



Village Blue: Real-time water quality monitoring and providing water quality information to the Baltimore Community

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Notice: Although this work was reviewed by EPA and approved for presentation, it may not necessarily reflect official Agency policy.





Challenge/Problem

- **How to more fully realize the potential of using real-time water sensors to understand processes that influence water quality in watersheds**
- **Seek innovative approaches for informing partners and communities on the status/challenges with water quality**
- **A demonstration project would be helpful to address these issues**



Village Blue as a Demonstration Project

EPA and the US Geological Survey (USGS) have initiated the “Village Blue” research project to provide real-time water quality monitoring data to the Baltimore community and increase public awareness about local water quality in Baltimore Harbor and the Chesapeake Bay.

The Village Blue demonstration project complements work that a number of state and local organizations are doing to make Baltimore Harbor “swimmable and fishable” by 2020.

USGS has set up a new real-time monitoring site upstream of the Waterfront Partnership of Baltimore Inner Harbor Water Wheel.



Healthy Harbor Report Card 2016

BALTIMORE WATER QUALITY SCORES INSIDE

MEET PROFESSOR TRASH-WHEEL



OVER 250 PADDLERS RALLY FOR CLEAN WATER





Village Blue Demonstration Project: Goals

- Characterize the performance of water sensors (quality assurance, robustness, maintenance)
- Use the sensor platform (sonde) to test new sensors and low-cost water sensors
- Analyze real-time water quality and weather data to develop models for community outreach and to inform basic understanding for important water quality parameters using statistical and process models
- Explore approaches to use sensor data to increase public awareness of the impacts of water quality on human and ecosystem health (community outreach)
- Create an EPA website that provides additional visualization tools for sensor and weather data and background interpretive information on sensors, and a how to guide so other communities across the US could install their own Village Blue stations
- Develop communication outreach documents on how to develop similar projects in other communities

