DEVELOPMENT OF A WATER QUALITY MONITORING AND EARLY WARNING DETECTION SYSTEM ON THE ALLEGHENY AND MONONGAHELA RIVERS IN PENNSYLVANIA

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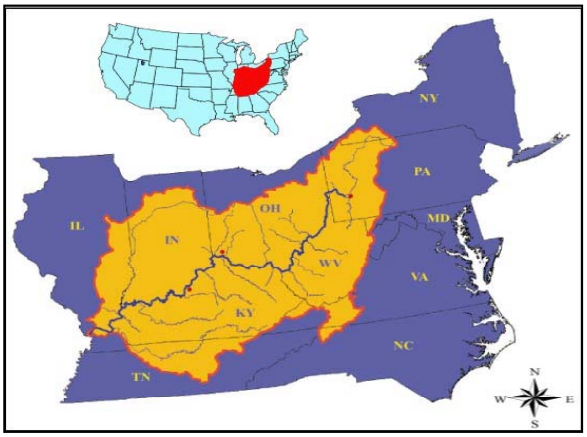
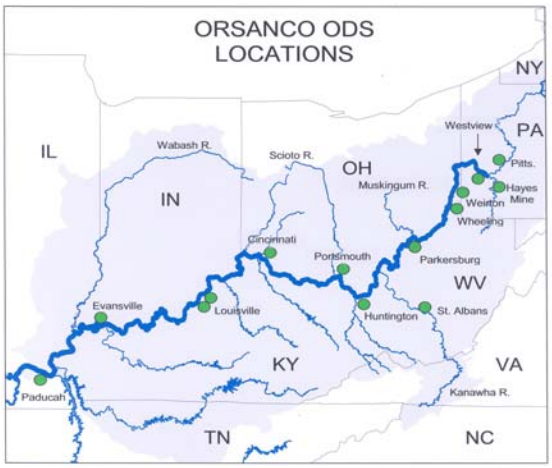
INTRODUCTION AND BACKGROUND

The Ohio River Valley Water Sanitation Commission (ORSANCO) is an interstate water pollution control agency created in 1948 to monitor and abate water pollution in the Ohio River Basin. The Ohio River Valley Water Sanitation Compact was signed in 1948 and establishes the Commission's responsibilities and authorities in pollution control. Signatory to the Compact are the states of Indiana, West Virginia, Ohio, New York, Illinois, Kentucky, Pennsylvania, and Virginia. Funding for the Commission is provided by its member states, the federal government, public and private sector grants and donations. The 981 mile long Ohio River is a resource for industry, commerce, recreation, and provides drinking water for over five million people.



The Commission undertakes numerous programs each year to carry out the provisions of the Compact. Paramount to its mission in water pollution control is the development and maintenance of water quality monitoring programs. Water quality parameters monitored by Commission programs include metals, nutrients, bacteria, dissolved oxygen, algae, fish, macroinvertebrates and organics. Of the various programs responsible for monitoring these parameters, the system developed to monitor levels of organic compounds is of particular interest to this project.

Organics monitoring on the Ohio River is accomplished through a unique and highly successful cooperative program involving the Commission, drinking water utilities and industrial partners. The Organics Detections System, or ODS, was established after a release of carbon tetrachloride on the Kanawha River in 1976 compromised and contaminated drinking water utilities on the Ohio River. The Commission's Water Users Advisory Committee, a committee comprised of Ohio River and tributary drinking water utility directors, recommended the development of a coordinated system of gas chromatographs strategically located at water utility locations along the river to monitor the presence (or absence) of organic compounds in their source water. The equipment would be owned by the Commission and operated by utility personnel. Commission staff would oversee the maintenance and performance of the equipment while utility personnel would provide daily operation and report detections of a pre-established



group of twenty-two purgeable organic compounds. The program was implemented as described in 1978. There are currently 15 participants, comprised of water utility and industrial sites that collect and analyze samples of Ohio River and/or tributary water on a daily basis. A key component to the success of this program lies in the communication, relationships and trust that has evolved over the years between the Commission and the water utilities.

