Groundwater Resources and Regulations in Tennessee

Environmental Show of the South
May 16, 2019

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Division of Water Resources
Overview

Principle Aquifers in Tennessee

Groundwater Use in Tennessee

Source Water Protection

Underground Injection Control

Ambient Monitoring
Tennessee Geology

GENERALIZED GEOLOGIC MAP OF TENNESSEE

Department of Environment & Conservation
Principle Aquifers in Tennessee

Explanation:
- Alluvial aquifer
- Tertiary sand aquifer
- Cretaceous sand aquifer
- Pennsylvanian sandstone aquifer
- Mississippian carbonate aquifer
- Ordovician carbonate aquifer
- Knox aquifer
- Cambrian-Ordovician carbonate aquifer
- Crystalline rock aquifer

A—A' Trace of cross section

Sea level
-2000'
0
2000'
4000'

50
100 MILES
Memphis Aquifer

Porous Media Flow

Confining Unit - Upper Claiborne
Central Basin and Highland Rim

Source:
Harry L. Moore,
A Geologic Trip across Tennessee by Interstate 40,
Sequatchie Valley

[Diagram of geological features, including layers labeled A through I2, and locations marked as NW, CP, SE, and A'.]
Head of Sequatchie and Grassy Cove
Cumberland Plateau
Hydrology of the Cumberland Plateau

Lost Creek State Natural Area
East Tennessee Aquifer System

EXPLANATION

- Valley and Ridge carbonate rock aquifers
- Valley and Ridge Province boundary

EXPLANATION

- Alluvium
- Shale
- Sandstone
- Limestone
- Direction of ground-water movement

Groundwater Use in Tennessee

Over 450 public water systems (58% of total) in Tennessee use groundwater as a source. These systems are estimated to serve over 1.6 million people in the state. The value of groundwater is further emphasized by the quantity that is withdrawn by private entities (e.g., residential and commercial/industrial wells).
# Groundwater Use Estimates in Tennessee

<table>
<thead>
<tr>
<th>Category</th>
<th>Groundwater (mgd)</th>
<th>Percentage of total groundwater</th>
<th>Percentage of total public supply</th>
<th>Percentage of total individual household supply</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>470</td>
<td>6.10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Public Supply</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>301</td>
<td>64.00%</td>
<td>32.80%</td>
<td></td>
</tr>
<tr>
<td><strong>Individual Household</strong></td>
<td>38.7</td>
<td>8.23%</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td><strong>Irrigation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44.3</td>
<td>9.43%</td>
<td>61.60%</td>
<td></td>
</tr>
<tr>
<td><strong>Livestock/Aquaculture</strong></td>
<td>29.4</td>
<td>6.26%</td>
<td>36.70%</td>
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</tr>
<tr>
<td><strong>Industrial, Self-Supplied</strong></td>
<td>47.6</td>
<td>10.10%</td>
<td>6.13%</td>
<td></td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.89</td>
<td>1.47%</td>
<td>47.20%</td>
<td></td>
</tr>
<tr>
<td><strong>Thermoelectric</strong></td>
<td></td>
<td>0.38%</td>
<td>0.03%</td>
<td></td>
</tr>
</tbody>
</table>

Source Water Protection

- Chapter 0400-45-01-.34
  - Public Water Systems – Drinking Water Source Protection
    - Surface Water Source
      - Source Water Protection Plan
    - Groundwater Source
      - Wellhead Protection Plan

[Diagram of water flow and wellhead protection]
Source Water Protection
“Critical Source Water Protection Zone” means the surface water body and adjacent land area from one half (1/2) mile downstream of the intake to five (5) miles upstream of the public water system intake, including a one thousand (1000) foot corridor parallel to the designated stream banks and any perennial streams which are tributaries to that stream.

“Significant Potential Contaminant Source” means a facility or activity that involves the handling of materials that could readily be introduced into the water supply source via spill, leakage, intentional discharge or other release of contaminants and presents a likely threat to drinking water quality and the public health.

Significant potential contaminant sources would include, but not be limited to, the following: automotive shops, service stations, automotive body shops, junkyards, salvage yards, machine shops, metal fabrication shops, chemical manufacturers, electronic and electrical equipment manufacturers, boat manufacturers, oil distributors, petroleum bulk stations and terminals, bus and truck terminals, storage or mixing areas for commercial fertilizers, pesticides and herbicides; landfills, construction debris landfills, dumps, sludge spreading or landfills; facilities that generate, treat or dispose of hazardous waste; concentrated animal feedlots, golf courses, and mining areas.
• Establish wellhead protection areas based upon requirements for different categories of systems

Category 1:  
(a) Community PWS with less than 100 connections and less than 20,000 gallons per day (gpd) average daily production
(b) All Noncommunity PWS

Category 2:  
(a) Community PWS with 100 to 999 connections and less than 315,000 gpd average daily production.
(b) Community PWS with less than 100 connections and 20,000 to 314,999 gpd average daily production.

Category 3:  
(a) Community PWS with 1000 to 2999 connections and less than 1,000,000 gpd average daily production.
(b) Community PWS with less than 1000 connections and 315,000 to 999,999 gpd average daily production.