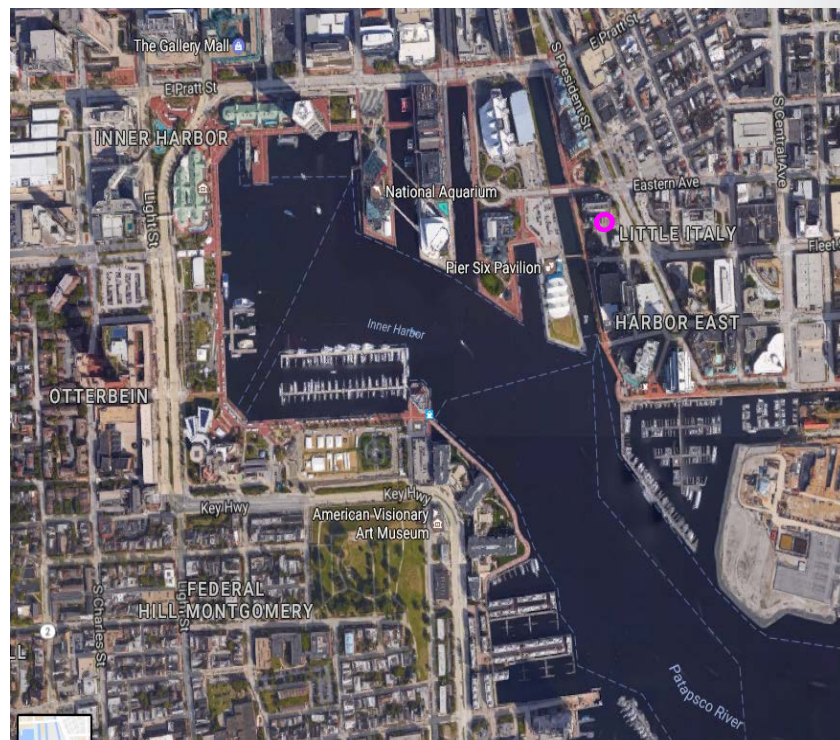


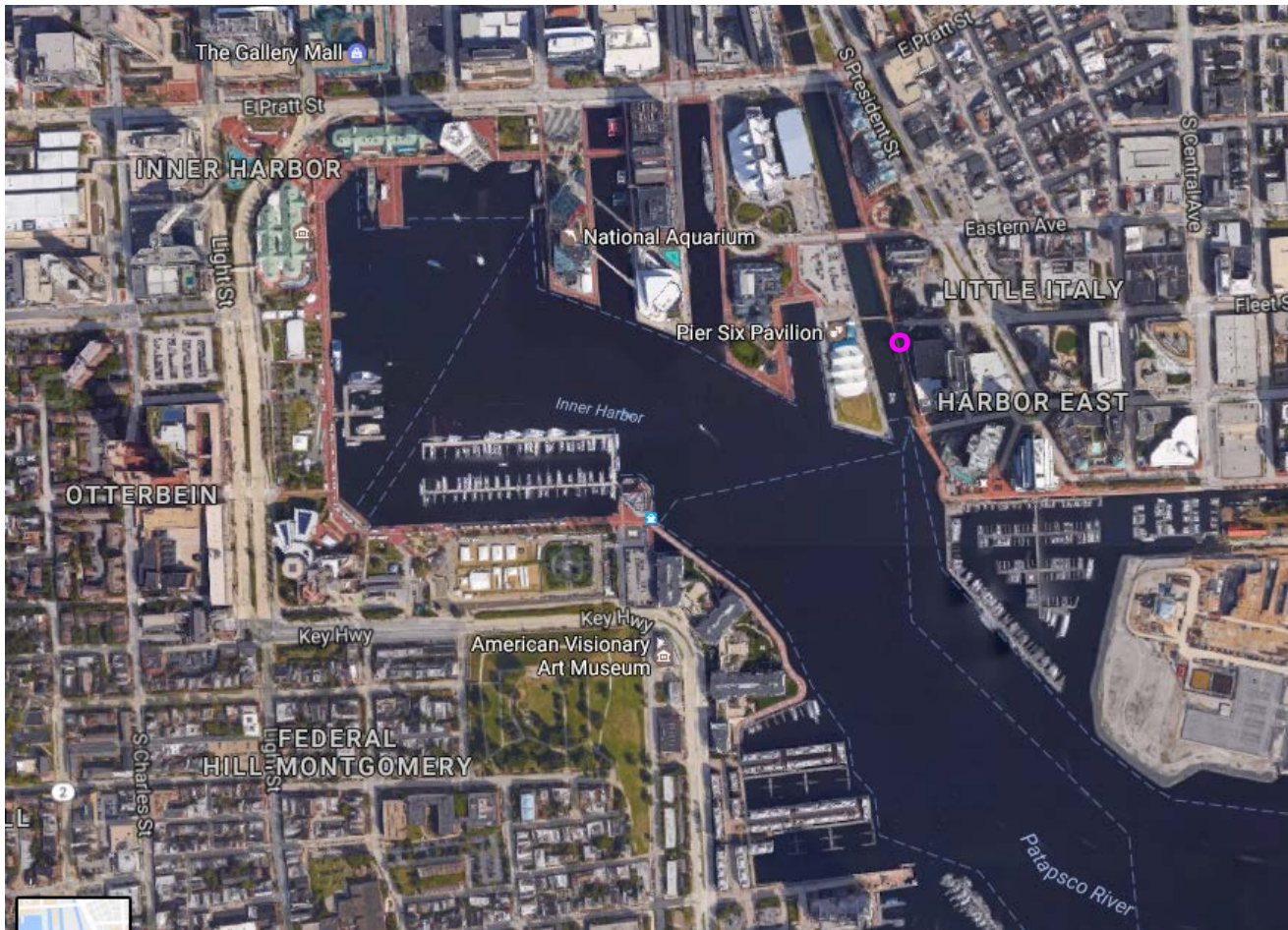
Village Blue Team

- USGS Sensor
 - Deployment and maintenance
- EPA Office of Research and Development
 - Microbiologists, engineers, modelers, community outreach, communications
- EPA Region 3
 - Communications and outreach
- Blue Water Baltimore
 - Sample collection and analysis for fecal indicator bacteria
- Outreach activities
 - Baltimore Aquarium, Baltimore Science Center, Baltimore Waterfront Partnership, Blue Water Baltimore, Baltimore Urban Waters Partnership, City of Baltimore

Main Components

1. Set up a new real-time monitoring site upstream of the Waterfront Partnership of Baltimore Inner Harbor Water Wheel
2. Develop new Village Blue mobile friendly website focused on data visualization and modeling of water quality
3. Develop community outreach opportunities of real-time sensor and weather data
4. Evaluate the impact of community outreach activities





Multiple Parameters

Real-time monitoring data on the Jones Falls River (sonde was deployed and maintained by the USGS)

- Conductivity, Dissolved Oxygen, Nitrate, pH, Temperature, Turbidity, Tidal Height, and flow direction/velocity
 - Data posted to the USGS National Water Information System (NWIS) every 5 minutes
- Chlorophyll and Phycocyanin
- NOAA Meteorological Data (precipitation and radar)

Floating platform keeps instruments 8 inches below water surface, measuring Jones Falls

