

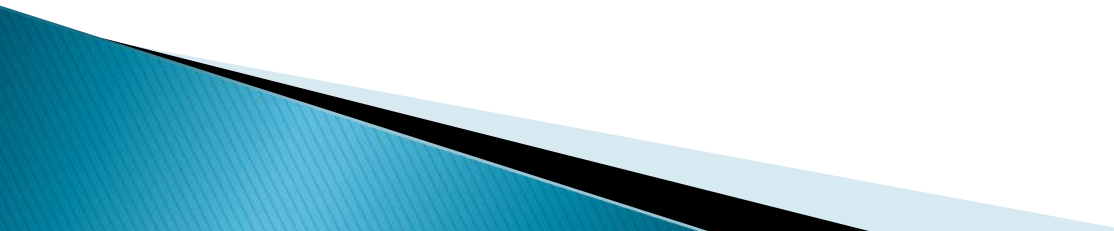
# Water Quality and Security

Peter Mock, Ph.D., R.G., P.H.

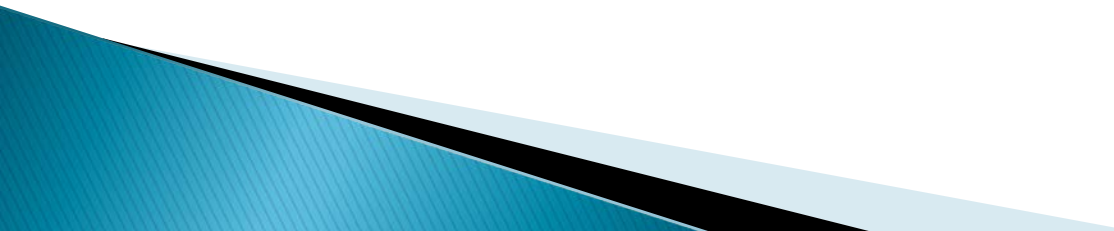
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# Opening Statement

- ▶ Security = Robustness, which can be built from an understanding of the characteristics, fate and transport of chemicals in a *specific natural system*
  - ▶ Vigilance = Monitoring, which requires understanding *beyond standards* – don't abdicate knowledge of your system to Official Standards
  - ▶ So today let's make a place in your thinking for the required understanding
  - ▶ I'll give my assessments of security along the way
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# Overview

- ▶ Major Ions
  - ▶ Minor Ions
  - ▶ Nuclear Chemistry
  - ▶ Organic Compounds
  - ▶ Suspended Particles
  - ▶ Summary
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# Major Ions and the Total

- ▶ A few “major” ions dominate the total dissolved load of natural waters
- ▶ Many don't sample for them (except  $\text{NO}_3$ ) because they don't generally represent a health risk
- ▶ They are:
  - Ca . Mg . Na . K
  - Cl .  $\text{HCO}_3/\text{CO}_3$  .  $\text{SO}_4$  .  $\text{NO}_3$
- ▶ Digress: the power of hydrogen (pH), acid rain, mine drainage
- ▶ *Security – context and total “salt” load*

# Minor Ions

- ▶ Mostly classic trace metals – Al, As, Hg, Sb, Cr, Pb, Cu ...
- ▶ Others – B, F, Si, PO<sub>4</sub>...
- ▶ Health-based standards
- ▶ Natural (dissolved and suspended) vs. pollution
- ▶ The natural levels of some pose an unacceptable health risk
- ▶ Tracers, Redox Pairs – context
- ▶ *Security – context and health*

# Nuclear Chemistry

- ▶ The nucleus of an atom for a given element can have differing numbers of neutrons and still be the same element – some stable, some radioactive
- ▶ We look at the various isotopes for two reasons:
  - Tracers (labels) – context
  - Radioactivity – health-based standards
- ▶ *Security – context and health*

# Organic Chemistry

- ▶ Vast array of compounds always built from C and H, sometimes O, and from there S, N, and the other attachments.
- ▶ Natural, human-synthesized, human-relocated
- ▶ Major categories to track:
  - Solvents
  - Fuels
  - Pesticides/Herbicides
  - Medications
  - Other, “Emerging” contaminants
- ▶ Security – *Health, depending on MNA, and what we haven’t analyzed for yet*

# Suspended Particles

- ▶ Not dissolved – “bumping along for the ride”
- ▶ An expanding list:
  - Sediment
  - Microorganisms
  - Nanoparticles
- ▶ Security – *total load, health, and what we haven't analyzed for yet*



# Summary

- ▶ **We are generally secure**, but understanding of a specific water system typically vanishes in **only meeting health-based standards**
  - ▶ Don't depend on the determining factors for input, fate and transport being **constant/static**
  - ▶ Build a foundational **understanding** of your water system – hydraulics and water chemistry relevant to natural systems
  - ▶ Be **vigilant** with the best tools available: Think about the context for chemistry in your system, investigate as necessary, **monitor** continuously and interpret the results on a regular basis.
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