Pennsylvania, as a signatory to the Ohio River Valley Water Sanitation Compact, participates in the development and implementation of Commission programs. Representatives of Pennsylvania's Department of Environmental Protection (PADEP) participate at the highest organizational and administrative levels of the Commission as well as the technical program and subcommittee levels. PADEP personnel have worked closely with ORSANCO staff and the ODS sites in Pennsylvania to detect and track releases of organic compounds that have occurred on the Allegheny, Monongahela and Ohio rivers within its borders. It is this close association with the Commission's Organics Detection System that encouraged PADEP personnel to approach Commission staff for assistance in the development of a similar monitoring system for the Allegheny and Monongahela rivers.

ALLEGHENY AND MONONGAHELA RIVER EARLY WARNING DETECTION SYSTEM

The ORSANCO ODS is the only coordinated source water protection program in use by water utilities in the United States. In 1996, an amendment to the Safe Drinking Water Act established a new requirement for states to assess source water used for potable water

systems. Data developed by the ODS protects public water systems and provides information that can identify sources of contaminants, i.e., contributions from contaminated groundwater, problem permitted discharges, leaking pipelines, unreported spills and releases, etc. This information can provide the basis for the development of protective strategies by source water and drinking water regulators that would lead to enhanced protection for utilities and consumers.

The Pennsylvania Department of Environmental Protection requested ORSANCO's assistance in the development of an early warning detection and water quality-monitoring program on the Allegheny and Monongahela rivers in Pennsylvania. ORSANCO currently supports ODS locations on the Allegheny River, 8.5 miles upstream of the confluence at Pittsburgh, and on the Monongahela River, 4.5 upstream. As the confluence of the Allegheny and Monongahela rivers create the Ohio River, these two locations provide information on organic contaminants in the two primary source water systems for the Ohio River.

The development of a new early warning detection and water quality monitoring system on these two rivers presented some unique challenges. Over 70% of the utilities on the Allegheny and Monongahela serve populations of 12,000 customers or less; with some servicing as few as 1,000 customers. Operators at smaller plants are responsible for multiple tasks on a daily basis and do not have the time or resources available to operate complex analytical equipment. Therefore, one significant objective of the project was to identify water quality monitoring equipment, which would be easy to operate, easy to maintain and would produce data that was readily interpretable by operators and staff. Respecting these key

points in the development of this system would facilitate the reliable operation of the equipment, the production of quality data and the quick recognition of changes in water quality that would be of concern to the utilities.

Identification of Utilities and Participants

In February of 2002, Commission staff met with PADEP staff members to discuss the development of an early warning detection system on the Allegheny and Monongahela rivers. PADEP's Pittsburgh office provided ORSANCO staff with a list of surface water utilities on the Allegheny, Monongahela and Youghiogheny rivers in western Pennsylvania. Telephone calls were placed to each utility and the project was briefly described and discussed. In March of 2002 Commission staff convened the first of several meetings with water utility representatives from both river systems to discuss the project and to further gauge their interest in supporting and participating in such an endeavor. The favorable response from the utilities prompted staff to develop a proposal to establish a cooperative early warning detection and water quality monitoring system on the Allegheny and Monongahela Rivers in Pennsylvania. The proposal was submitted to PADEP and approved for funding.

Scope of Work

The proposal developed by ORSANCO staff for the Allegheny and Monongahela Early Warning Detection system contained eight activities:

1. Suitability and Susceptibility Analysis

2. Instrument Identification
3. Instrument Purchase
4. Instrument Installation
5. Operator Training
6. Advisory Committee Development
7. Spill Notification Committee Development
8. On-going Support and Maintenance
9. Website Development

Suitability and Susceptibility Analysis

A Suitability and Susceptibility Analysis was undertaken to help identify potential contaminant sources and provide a list of contaminants that would be of concern to the drinking water utilities. It would also identify which utilities are best suited to support monitoring equipment based on pumping schedules, intake locations, personnel and facility resources. This information would characterize the water quality issues of the basin and provide a basis for instrument identification and placement.

Instrument Identification

The ORSANCO ODS program monitors organic compounds in the Ohio River using research grade gas chromatographs and purge and trap concentrators. Due to the complex nature of this equipment, it was not practical to consider its use for this project. As stated earlier, equipment identified for this project must be easy to operate, maintain and interpret. Additionally, the results of the Suitability and Susceptibility Analysis identified groups of

contaminants other than organic compounds that would be of concern to the utilities in the project area.

