

## #9. Water Quality

**Summary:** In this module you will learn about major sources of water pollution and measures taken to identify and quantify water quality with respect to public health and the environment.

**Goals:** By the end of this module you will be able to describe major sources of impairment of water quality globally and in your region, current efforts by the U.S. Congress to protect water resources, and design your own study to evaluate the quality of your drinking water.

### Required readings:

Water Quality -- [https://www.usgs.gov/special-topic/water-science-school/science/water-quality-information-topic?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/water-quality-information-topic?qt-science_center_objects=0#qt-science_center_objects) The menu bar on the left of the screen lists WQ topics. Read each of the short write-ups for all of the topics under the following Headings: Water Quality Basics, Groundwater Quality, Wastewater and Sewage Water. The topics under the Water Quality Properties heading will be introduced in the next required reading.

Water Pollution -- [https://cnx.org/contents/F0Hv\\_Zza@45.1:L4NPRKh@8/Water-Pollution](https://cnx.org/contents/F0Hv_Zza@45.1:L4NPRKh@8/Water-Pollution)

Water Quality Policy -- U.S. House Water Resources and the Environment Sub-committee of the House Transportation Committee (web page has results of their current work and hearings) <https://transportation.house.gov/subcommittees/water-resources-and-environment-116th-congress> Note: the URL will change in 2021 when the new session of Congress gets underway

Water Sampling – <https://www.usgs.gov/products/data-and-tools/data-management/management-quality>

SOP for drinking water sample collection:

<https://www.epa.gov/sites/production/files/documents/samplingprocedures.pdf>

SOP for wastewater sample collection:

[https://www.epa.gov/sites/production/files/2017-07/documents/wastewater\\_sampling306\\_af.r4.pdf](https://www.epa.gov/sites/production/files/2017-07/documents/wastewater_sampling306_af.r4.pdf)

Stream sample water collection: [https://www.usgs.gov/special-topic/water-science-school/science/water-quality-sampling-techniques?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/water-quality-sampling-techniques?qt-science_center_objects=0#qt-science_center_objects)

**Supplemental Content** (review in class or assign directly):

<https://pubs.usgs.gov/fs/2012/3095/> (WQ changes following wildfire – implications for negative impacts on drinking water supplies)

Connection between Ag & WQ: <https://pubs.er.usgs.gov/publication/cir1433>

<https://www.usgs.gov/special-topic/water-science-school/science/water-quality>

**Key Vocabulary:** ppm, ppb, total dissolved solids, water pollution, residence time, point source, nonpoint source, POTW, biochemical oxygen demand, eutrophication, biomagnification, QAQC, calibration

**Assessment Tools:**

**Database Use:** Every 2 years states are required to report to the USEPA on the status of the surface waters within their boundaries and identify those which do not meet water quality standards. States must then develop plans to restore those “Impaired Waters”. Use the USEPA’s Water Quality Assessment tool to determine how your state is doing with identifying water quality problems ([https://ofmpub.epa.gov/waters10/attains\\_index.home](https://ofmpub.epa.gov/waters10/attains_index.home)). In what year(s) were these data collected? What are the most common causes of impairment of rivers & streams in your state and how do those compare to the causes of impairment in lakes/reservoirs/ponds? Drill down in the state data to determine which waterbodies in close proximity to your campus do not meet water quality standards. What are the causes of impairment of those waterbodies?

**SAP Preparation:** Let’s pretend that your drinking water has a suspicious odor that reminds you of gasoline. Budgets are limited, so you need to be careful about costs, but you need to know if your water is safe to drink. Prepare a Sampling and Analysis Plan (SAP), that includes a section on QAQC, and is designed to identify whether there are hydrocarbon compounds in your drinking water. Your plan should include all aspects of sample collection, handling and shipping instructions designed to get the samples to *OnSite Environmental’s* laboratory (<http://www.onsite-env.com/pdf/Schedule-of-Fees.pdf> ) within appropriate holding times. Include a budget in your SAP.

**SAP Evaluation:** The upper reaches of the San Juan River originate in the Colorado Rockies and flow through the 4-Corners area before terminating in Lake Powell (UT). In 2015, there was a significant spill of contaminated mine waste from the Gold King Mine in Colorado which eventually entered the San Juan River system upstream of lands owned by the Navajo Nation in NM, AZ and UT. Substantial post-spill monitoring was undertaken by USEPA. Review the EPA’s SAP and prepare a 1-3 page of its strengths and weaknesses. [https://www.epa.gov/sites/production/files/2016-03/documents/post-gkm-final-conceptual-monitoring-plan\\_2016\\_03\\_24\\_16.pdf](https://www.epa.gov/sites/production/files/2016-03/documents/post-gkm-final-conceptual-monitoring-plan_2016_03_24_16.pdf)

Discussion Questions (can be used in classroom or for on-line discussion board):

- In your own words, describe the steps in which wastewater is treated at a sewage treatment plant and also at a residential septic system.
- The major cause of water pollution problems in the U.S. is “Agriculture”. Why and how?
- What are some of the water quality issues in your community? What is being done to address them?
- What are some of the procedures that can be used in a field sampling program to maximize data quality?

The following are the discussion questions from the Water Pollution assigned reading:

## Review Questions

Question:

What are the major kinds of water pollutants and how do they degrade water quality?

Question:

How would you rank the water pollution problems described in this chapter? Why?

Question:

Why is untreated sewage such an important water pollutant to remediate?

Question:

What should society learn from the case history of Love Canal?

Question:

Why are people facing a crisis involving water pollution and how can we solve it?

### Module 9 Lab Activity

Data Handling QAQC: Prepared lab lesson (recommended by USGS) with ppt, handout, data evaluation exercise etc. Note: instructor notes and student instructions are in the same pdf file.

[https://dataoneorg.github.io/Education//lessons/05\\_qaqc/index](https://dataoneorg.github.io/Education//lessons/05_qaqc/index)

### Alternate Lab Activity

Compare & Contrast QAQC Requirements: Prepare a detailed QAP for a sampling program designed to evaluate the pH of water samples from: the wadable stream closest to your campus, rainwater collected in a weather gauge on your campus, and tap water in your science lab on campus. Sample analysis should be done both on-site, and at an off-site commercial analytical laboratory. The QAP should address: data quality objectives, instrument calibration, sampling considerations, sample holding and preservation, corrective actions.

The QAP should be consistent with the information presented in the assigned readings for this Module. Additional guidance is available at:

[https://www.usgs.gov/products/data-and-tools/data-management/quality-assurance-plans-recommended-practices-and-examples?qt-science\\_support\\_page\\_related\\_con=0#qt-science\\_support\\_page\\_related\\_con](https://www.usgs.gov/products/data-and-tools/data-management/quality-assurance-plans-recommended-practices-and-examples?qt-science_support_page_related_con=0#qt-science_support_page_related_con)