An Overview of Maine’s Ground Water Resources

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

Only northwestern-most Maine remains unmapped.

Aquifer maps available from the Maine Geological Survey.
Examples of sand and gravel aquifer units entirely within single watersheds.
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
Bedrock Wells Yield

Median yield = 5 gpm
Range 0 – 275 gpm

Portion of Open-File Map 07-116, Bar Harbor 1:100,000 quad
Portion of Open-File Map 07-117, Bar Harbor 1:100,000 quad

Median depth = 200 ft
Range 30 – 748 ft
Median thickness = 10 ft
Range 0-212 ft
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
Long-term record for a well in west Texas

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

Freeport watershed study.

Winter base-flow = ground water discharge
Ground water / surface water interaction

Equilibrium

Pumping usually results in a combination of all of these effects.
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
Saltwater intrusion

Harpswell, Maine
Salt water intrusion

Presumed Area of Submarine Springs

Non-pumping Condition

Emery & Garrett Groundwater, Inc.
Salt Water Intrusion: 2

Pumping Condition

Emery & Garrett Groundwater, Inc.
Saltwater Intrusion

Sea Level, Portland, Maine

\[ y = 0.0059x - 11.768 \]

\[ R^2 = 0.7255 \]

Impacts of Sea Level Rise?

Portland Tide Gauge

Maine Geological Survey graphic
**Water Resources**

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

*Used systematic datasets across entire state:*

- 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:**

| Maine Agricultural Council of Maine | Maine Geological Survey |
| Maine Potato Board | Maine DEP |
| Maine Water Utilities Assoc. | Maine Drinking Water Program |
| Maine Rural Water Assoc. | Maine Dept. Agriculture |
| Maine Ground Water Assoc. | Maine IFW |
| Ski Maine Assoc. | LURC |
| H₂O for Maine | Nestle Waters North America |
Water Resources Planning Committee

2008-2009 work in Freeport watersheds.

Further characterization of aquifers.

Stream discharge measurements.

Maine Geological Survey graphic

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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.