The inclusion of the web-based, data-sharing component was also a consideration in instrument identification. Adding this capability to the system suggested the use of on-line monitoring equipment so water quality conditions could be monitored, the data automatically processed and upload to the website and associated database with minimal operator assistance.

An investigation into the existence and availability of on-line monitoring equipment was undertaken. It became apparent that, even as advanced as the environmental industry has become, there are a limited number of automated, real time/near real time monitoring devices that can measure changes in source water quality with minimal assistance and maintenance. Four on-line instruments were identified as suitable for use in early warning monitoring and detection for this project.

1. Multi-parameter Probes

   Multi-parameter probes configured for this project measure temperature, pH, specific conductance, dissolved oxygen, turbidity and chlorophyll reported at thirty-minute intervals. Of these six parameters, only two are currently monitored with any regularity; temperature and turbidity. Developing baseline levels for the other parameters will help identify anomalous changes that could be spill or pollution incident related. This is of particular significance to the Monongahela River system as drainage from orphaned

underground coal mines starts discharging to the river and tributaries as early as 2004. The geographic extent of the coal seam that was mined spans three states, and has the potential to release hundreds of millions of gallons of water.

2. Argon Gas Chromatograph

The Commission operates an organics monitoring program on the Ohio River and lower reaches of the major tributaries called the Organics Detection System. This system uses research grade gas chromatographs with flame ionization detectors and purge and trap concentrators to monitor and detect organic compounds in source water. The complexity of this equipment was not deemed feasible for use in this project. As such, a different type of gas chromatograph was identified which used a highly simplified purge cell and a micro argon ionization detector. Its sensitivity is in the low ppb range and can be configured to run automatically, needing only a source of raw water (hose) and a suitable container (bucket). It is useful for monitoring a range of organics including water-soluble components of refined petroleum products.

3. Fluorometer

ORSANCO has used fluorometers to track numerous oil spills on the Ohio River. The fluorometer used in this project is designed for on-line application, which allows for the continuous flow of water passed the detector without contacting any components of the detector. This configuration minimizes the need for routine cleaning and prevents the optics from becoming contaminated when a petroleum product is detected. The

fluorometer can be converted to monitor chlorophyll, which can be of significant interest to drinking water utilities during the summer months.

4. Total Organic Carbon Analyzer

Total organic carbon (TOC) analyzers monitor and can detect changes in organic carbon levels in the source water. This is important to drinking water utilities for two reasons; fluctuating organic carbon levels in the source water can identify contaminants from certain types of spill events, including petroleum spills, and, organic carbon in the source water creates disinfection by-products known as trihalomethanes, or THMs, during chlorination. THMs are regulated under the Safe Drinking Water Act. Organic carbon levels can be reduced prior to chlorination if the incoming water is monitored.

Creating a network utilizing this equipment would establish a system that would monitor source water quality conditions and detect a range of source water contaminants. Integrating the data generated by this equipment on an internet display in near-real time would provide the opportunity for remote advanced warning of changes in water quality to downstream utilities.

An instrument demonstration meeting was held so the utilities could review and evaluate these instruments and consider their station's ability to provide support; physically, technically and financially. Following the instrument meeting, discussions were held with individual utilities to determine what equipment they felt they could support. The following utilities expressed interest in and are now supporting the instruments as identified.

Allegheny River Instrument Installations

Emlenton Water Company	Multiparameter Probe, Argon Gas Chromatograph
Allegheny Power Armstrong Station	Argon Gas Chromatograph
Kittanning Suburban Water	Multiparameter Probe
Harrison Township Water	Multiparameter Probe, Total Organic Carbon Analyzer
New Kensington Municipal	Argon Gas Chromatograph
Pittsburgh Water Authority	Multiparameter Probe, Total Organic Carbon Analyzer

Monongahela and Youghiogheny River Instrument Installations

Allegheny Power Hatfield Station	Multiparameter Probe and Argon Gas Chromatograph
Tri County Joint Authority	Fluorometer
PAWC Brownsville	Total Organic Carbon Analyzer
Charleroi Authority	Multiparameter Probe
North Fayette Authority	Multiparameter Probe, Argon Gas Chromatograph

Selection and distribution of the instruments was based on the input from the utilities at the onset of the project, the suitability and susceptibility analysis, and each utilities interest and ability to provide the necessary instrument support. As the value of the system is demonstrated over the course of the next year, and additional funding becomes available, it is hoped that more utilities will participate as water quality monitoring locations.

