine's Ground Water Monitoring Network

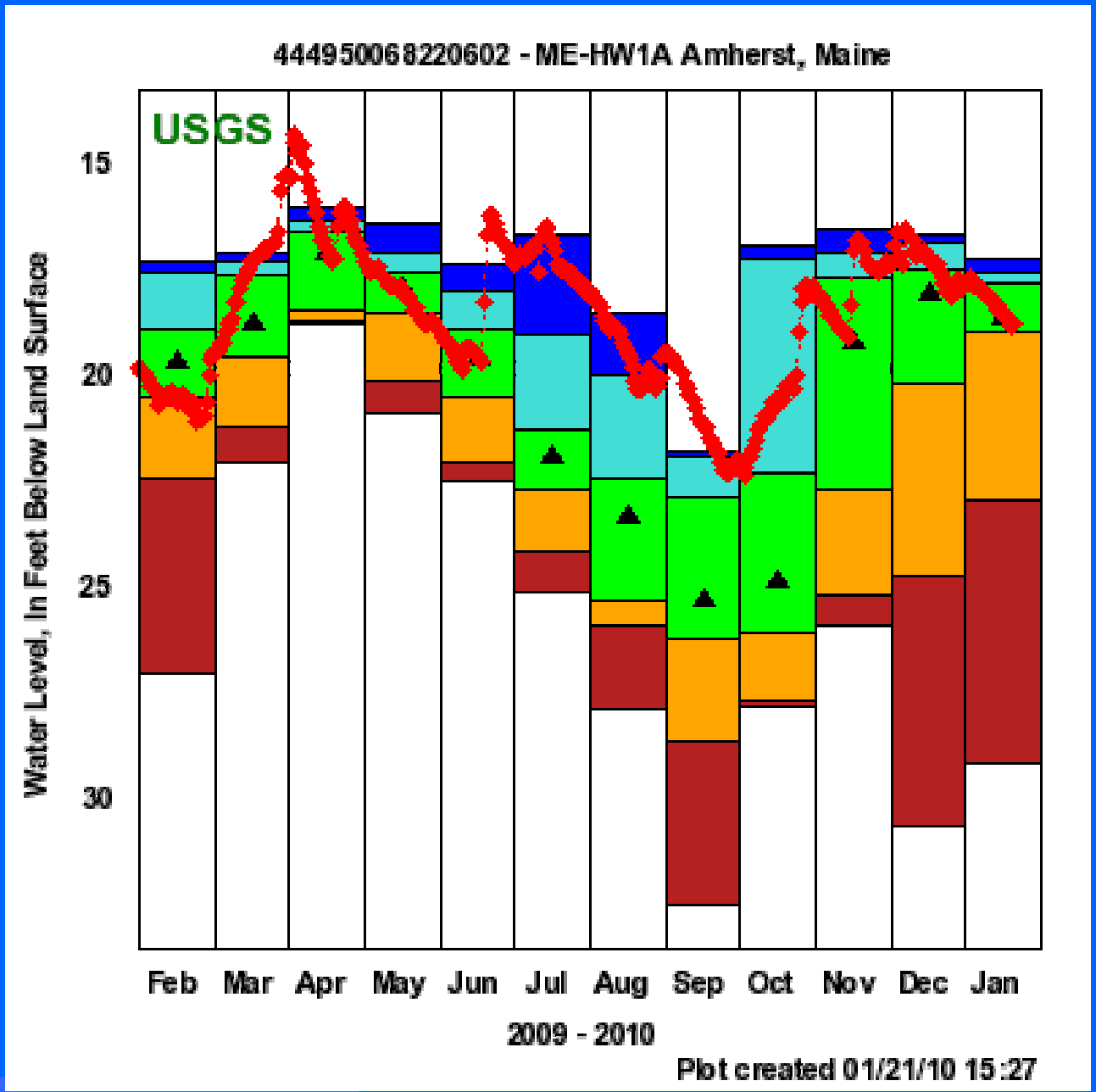
Purpose: To provide near-real time data on ground water levels in wells representative of Maine's 3 water-bearing units (bedrock, till, and sand and gravel aquifers), over as great a spatial distribution as possible. **Maintained by the USGS Maine Water Science Ctr.**



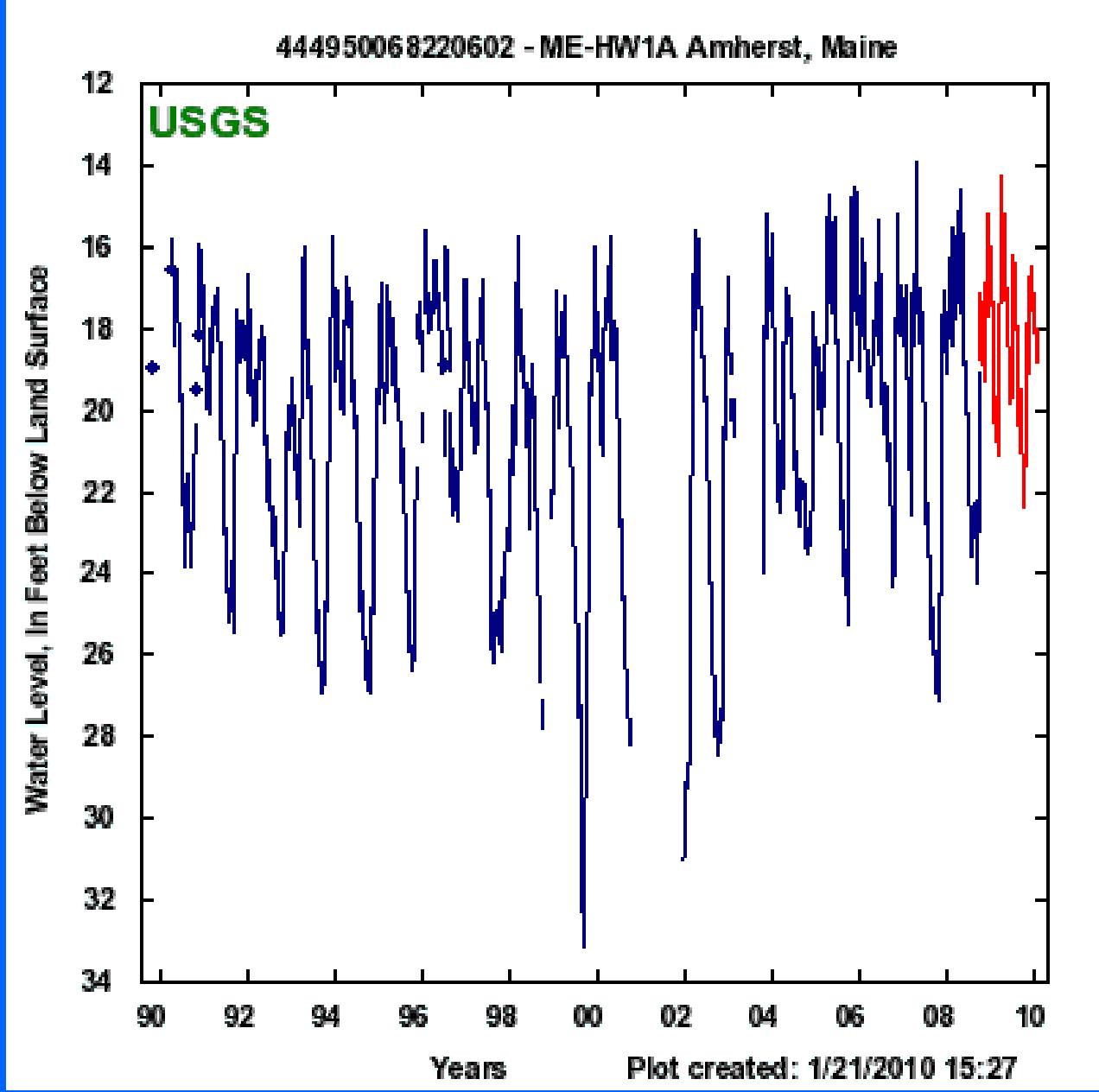
Map at: http://groundwaterwatch.usgs.gov/StateMaps/ME.html

Annual water level variation for a well in Amherst, Maine.