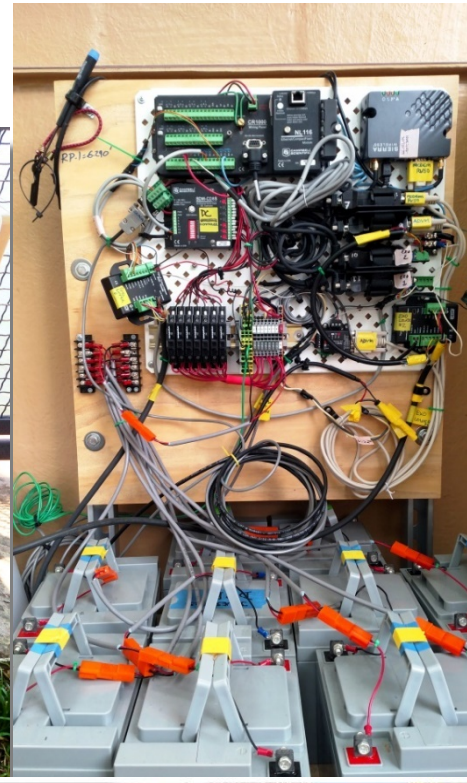


Platform 2 x 3 x 1 ft.





- Custom electronics board and program
- Data from 5 platforms collected and transmitted to national database (NWIS)
- 5-minute data, publicly viewable



Powered by 10, 12v 48A batteries

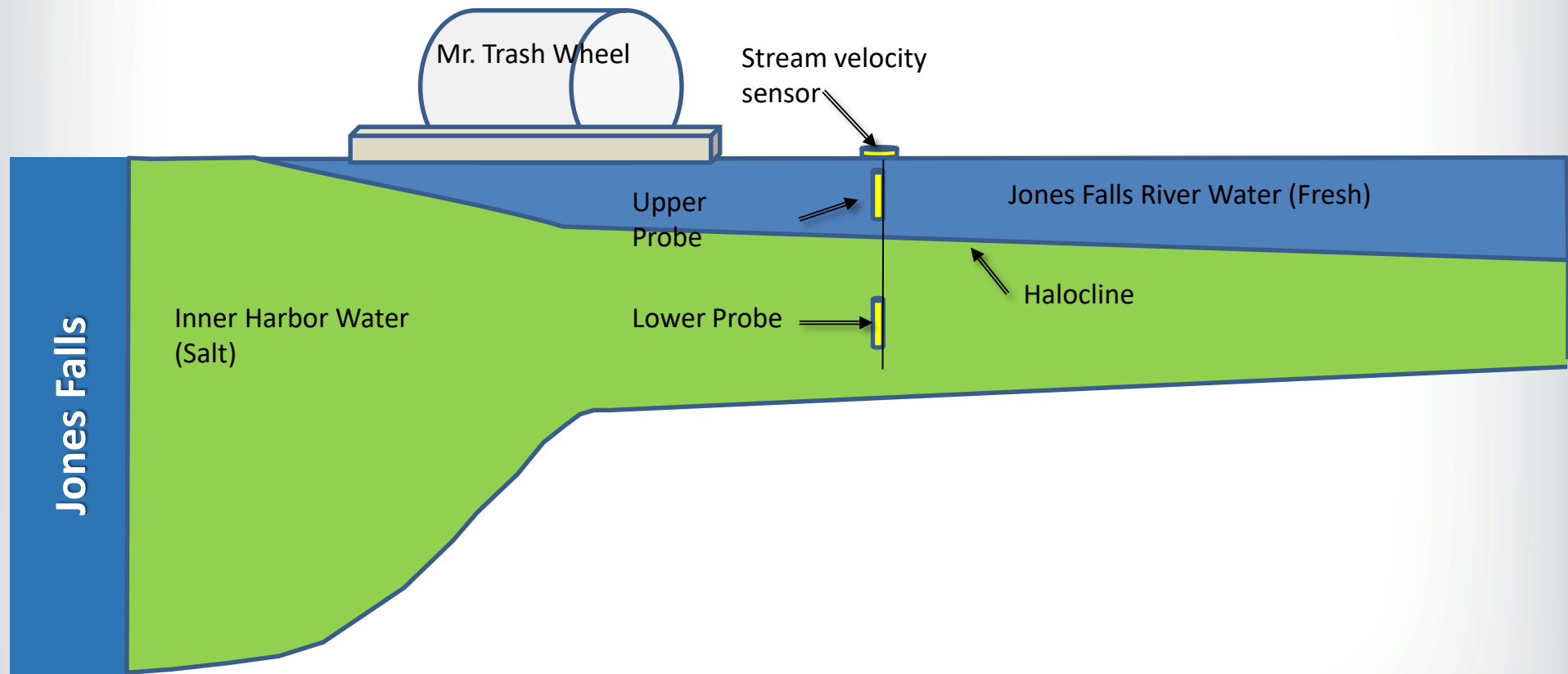




Jones Falls Link:

https://waterdata.usgs.gov/md/nwis/uv?site_no=01589485

Village Blue Background

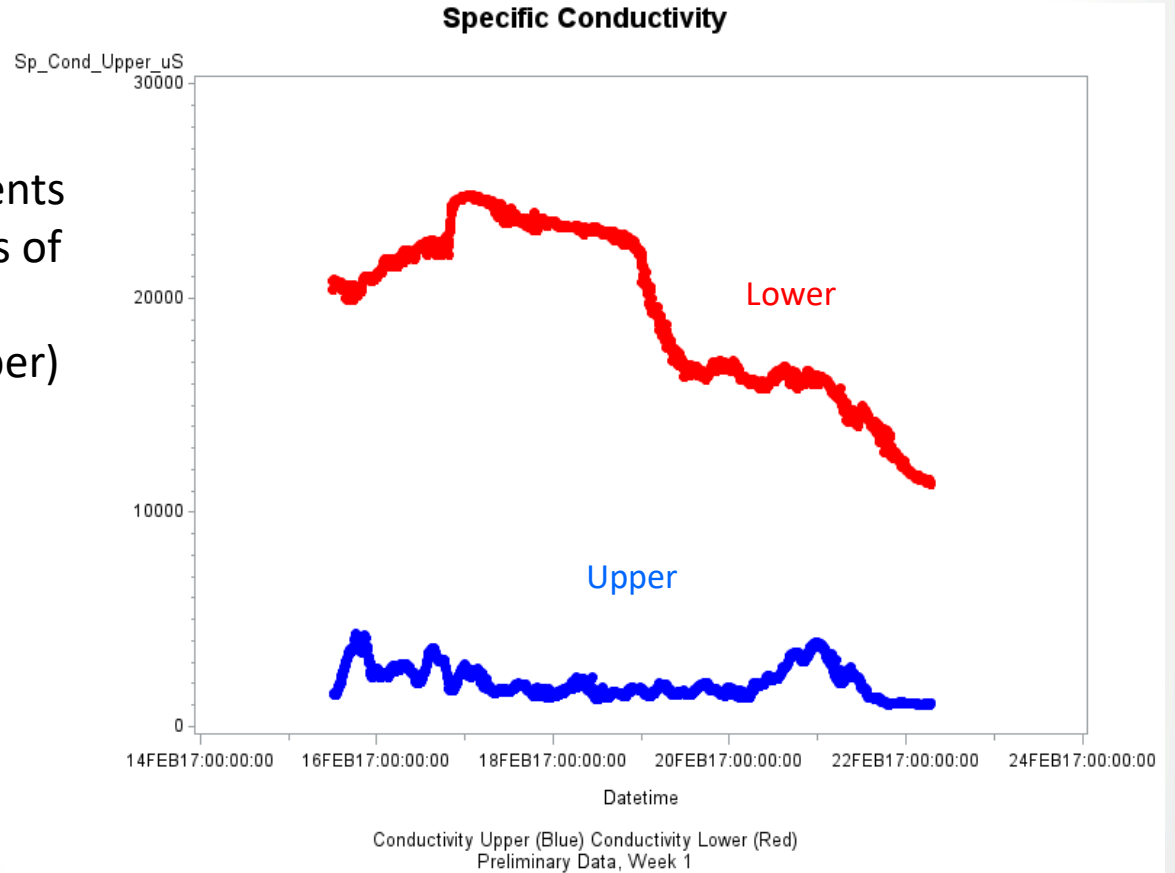


Not to scale



Preliminary Data – Jones Falls River

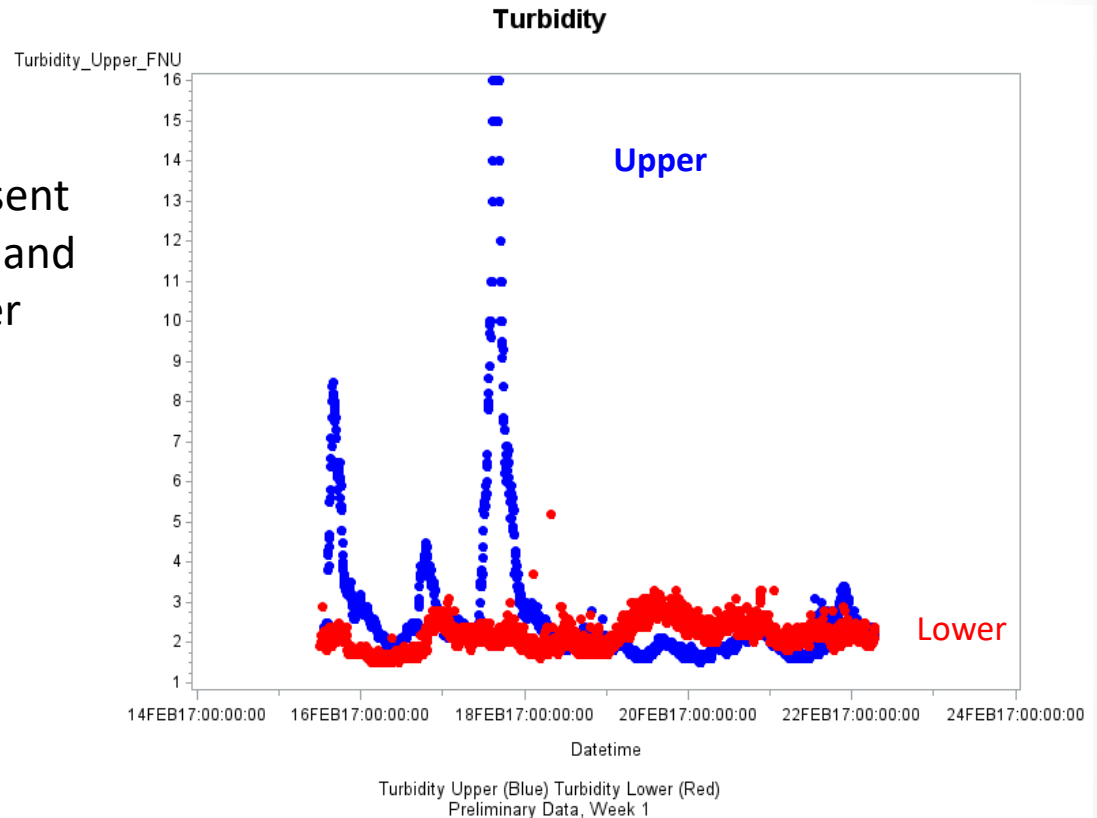
Conductivity measurements confirm that the two sets of sensors are collecting brackish river water (upper) and inner harbor water (lower)