Operator training was provided to plant personnel with the installation of each piece of monitoring equipment to familiarize them with proper operating and calibration procedures, and data interpretation. Operator training is an ongoing process and will be provided to the various facilities and operators as needed. Standard Operating Procedures documents were developed for each location and equipment type. ORSANCO staff are available at any time to plant personnel to answer any questions that may arise regarding the operation of the equipment or interpretation of water quality data.

Spill Notification Committee Development

The Water Users Advisory Committee of the Commission and the Organics Detections System Operators Committee play key roles in the operation of the Organics Detection System. Pooling the wisdom, knowledge and experience of each of the operators and water utility managers has been the key to identifying and solving many water quality problems and treatment issues on the Ohio River. As such, development of similar groups was recommended for this project.

Several years ago a group of Monongahela River water utilities created the Monongahela River Communications Network, MRCN, an organization dedicated to the communication of spills and spill information on the Monongahela River. As such, this group has the ability to operate as both a spill communication committee and advisory committee for the Monongahela River. However, no such group existed on the Allegheny.

River-specific project implementation meetings were held with the water utilities in 2002. A presentation on the Commission's Water Users Advisory Committee was given to the Allegheny River project meeting attendees. The need and utility of an Allegheny River Communications Group was discussed by the group following the presentation. Shortly thereafter, the Allegheny River Communication Network and advisory committee was created following the ORSANCO and MRCN models.

On-going Support and Maintenance

The instrumentation to be used in this effort will require some level of maintenance and routine calibration. The operators will assume some of this responsibility and perform many of the required tasks for daily operation; however, outside assistance may be needed periodically. This support will be provided by ORSANCO staff through the duration of the project.

Website Development

The development, operation and maintenance of an integrated, web-based communications and data sharing system for water utilities on the two river systems had not been considered in the original proposal. However, this component was added due to the high priority placed on this capability by the utilities, its consistency with project objectives and the concurrence for its inclusion by PADEP. The addition of this component significantly expanded the scope of the project, taking it to a new level. Not only would a coordinated early warning detection and water quality monitoring system be developed on these two river systems, but the data

from the monitoring locations, and other pertinent water quality information, would be available on a secure website.

The website is secure with restricted availability. It provides viewers with the option to view data from either the Allegheny or Monongahela Rivers on a location-specific basis. Users can view the current data or download historic data from the sites. A discussion board allows users to post problems or discuss issues of common interest.

While interconnecting the monitoring locations via the website is of benefit to the users, an additional feature of the communication software provides automatic notification when preset parameter levels are exceeded. If a benzene level is detected above a pre-established threshold (i.e., 2 ppb), a telephone notification to a pager, cell phone, etc, is automatically be initiated. The software can be set for any parameter that is monitored and can be tailored for the needs and parameters at each location.

Summary

Since 1978, ORSANCO has been involved in the operation and maintenance of a coordinated organics monitoring program on the Ohio River. The Allegheny-Monongahela River Early Warning Detection System provided the opportunity to build upon this experience in the development of a new water quality monitoring network that would evaluate additional parameters and communicate this information via a website.

In the National Strategy for the Physical Protection of Critical Infrastructures and Key Assets[1], there are Eight Guiding Principles that form the underpinning for this *Strategy*. The first of these recognizes the need to "Assure public safety, public confidence, and services"; another identifies the need to, "Facilitate meaningful information sharing", and a third states, "Develop technologies and expertise to combat terrorist threats". The development and operation of a coordinated water quality monitoring, detection and data sharing program fulfills these and many more of these Principles. This project can serve as a model for the development of other water quality monitoring initiatives needed on industrialized rivers throughout the country.

[1] Anonymous. 2002, "National Strategy for the Physical Protection of Critical Infrastructures and Key Assets.", 83pp (available at http://www.whitehouse.gov/pcipb/physical.html)