The red line shows the level over the past year. Green bar represents normal, blue above normal, brown below normal.

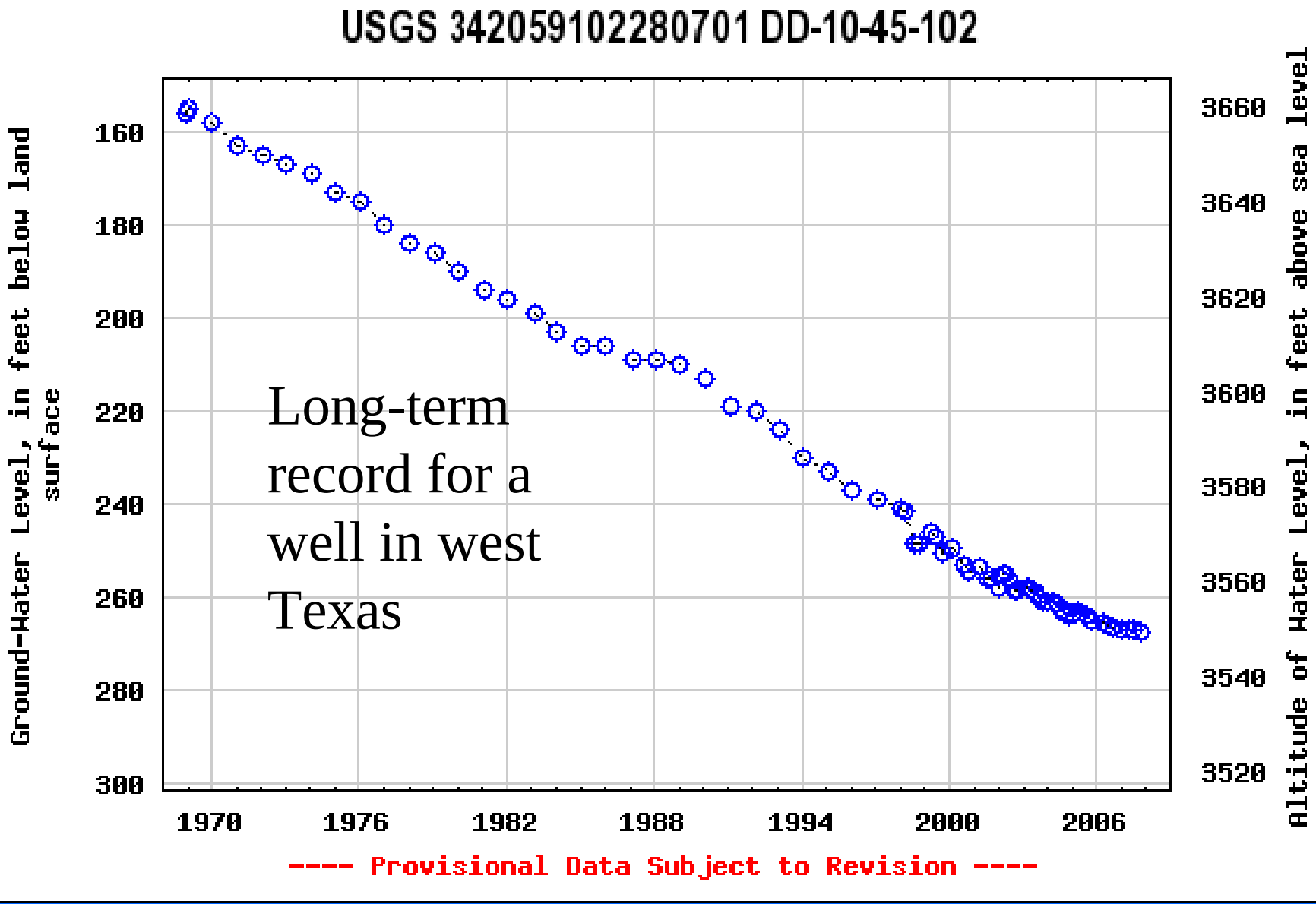


http://groundwaterwatch.usgs.gov/StateMaps/ME.html



Long-term record for a well in Amherst, Maine

USGS http://groundwaterwatch.usgs.gov/StateMaps/TX.html



USGS study of Ground Water Resources

- Detailed analysis of a fractured bedrock aquifer.
- Estimated static volume of ground water in fractured bedrock.
- Estimated recharge to system.
- Estimate use = approx. 2.5% of estimated recharge in the study area.

Nielsen, M., 2002, USGS Water Resources Investigation 02-4000

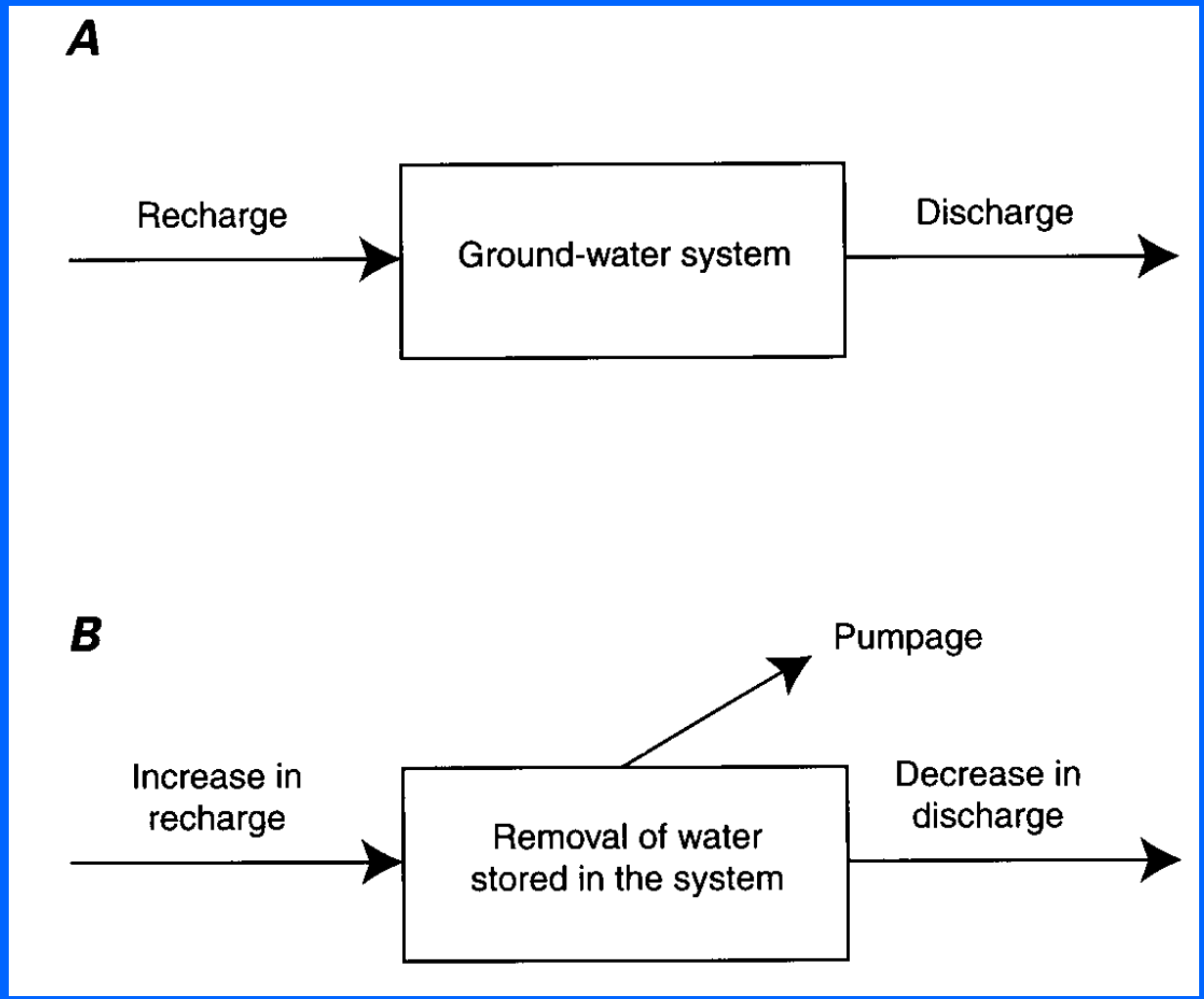
Summer base-flow = ground water discharge