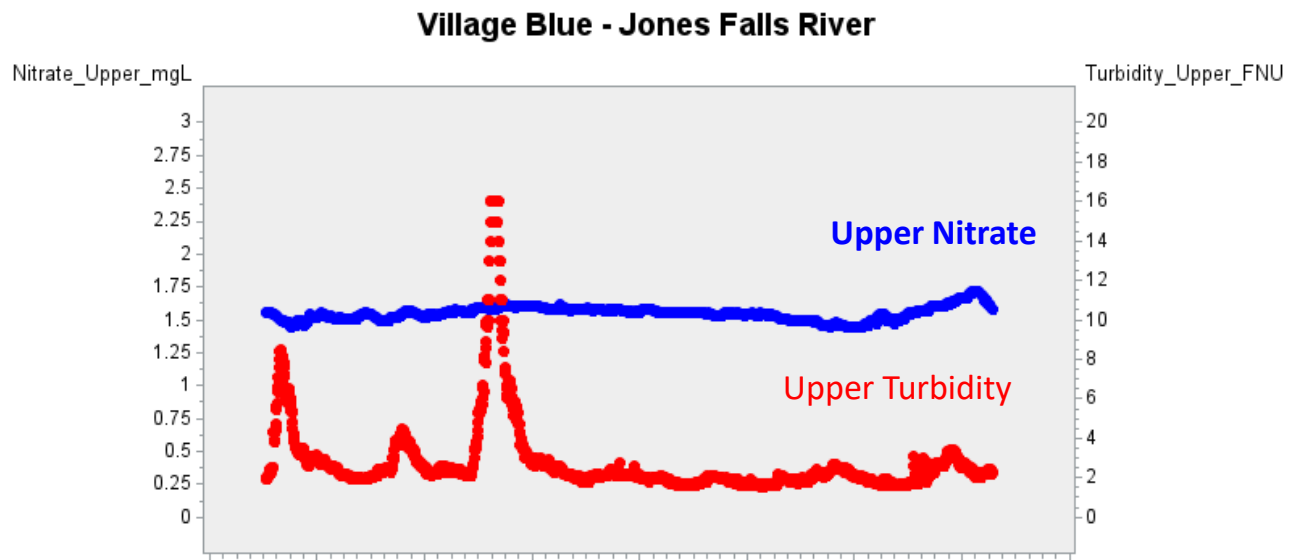


Preliminary Data – Jones Falls River

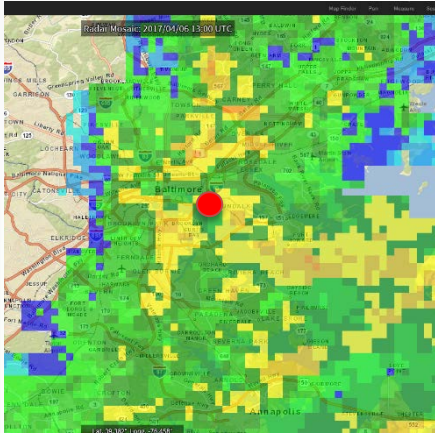
Peaks in turbidity are present in the river water (upper) and not the inner harbor water (lower)



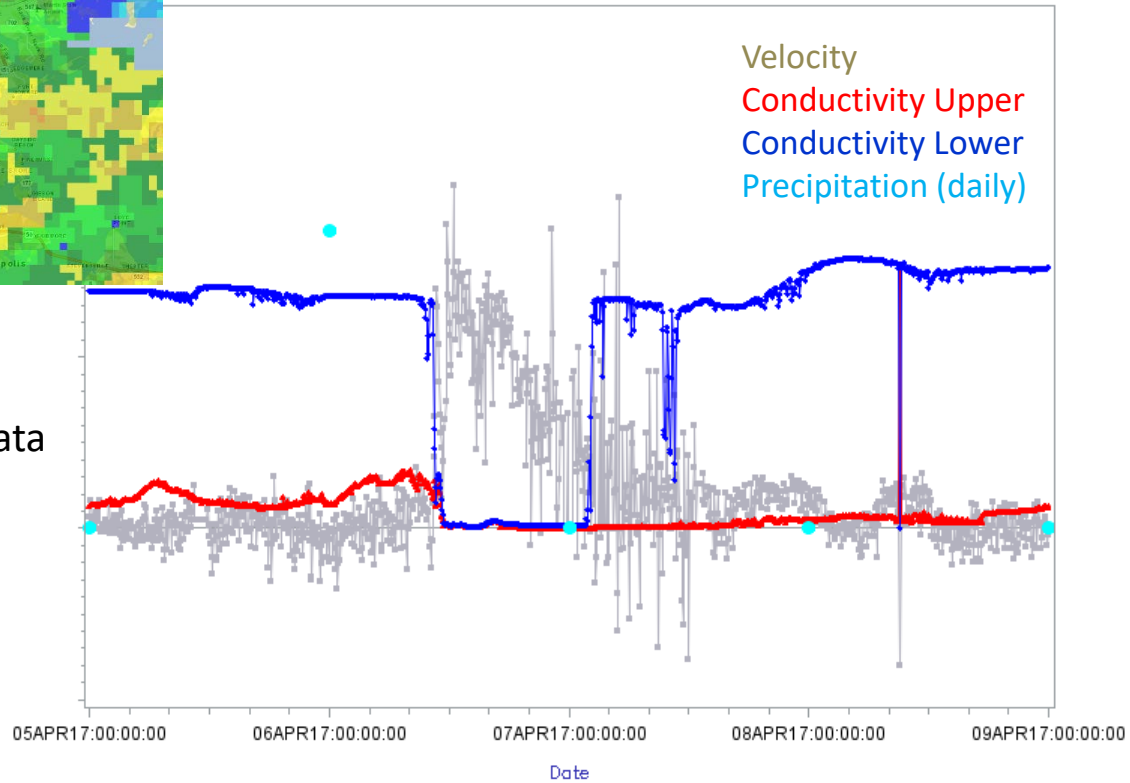
Relationships between turbidity and nitrate in the fresh water layer



