KINGSTON ASH RECOVERY PROJECT
ROANE COUNTY EDUCATION INITIATIVE

"MONITORING WATER QUALITY AT THE KINGSTON SITE"

Abstract: Since the coal ash spill occurred at Kingston, TVA, the Tennessee Department of Environment and Conservation (TDEC), and the United States Environmental Protection Agency (EPA) have been monitoring the quality of surface water and ground water in the vicinity of the spill. In particular, thousands of water quality tests have been performed on surface water samples from the Emory, Clinch, and Tennessee Rivers. The municipal drinking water intakes for the cities of Kingston and Rockwood are down river from the spill and there was also concern about the water quality impacts on fish and other aquatic organisms.

In addition to analyzing surface water for coal ash chemicals such as arsenic and selenium, other tests were performed to determine overall water quality, including hardness, pH, turbidity, total suspended solids, and dissolved oxygen. A variety of instruments and technology are used, some of which will be displayed at this station. Students will observe and participate in a demonstration of water quality measurements, including hardness, turbidity, and remote sensing of water quality parameters using Internet-based technology.

Water Hardness

Water hardness is caused by the presence of divalent (+2 charge) and polyvalent (>+2 charge) cations dissolved in water. The most prevalent of these are the ions of calcium (chemical symbol Ca) and magnesium (chemical symbol Mg). These are present when the water has been exposed to sedimentary rock or sedimentary geologic formations such as limestone. Water hardness is absent when the water is directly from precipitation, snowmelt, or regions such as mountains where there are no sedimentary rock formations.

A simple indicator of water hardness can be observed when you add soap to water. In "hard" water, the soap will not lather well; in "softer" water it will. That is because the calcium and magnesium ions in hard water react with the soap fatty acids, precipitate, and form a "soap scum."

Water hardness is important to fish health, as fish can absorb calcium directly from the water for bone formation, blood clotting and other functions. It is important to know what other factors, such as water hardness, impact fish health in addition to the potential presence of chemical contaminants from the ash.

Water hardness can be determined in a laboratory by measuring the amounts of calcium and magnesium. But there is also a simple titration procedure that can used to determine approximate hardness. In this titration, a buffer is added to change the water to the appropriate pH, and then ethylenediamenetetraacetic acid (EDTA) is slowly added to the sample. EDTA reacts with calcium and magnesium in the water, removing them from solution. When all of the calcium and magnesium have been used up, the indicator changes color and you can calculate the amount of hardness that was present in the sample water. We will use a simple test kit to determine the hardness of samples of Emory and Clinch River water.

Hach Total Hardness Test Kit

Hydrolab Measurements and Turbidity

There are other indicators that are used to assess general water quality. Advances in electronics and computer technology have been applied to the development of instruments that can perform multiple functions, log data electronically, and even be used remotely. TVA has used the Hydrolab instrument to collect water quality data at the same time chemical samples are collected and also to obtain data from multiple river locations around the clock. The measurements obtained by these instruments include water temperature, dissolved oxygen, conductivity, pH, depth, flow velocity/direction, and turbidity.

Turbidity is the "cloudiness" or "haziness" in water caused by the presence of suspended solid particles generally invisible to the naked eye. When the ash was being dredged from the Emory River, the action of the dredging greatly increased the turbidity of the water in the immediate vicinity. Turbidity "curtains" were installed around those areas to contain the suspended solids and limit ash particle movement further down river. TVA used the turbidity measurements from Hydrolabs to determine the effectiveness of the turbidity curtains and to help determine the overall impact of the dredging operation on general water quality. We will use a Hydrolab and a bucket of water with some ash in it to illustrate the turbidity measurement, comparing clear water to water with suspended ash.

A Hydrolab Linked to a Laptop Computer for Water Quality Measurements

Remote Measurements of Water Quality

Through the application of Web-based technology, water quality instruments such as the Hydrolab can be used to generate, record, and report data from remote locations. TVA currently has Hydrolab instruments located on floats at seven locations around the Kingston spill site. Locations are displayed on the poster and include a station upstream on the Emory River and several stations downstream from the spill site.

While the majority of the ash has been removed from the Emory River, TVA will continue to monitor water quality while ash is being removed from the Swan Pond Embayment. This will also help determine the extent to which heavy local rain events might mobilize ash from the Embayment to the Emory River via runoff.

The instruments from each float are linked to the Internet via cell phone and log instantaneous readings every 15 minutes around the clock. Running average values are also recorded. If pre-set levels are reached, an e-mail message is generated and sent automatically, alerting TVA engineers to investigate a possible cause that can be controlled in some way, for example, stopping operations temporarily. We will establish a link between the instruments and a computer at the station and observe the different data that are being recorded.

A Float with a Hydrolab to Monitor Real-time Water Quality