Flow measurement site, Merrill Brook, Freeport, showing typical summer base-flow conditions.

Freeport watershed study.

Maine Geological Survey image

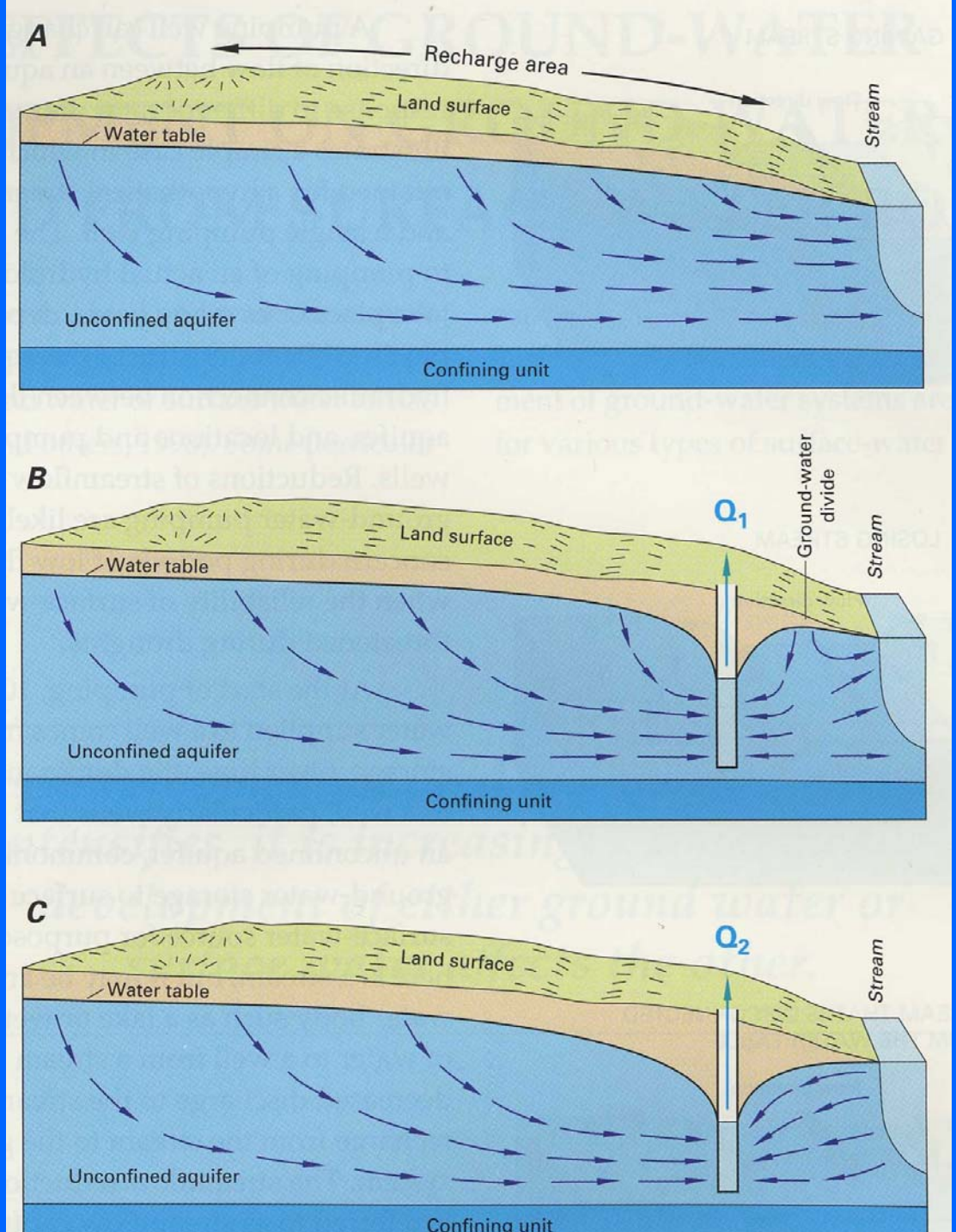
Ground water / surface water interaction