Preliminary Data – Jones Falls River



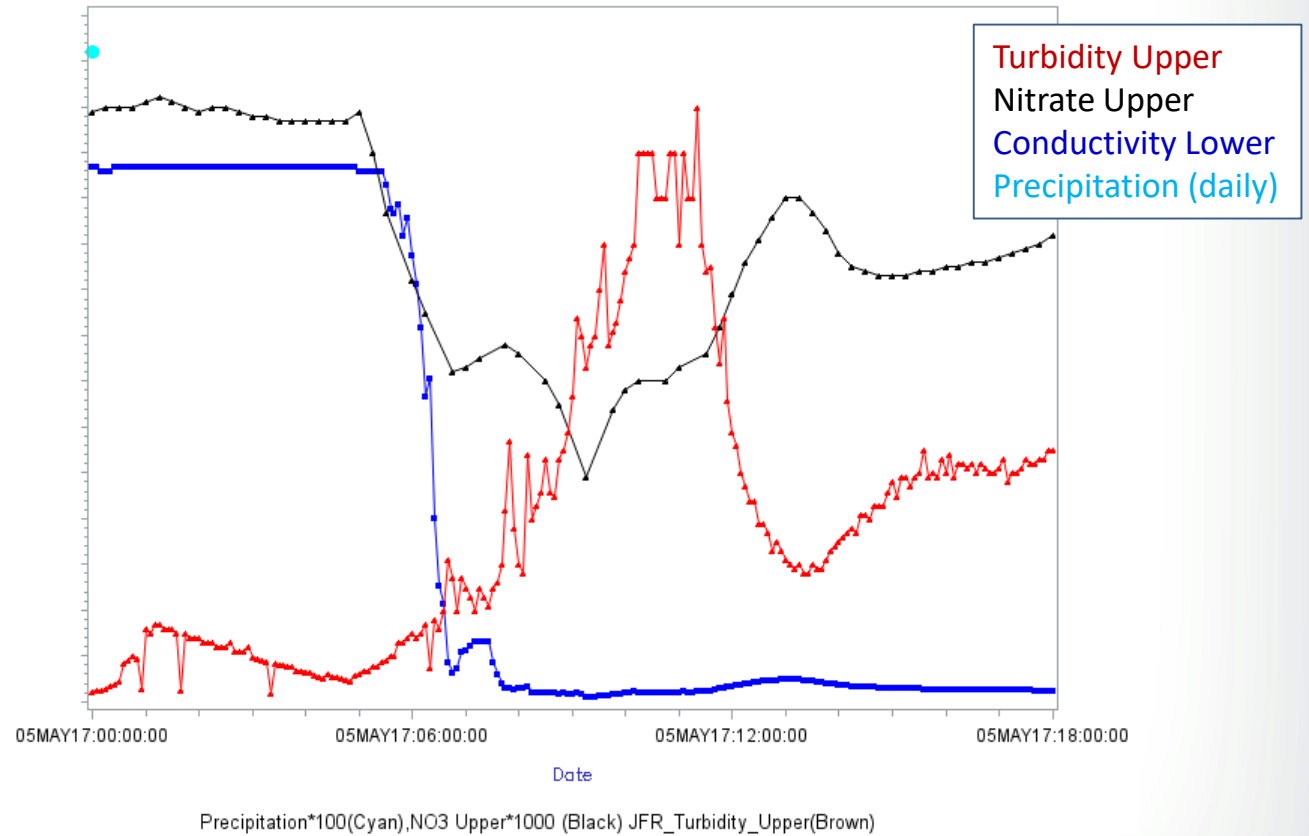
Provisional Data





Preliminary Data – Jones Falls River

Rain Event and Effect on Sensor Readings





Focus Areas for Research

Water Sensors

- Water sensors are a relatively new technology; need for developing quality assurance/quality control (QA/QC) approaches, management of data, and characterizing the robustness of the deployed sensors in marine and freshwater environments
- Application of software tools to model water quality parameters using sensor data; use EPA modeling tools such as CANARY and Virtual Beach to model sensor performance, microbial water quality, sources of fecal contamination, dissolved oxygen, nutrients, algae etc.).
- Effectiveness of community outreach based on sensor applications

