

A photograph of a desert canyon with layered rock walls and a pool of water at the bottom. The rock walls are light-colored with horizontal strata. The water is a greenish-brown color. The foreground shows more rocks and some sparse vegetation.

# **Aquifer-Based Ground-Water Management**

**Mike Wireman**  
**US EPA Region 8**



# WHAT IS THE ISSUE?

**“The country cannot sustain even the current levels of ground-water use, never mind the projected increases in ground-water consumption in the next two decades. Our enormous expansion of ground-water pumping since the 1940’s....has caused a number of serious environmental problems.” (Such as rivers drying up, wells going dry, subsidence, loss of wetlands, springs, lakes)**

**From “Water Follies” by Robert Glennon, 2002,  
Island Press—page 32**

# GROUND-WATER USE

- **Accounts for 98% of fresh water in the world**
- **GW USE (2000) (USGS)**
  - 25% (1.5 billion) of world population use GW
  - USA- 83.3 bgd (14 % increase from 1985)
  - 140 million people (50%) in USA drink GW
  - PWS use increased 400 % between 1950 & 2000
  - GW use for irrigation increased from 24 % of total irrigation use in 1950 to 42 % in 2000

# **Current Approach to GW Management**

- **State governments**
  - **Withdrawal & use of ground-water administered by different agency than regulation / protection of ground-water quality**
  - **Within DEQs and Public Health Dept. –gw management related to protection of quality is commonly split among numerous programs**

# Current Approach to GW Management

- **State governments**
  - i. SDWA programs focus on drinking water**
  - ii. CERCLA / RCRA programs focus on cleanups**
  - iii. Non-point source programs focus on ag chemicals in gw**
  - iv. Storm water management (CWA Sec??)**
  - v. Wetlands (CWA Sec 404)**

# Current Approach to GW Management

## ➤ **Federal Gov'ts role in gw management**

- Derived from 16 different federal statutes
- Federal role primarily related to cleanup authorities under CERCLA / RCRA / drinking water protection
  - Not very active in ground-water management
- No national framework for monitoring or standards
- Poor transboundary cooperation – many aquifers span State boundaries

# **PROBLEMS RELATED TO CURRENT GW** **MANAGEMENT**

- **Not aquifer based**
- **Fragmentation of management at Federal/State level**
- **Poor coordination between water supply and water quality management programs**
- **Inadequate recognition of GW/SW connections**
- **Rules/regulations not aimed at preventing aquifer mining**
- **Decline in resources and emphasis on GW protection, especially monitoring programs**

# WHAT CAN BE DONE?

- **Need to refocus and strengthen ground-water protection / management efforts at State / Tribal level**
- **Better coordination between Federal; State /Tribal and local governments** (for example – GW quality may be impacted by land use in recharge area –which may be indifferent county or state)
- **Federal leadership**
- **Implement aquifer-based approach to ground-water management**



# Aquifer-Based GW Management

- **Aquifers and aquifer systems are natural units of management for ground-water just as a stream, lake or watershed are natural units of management for surface water.**

# Aquifer-Based GW Management

- Aquifers have mappable boundaries that are delineated based on:
  - Geologic features (formation boundaries)
  - Hydrologic features (flow system divides)
  - Water quality ( quality related to aquifer mineralogy)
- Aquifers have hydrologic / hydraulic properties that are routinely assessed using standardized methods

# Aquifer-Zones

- **Sub-divisions of aquifers with differing hydrologic conditions**
  - **Recharge /discharge areas**
  - **Confined vs unconfined**
  - **Gaining / losing reaches of streams**

# Aquifer-Based GW Management

- **USGS & State have mapped and assessed hundreds of aquifers and aquifer systems in the US**

**USGS Circular 1279 – Estimated Withdrawals from Principal Aquifers in the United States**





# Aquifer-Based GW Management

- Data / information needs
  - A map of the aquifer or aquifer system which depicts the aerial extent and describes the lithology
  - **Delineation of recharge and discharge areas**
  - Sound understanding of the hydrology of the aquifer (confined vs. unconfined, hydraulic properties, interaction w/ surface waters, ecological importance)
  - **Real time tracking of water levels and water quality**
  - Information on location and annual yield of ground-water supply wells
  - **Data on chemistry of the ground water in different parts of the aquifer, including areas of known contamination**

# Aquifer-Based GW Management

- **Management goals**
  - Allowable annual withdrawals should be based on *sustaining* the use of the aquifer for future beneficial uses including ecological needs
  - Effective integration of ground-water quality and ground-water quantity / supply management
  - Full cost pricing should be applied to ground-water development and use- use asset management concepts – *an aquifer is an asset!*

# Aquifer-Based GW Management

- **Management goals**
  - **Differential / adaptive management**
    - Example - recharge areas need to be managed differently than recharge areas
    - Will need to adapt management of climate change conditions
    - Acknowledge uncertainty in model results
  - **Need to plan for large increase in GW use required to produce energy from new sources (ethanol, nuclear)**

# Aquifer-Based GW Management

- **Management goals**
  - **Need to improve methodologies for estimating recharge and discharge from aquifers**
  - **Need to improve technologies for artificially recharging aquifers**
  - **Need to better understand / manage ground water dependent ecosystems**

# How to implement?

- **Need to refocus and strengthen State /Tribal GW protection & management programs**
- **Need a paradigm change in Federal agencies (EPA, USGS)  
– GW protection /management is NOT just a State /local responsibility**
- **Need to recognize ground water in Clean Water Act**
- **Need to focus on the resource!**



**Thank you!**

**[wireman.mike@epa.gov](mailto:wireman.mike@epa.gov)**

**The Alps above Innsbruck**