Equilibrium

Pumping usually results in a combination of all of these effects

USGS graphic

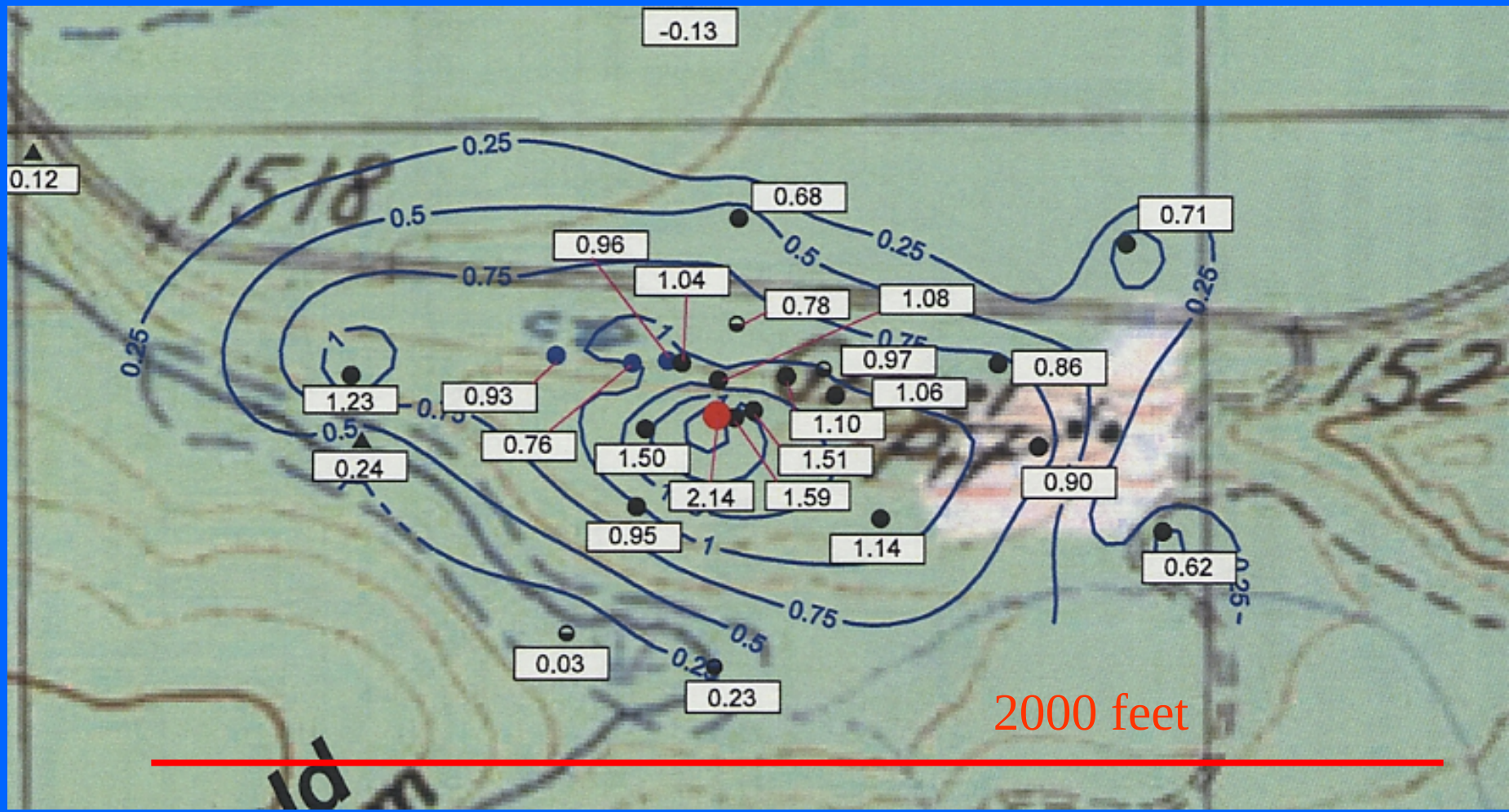


Impacts of pumping

(A)natural ground water flow. (B) At a lower rate of pumping the well intercepts water that would flow out to the stream. At a higher rate (C), the well draws water from the stream into the aquifer – induced recharge.

USGS graphic

Pump test draw down. 450 gpm for 7 days. These realistic tests show an area of drawdown measured in a few thousand feet.

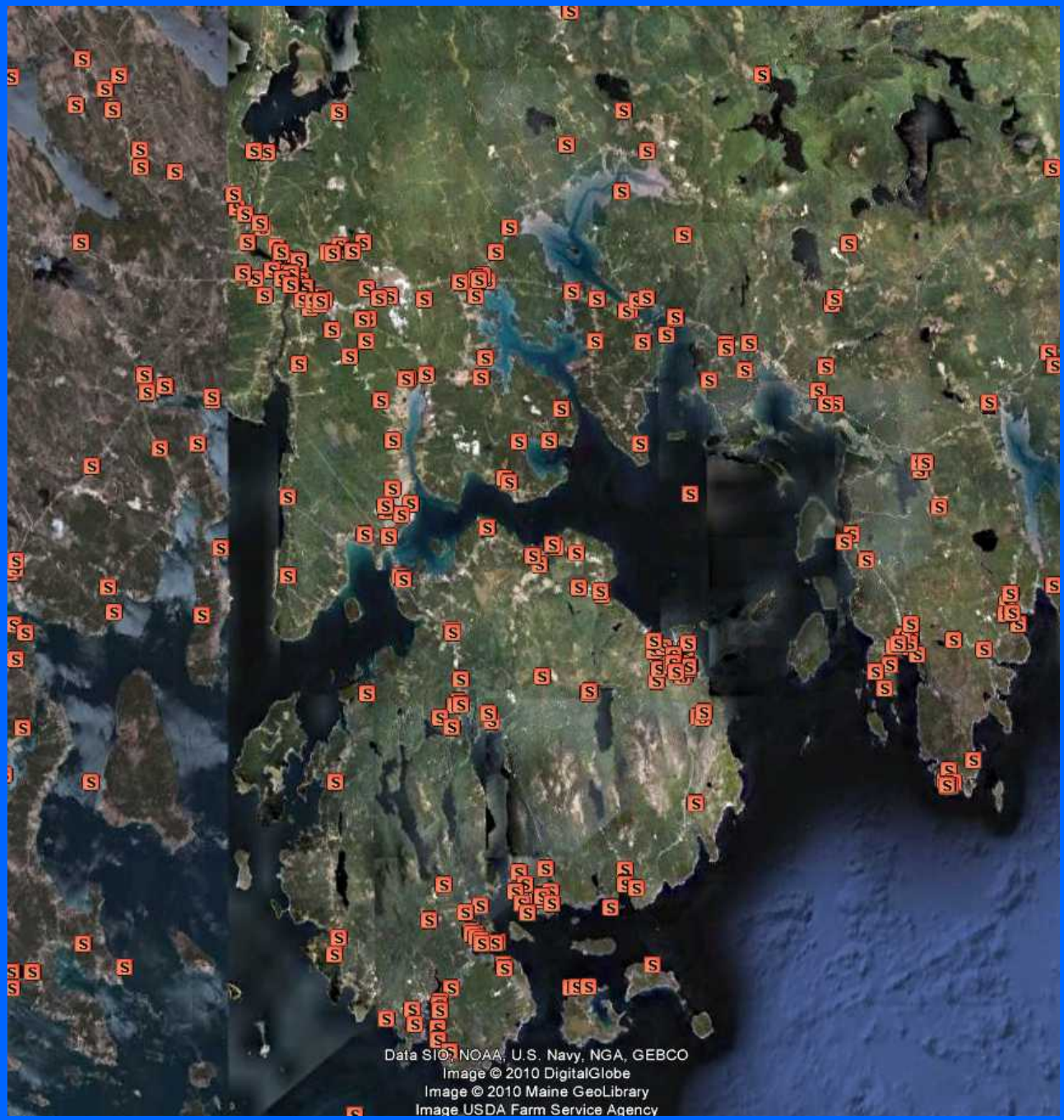


Ground Water Quality Issues

- **Naturally occurring contaminants**
  - **Arsenic, Uranium, Radon, others**
- **Impacts from Human Activities**
  - **Spills of all types**
  - **MTBE**
  - **Salt-water intrusion**
  - **Landuse patterns**
  - **Geothermal systems**
  - **Pharmaceuticals**
  - **Pesticides**