Category 4:  
(a) Community PWS with 3,000 or more connections.
(b) Community PWS with less than 3,000 connections and 1,000,000 gpd or greater average daily production.
Wellhead Protection Areas

The Wellhead Protection Program was established to protect public water systems using ground water from contamination. This program has an emphasis on the prevention of ground water contamination due to the difficulty in cleaning up the contamination once it occurs. These drinking water sources are vulnerable to a variety of contaminant sources such as industrial spills, shallow underground injection discharges {referred to by EPA as class V (5) wells} through wells, floor drains and septic tanks, leaks from underground storage tanks, etc.
Wellhead Protection Areas

• Wellhead Analytic Element Model (WhAEM)
  • Area Delineation
    • Radius
    • Uniform Flow Models
    • Hydrogeology
Contaminant Source Inventory
Contingency Planning

- Making sure measures are in place for protection of the public water supply
- Actions to be taken in an emergency
- Establishing and updating emergency contacts

Underground Injection Control

- Objective: Protect Underground Sources of Drinking Water
  - Already being used or of sufficient quantity and quality to be used in the future

- “Injection well” means structure or device which is used for the emplacement of fluids into a subsurface stratum including, but not limited to:

  (a) a well used for the emplacement of fluids;
  (b) a subsurface fluid distribution system;
  (c) an improved sinkhole;
  (d) infiltration cell and any other structures or devices designed, constructed or used to emplace fluids into the subsurface, except as provided in paragraph (3) of Rule 0400-45-06-.03; or
  (e) modified recharge point.
Underground Injection Control

• Injection Well Classes

  – Class I (deep well industrial)
  – Class II (oil field brine or enhanced recovery)
  – Class III (mineral extraction)
  – Class IV (hazardous waste)
  – Class V (shallow, non-hazardous)
  – Class VI (geo-sequestration of carbon dioxide)
Injection Well Class Types

Source: U.S. Environmental Protection Agency, Underground Injection Control, Typical Injection Wells. For additional details, see http://water.epa.gov/type/groundwater/uic/wells_drawings.cfm.
Class II Injection Wells

- Produced water return
- Enhanced recovery
Class V Injection Wells

(a) Air conditioning return flow wells used to return to the supply aquifer the water used for heating or cooling in a heat pump;
(b) Drainage wells used to drain surface fluid, primarily storm runoff, into a subsurface formation;
(c) Cooling water return flow wells used to inject water previously used for cooling;
(d) Recharge wells used to replenish the water in an aquifer;
(e) Sand backfill and other backfill wells used to inject a mixture of water and sand, mill tailings or other solids into mined-out portions of subsurface mines whether what is injected is a radioactive waste or not;
(f) Subsidence control wells (not used for the purpose of oil or natural gas production) used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with the overdraft of fresh water;
(g) Injection systems associated with remedial activity. This subparagraph does not allow the injection of hazardous waste into a Class V well.

Systems used to inject contaminated ground water that has been treated and is being reinjected into the same formation from which it was drawn are not prohibited by this rule if such injection is approved by state or federal agencies operating under the Tennessee Hazardous Waste Management Act, Part 1 or Part 2, T.C.A. §§ 68-212-101 et seq. or 68-212-201 et seq., Tennessee Petroleum Underground Storage Tank Act, T.C.A. §§ 68-215-101 et seq., Water Quality Control Act of 1977, T.C.A. §§ 69-3-101 et seq., Resource Conservation and Recovery Act (RCRA); 42 U.S.C. §§6901-6992k, or Comprehensive Environmental Response and Liability Act of 1980; 42 U.S.C. §§9601-9675;
(h) Injection wells associated with the recovery of geothermal energy for heating, aquaculture and production of electric power;
(i) Wells used for solution mining of conventional mines such as stopes leaching;
(j) Injection wells used in innovative or experimental technologies;
(k) Injection wells used for in site recovery of lignite, coal, tar sands, and oil shale; and
(l) Wells used to inject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts.
(m) Large capacity subsurface fluid distribution systems with the capacity to serve more than 20 persons per day.
(n) Infiltration cells.
(o) Subsurface fluid distribution systems disposing of waste other than sanitary waste.
(p) Dry wells used for the injection of wastes into a subsurface formation;
(q) Modification of a recharge point or the area where the recharge originates; and
(r) Improved sinkholes.
Improved Sinkhole

- “A naturally occurring karst depression modified by man in such a manner that the chemical, physical, biological, radiological, or bacteriological properties of the water or fluids moving into the subsurface through it have been or will be altered."
Ambient Groundwater Monitoring

• Funding Mechanism
  – Section 106 of the Clean Water Act

• Establishing a baseline of groundwater quality in the state
  – Initial focus:
    • Elementary Schools
    • Head Start Facilities
    • Summer Camps
Groundwater Monitoring - Future Plans

- Incorporation of historical data
- Evaluation of spatial distribution among principal aquifers
- Identify areas that may need additional sampling points
- Continue to engage cooperators and stakeholders
- Refine analytical parameters
Questions?

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