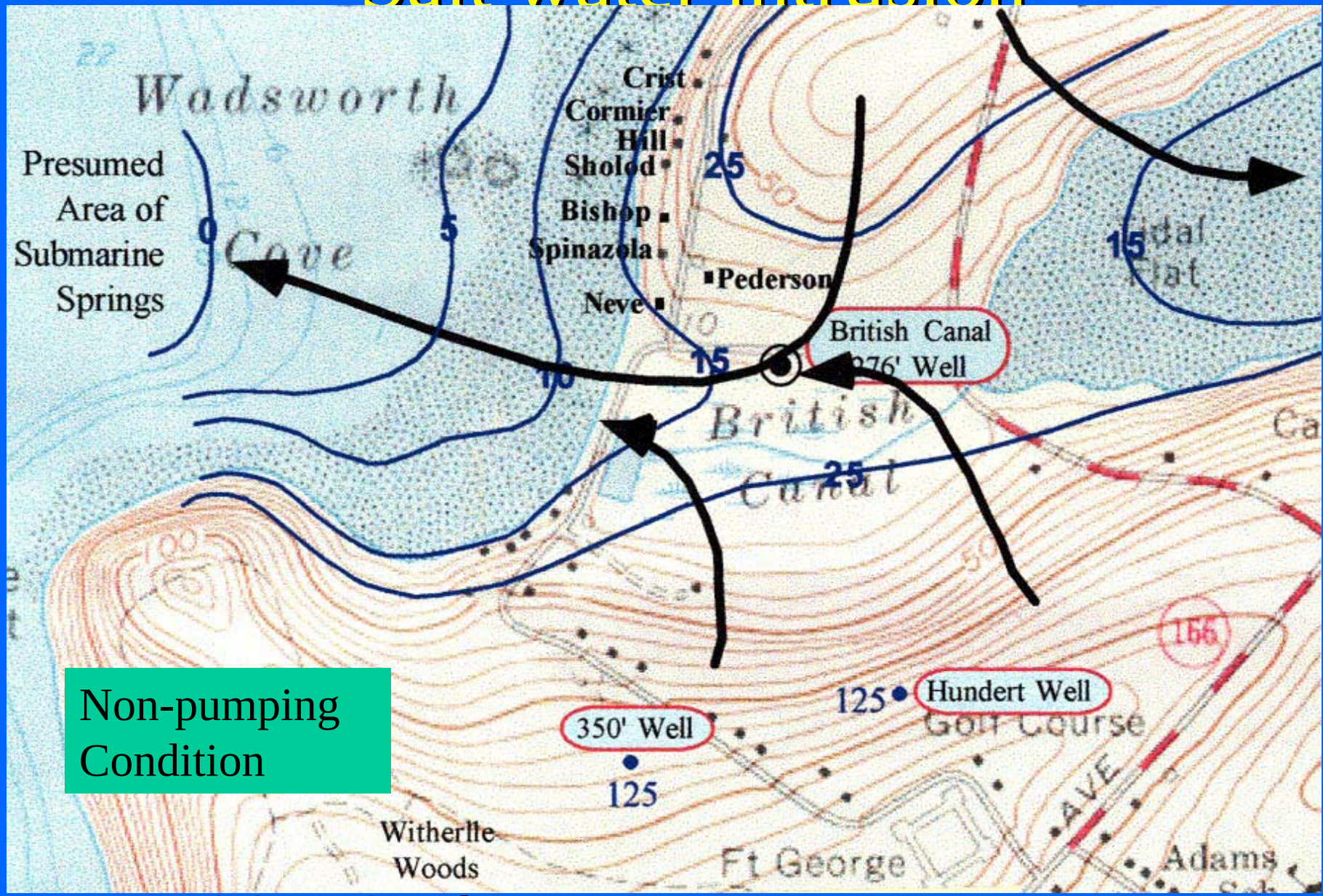
Hazardous Oil Spill Sites

DEP Database

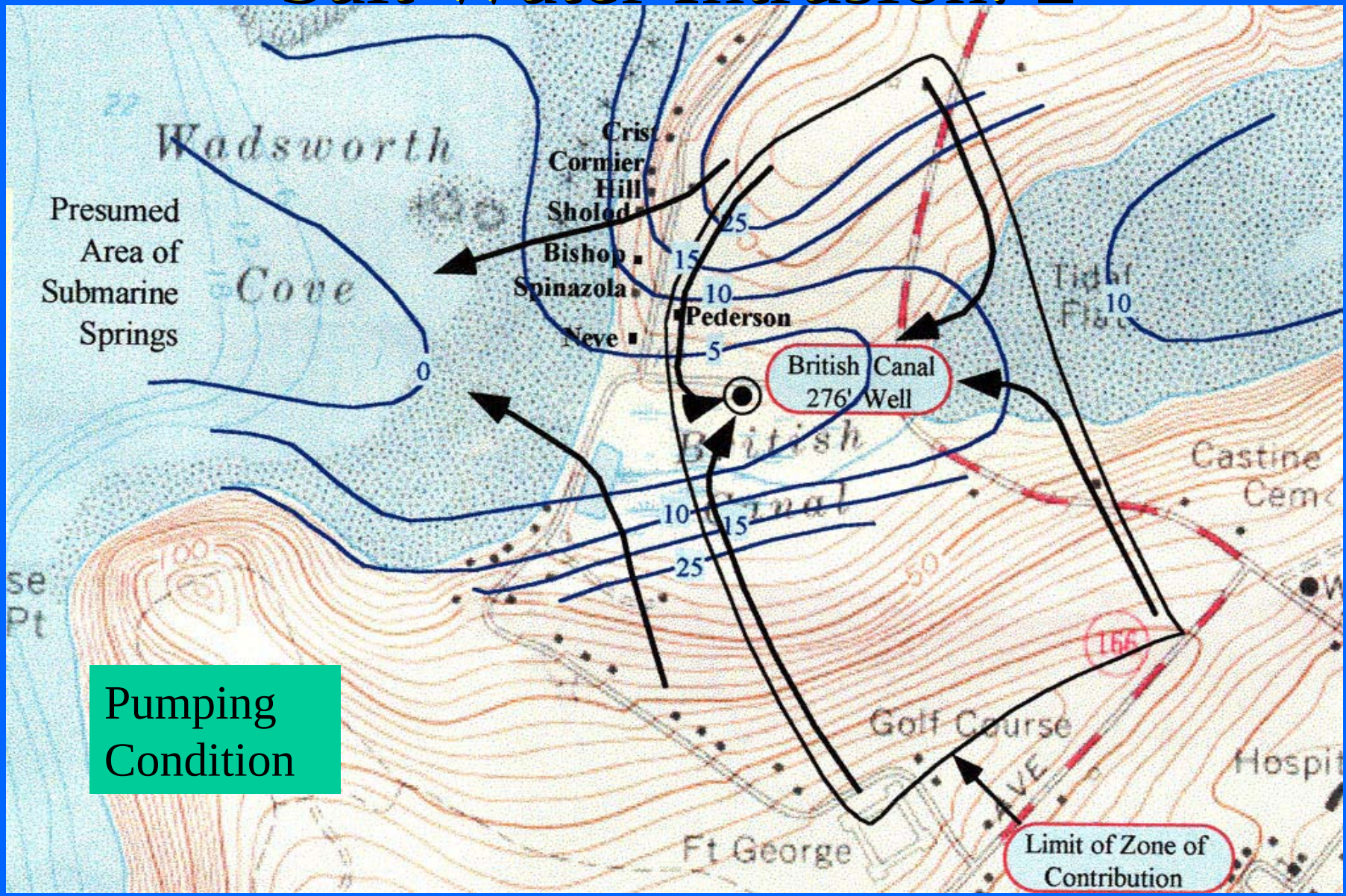



Edit View Tools Add Help
Saltwater intrusion
Gun Point Rd
Harpswell, Maine
Long Point Island
Hen Isl
©2009 Google
Image © 2009 Maine GeoLibrary
© 2009 Europa Technologies
©2009 Google
gery Date: 2003
43°46'17.81" N 69°56'36.90" W elev 0 ft
Eye alt 4409 ft

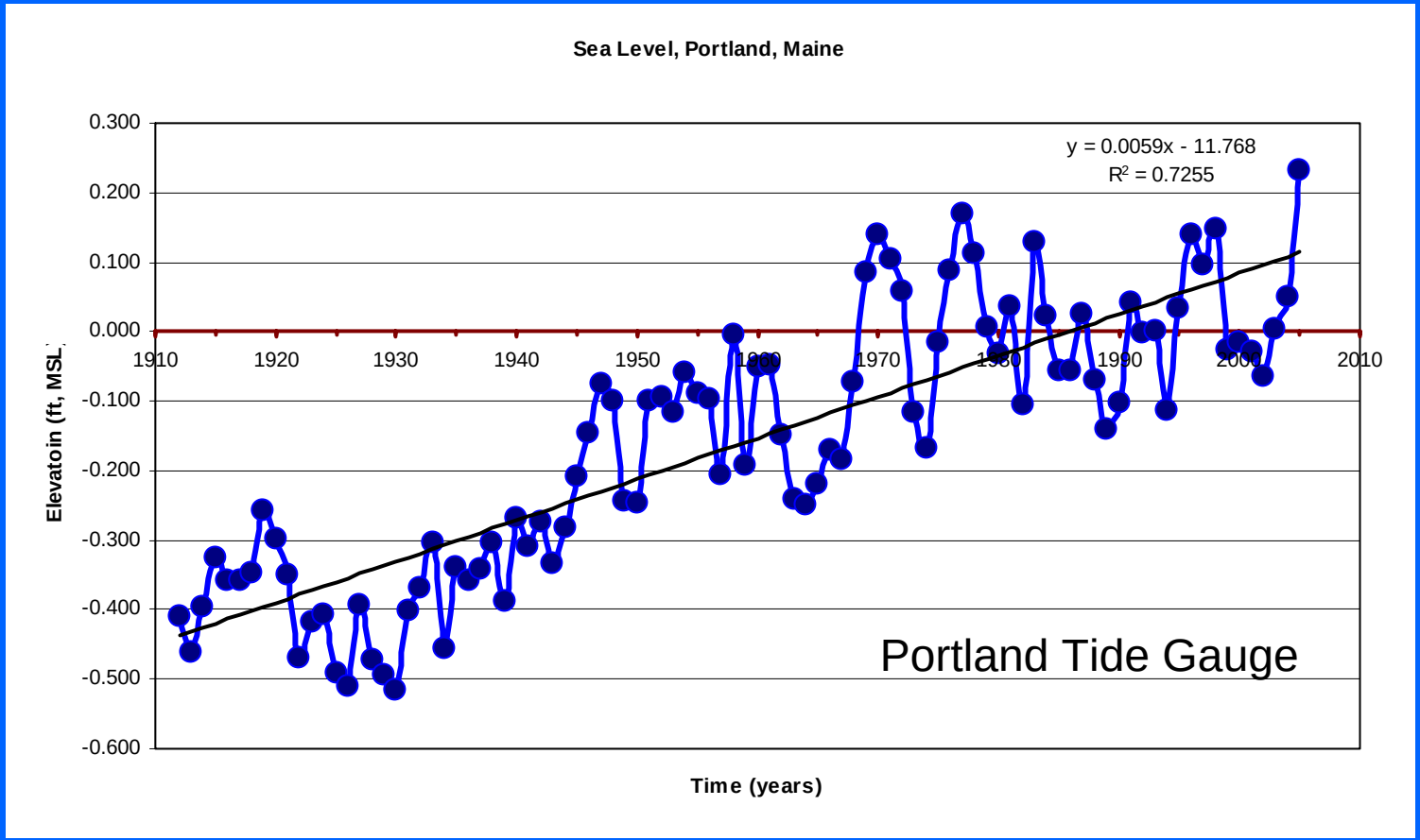
Salt water intrusion



Salt Water Intrusion: 2



Saltwater Intrusion



Impacts of Sea Level Rise?

Maine Geological Survey graphic

Water Resources

Watersheds-at-risk analysis provides guidance for additional water resources studies.

<u>Used systematic datasets across entire state:</u>

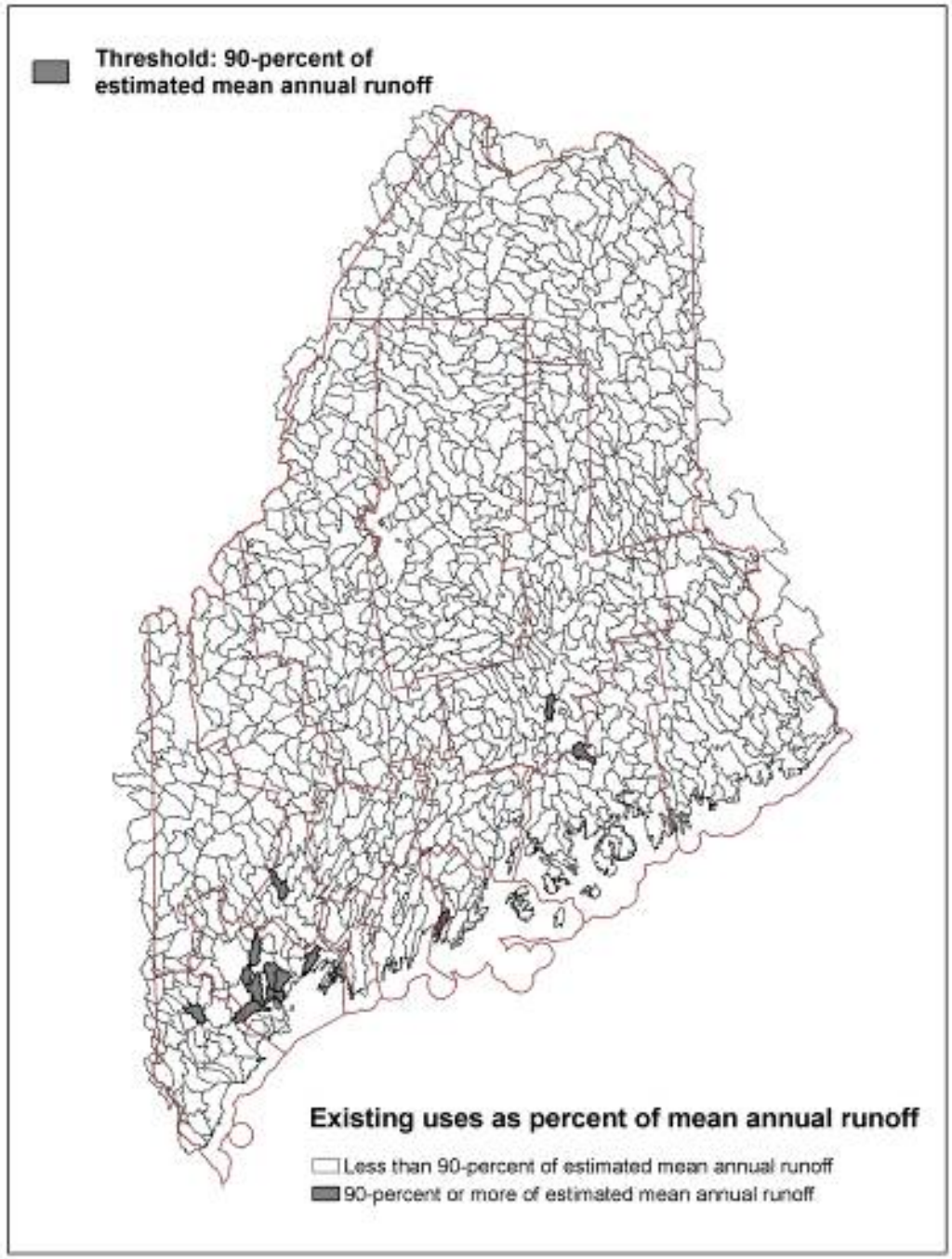
12-digit hydrologic units

Annual runoff equations from USGS.

In-stream flow requirements.

Water use: by industry, agriculture, public water systems, private wells.

Maine Geological Survey graphic

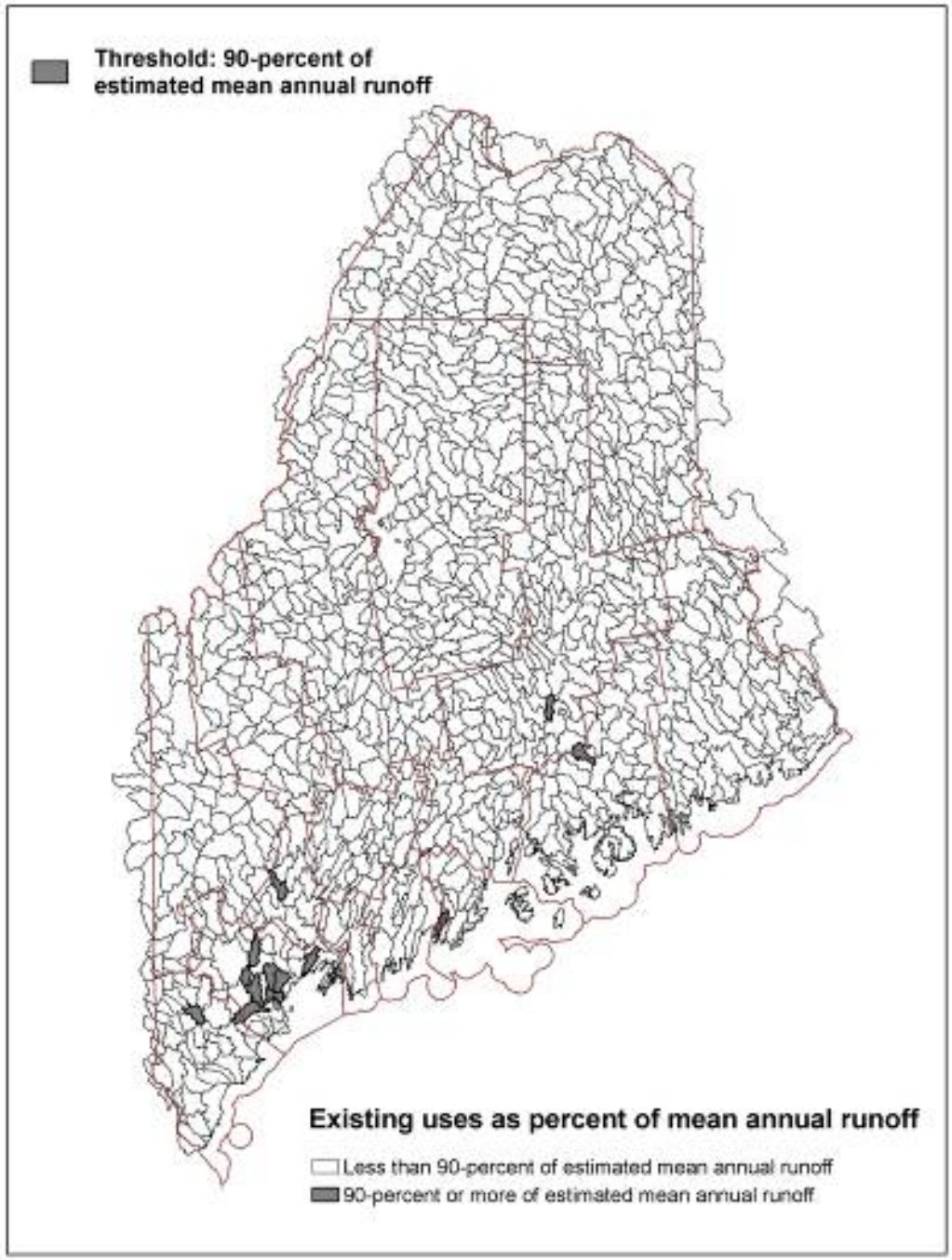


Water Resources

Watersheds-at-risk analysis provides guidance for additional water resources studies.

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

A: A few areas need more detailed investigations.



Maine Geological Survey graphic

Water Resources Planning Committee

Established by the Legislature in 2007 (PL 2007 Chap 399)

Stakeholder group with representation from major ground water users, state agencies, conservation groups, well drillers.

Phase 1: Focus on improving water information in watersheds where the potential exists for conflicts in water use. Is there really a problem in these watersheds?

Phase 2: Convene planning groups in watersheds at risk to develop water management plans.

Phase 3: Make recommendations to the Legislature in the event that Phase 2 does not adequately resolve problems.

Water Resources Planning Committee

Participants:

Agricultural Council of Maine

Maine Potato Board

Maine Water Utilities Assoc.

Maine Rural Water Assoc.

Maine Ground Water Assoc.

Ski Maine Assoc.

H_2O for Maine

Nestle Waters North America

Maine Geological Survey

Maine DEP

Maine Drinking Water Program

Maine Dept. Agriculture

Maine IFW

LURC

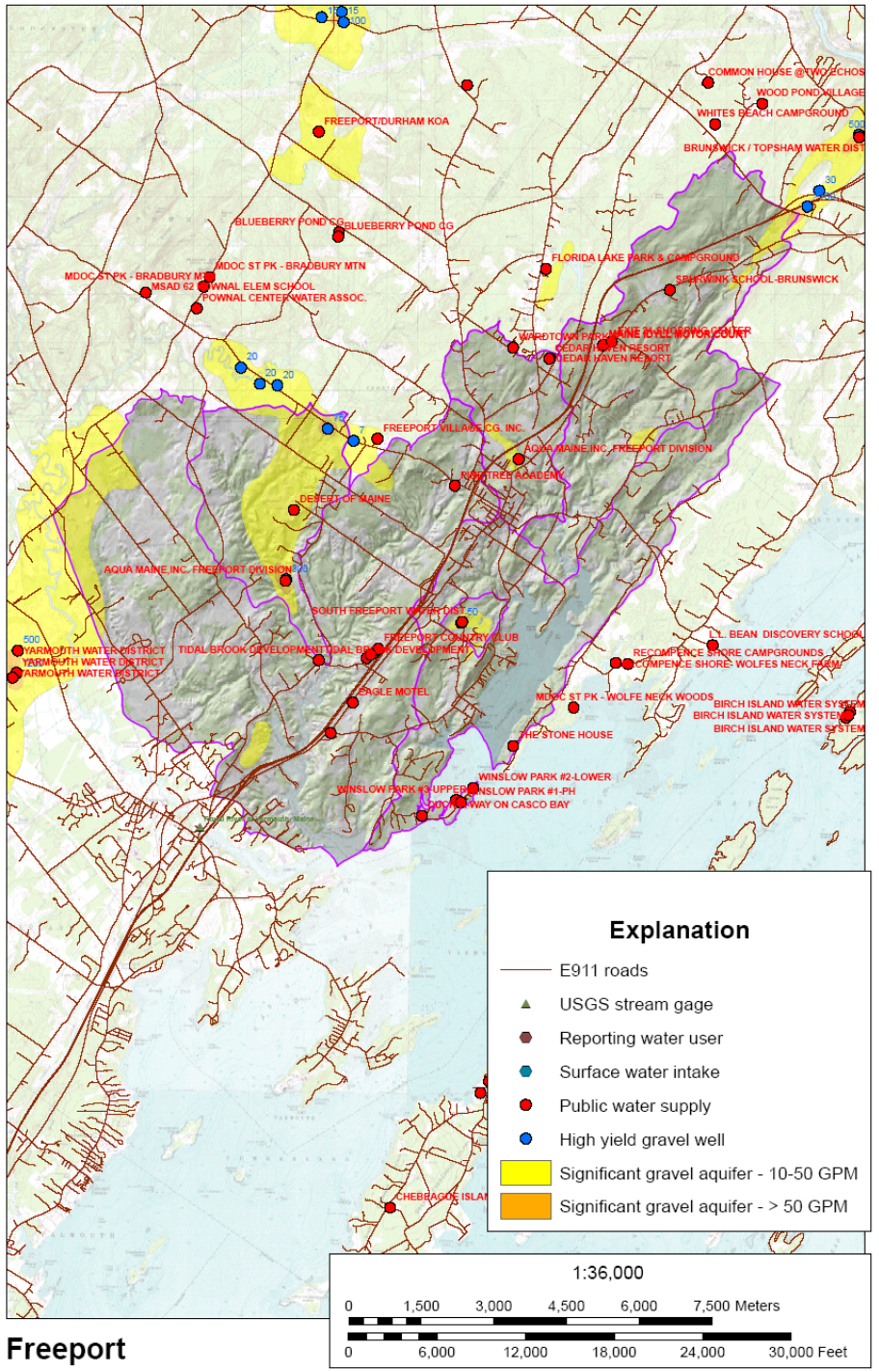
Water Resources Planning Committee

2008-2009 work in Freeport watersheds.

Further characterization of aquifers.

Stream discharge measurements.

Maine Geological Survey graphic



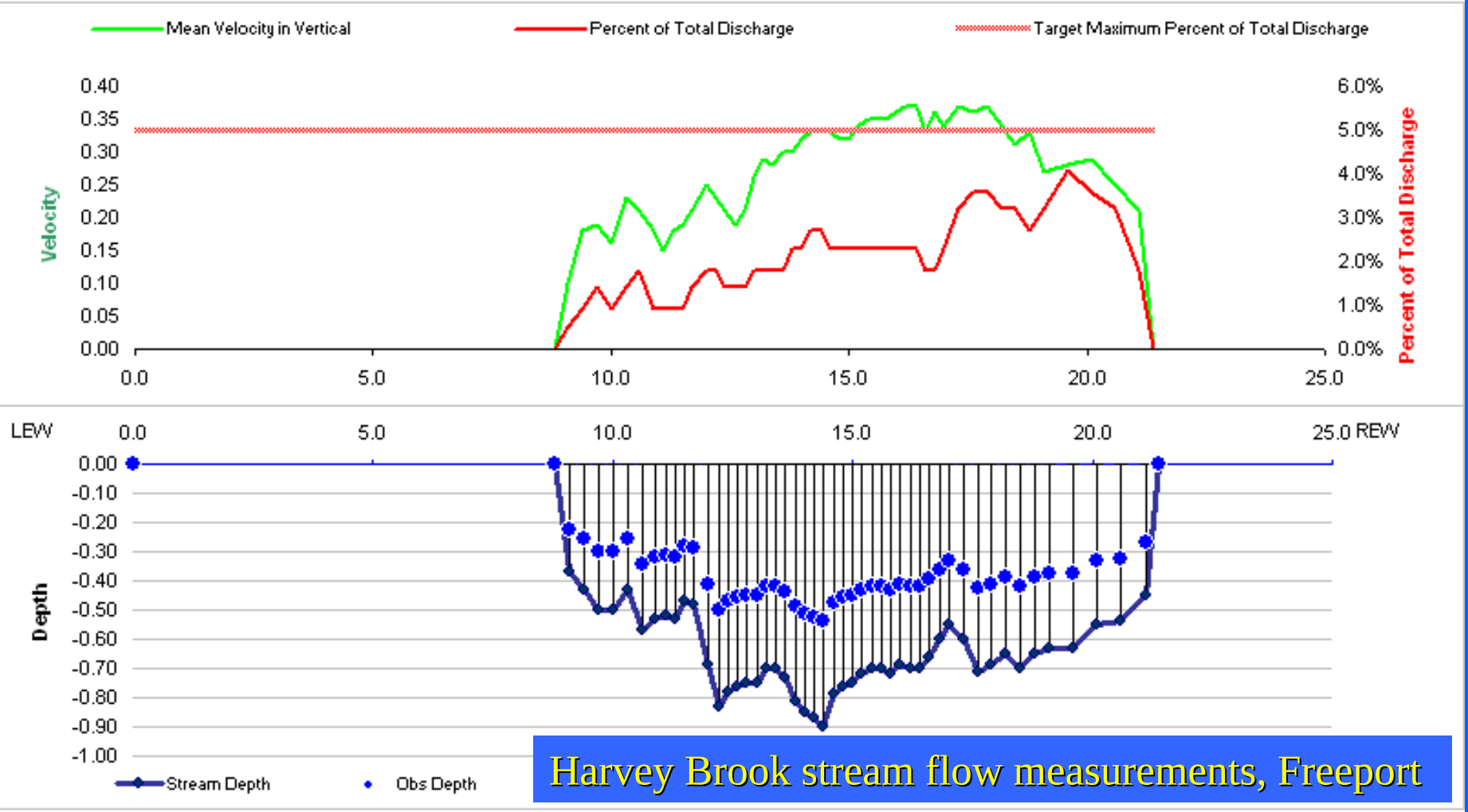
Freeport

AquaCalc Pro Discharge Measurement Summary

Imported Values | Re-Calculated Values

Station: HVYBK1P

9/17/09 10:52



Harvey Brook stream flow measurements, Freeport

Measurement Information

Measure standard:	SAE	Max Vertical Q:	0.05
Measure equipment:	TopSet Rod	Percent Slope:	0.20
Sounding Weight:	NA	Measure Start at:	LEW
Measure ice:	No	Vertical Count:	50.00
Flood Measurement:	No		
Flood Coef:	0.00		

Adjust Axis

Section Summary

Section Velocity:	0.29	Section Pct Err:	0.00
Section Width:	12.60	Section Quality:	na
Section Area:	7.78	Section WetPerim:	13.34
Section Q:	2.22	Section Hyd Rad:	0.58
Section Diff:	2.22	Section Manning:	1.09

Maine Geological Survey graphic

Regulation of Ground Water Withdrawals

Site Location of Development Act: Any activity that triggers this regulation and includes ground water withdrawal undergoes hydrogeologic review and monitoring.

Bulk Water Transport Law: Transport of water across town lines in containers larger than 10 gallons is prohibited, unless exempted. Review for exemption – public health and safety, no adverse affect on existing uses.

LURC: Finding of "no undue adverse affect" and "harmonious fit." Requires hydrogeologic review and monitoring.

NRPA – Significant ground water well: Any well producing 50,000 gallons per day requires a permit. Hydrogeologic review and monitoring.

Regulation of Ground Water Withdrawals

Chapter 587 Rules: Protect in-stream flows from direct withdrawals that would impact habitats. Also from groundwater withdrawals that may reduce stream flow.

Water Use Reporting: Major users report annually. Summary report to Legislature for their consideration.

SUMMARY

1. Ground water is an abundant, renewable resource.
2. Total annual ground water use in Maine is a small fraction of annual recharge.
3. Sand and gravel deposits of glacial origin are Maine's best ground water resources.
4. Impacts from ground water use are local.
5. There are a few watersheds where cumulative use (including flows to protect aquatic habitat) may be approaching available supply. These are the subject of on-going studies.
6. There are well coordinated regulations that ensure sustainable withdrawals and minimal impacts on other uses.