Water Sensors

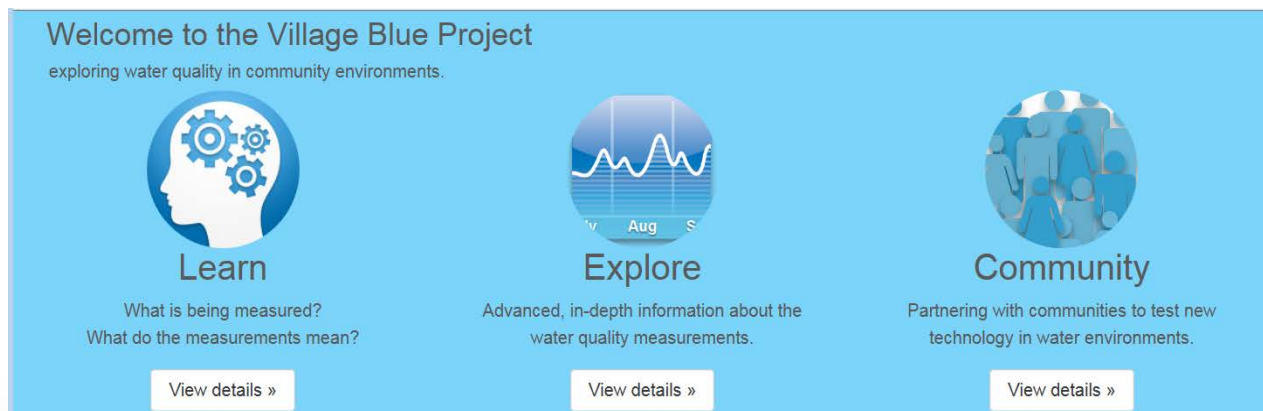
- This sensor emplacement (sonde) provides an excellent testbed for comparative studies of new sensors that have been previously tested in the laboratory
- New technologies are being developed through challenge grants and other pathways, and these may be commercially ready and suitable for field deployment in a test and demonstration platform such as Village Blue
- Novel techniques for data quality assurance may be implemented

EPA and USGS display the real-time data on the National Water Information System and Village Blue website. The Village Blue website includes:

- The landing page that provides additional context about Village Blue, interpreting sensor data and a link to the Village Blue application (web address is pending)

Fact sheet: <https://www.epa.gov/sites/production/files/2016-09/documents/villagebluefactsheet.pdf>

- Application provides additional visualization of the sensor data that helps users interpret sensor data (will be available by the end of 2017)



Welcome to the Village Blue Project
exploring water quality in community environments.

Learn
What is being measured?
What do the measurements mean?
[View details »](#)

Explore
Advanced, in-depth information about the
water quality measurements.
[View details »](#)

Community
Partnering with communities to test new
technology in water environments.
[View details »](#)



Village Blue Website

Tour of:

- Landing Page
- Application



Outreach Activities

- **Objectives:**

- Working with stakeholders, develop outreach opportunities to highlight how sensor data can be used to inform Inner Harbor water quality
 - Baltimore National Aquarium
 - Baltimore Science Center
 - Baltimore Waterfront Partnership
 - Blue Water Baltimore
 - Baltimore Urban Waters Partnership
- Examples of outreach activities being pursued
 - Characterization of rain events on water quality in the Inner Harbor (dissolved oxygen, turbidity, microbial water quality, nitrogen etc)
 - Impact of river outfall on inner harbor water quality
 - Education on sensor technology
 - Modeling of water quality to environmental conditions
- Provide documents to help other communities/stakeholders develop sensorbased outreach activities



Impact of Outreach Initiatives

Water Quality Information

- Assessing the Value and Impact of Delivering Water Quality Monitoring Data to the Public - A Pilot in Baltimore Harbor
- Questions being addressed:
 - Is data being delivered as information the public can absorb, and resonates and educates at the appropriate level?
 - Does water quality information stimulate public action, participation, or the interest to obtain additional information?
 - Are there ways to measure and document success in any of the above?
- Outreach from Village Blue will be assessed for impact to stakeholders



Village Blue Impacts

- Quality assurance and maintenance of sensors
- Performance characteristics of new sensors
- Web access of visualization of Village Blue sensors
- Implementation of outreach to increase awareness and understanding of water quality in the inner harbor and the application of water sensor information more broadly
- Assessment of the effectiveness of outreach
- Documentation to assist other stakeholders on the utilization of water sensors



Village Blue Timeline

- Website goes live by the end of 2017
 - The landing page and application will continue to evolve even after they are rolled out
- Evaluate and procure new sensors
- Continue to work with partners to support outreach activities FY18
- Measure impact of outreach activities FY17-18
- Research products
 - Findings of QA/QC, robustness of the deployed sensors in marine and freshwater environments
 - Application of software tools to model water quality parameters; evaluate sensor data vs. batch (more limited) environmental data on model performance; applies to scientific and outreach needs
 - Effectiveness of community outreach based on sensor applications

Feedback


- Is there interest in similar programs in other locations?
- Opportunities for collaboration?
- Suggestions for outreach or partnerships?
- When the website does go live, we welcome comments and suggestions

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EPA's Village Blue: A Real-Time Water Quality Monitoring Project supporting ongoing efforts to understand and improve water quality in Baltimore Harbor

What is Village Blue?
 EPA and the U.S. Geological Survey (USGS) initiated the "Village Blue" research project to provide real-time water quality monitoring data to the Baltimore community and increase public awareness about local water quality in Baltimore Harbor and the Chesapeake Bay. The Village Blue demonstration project complements work that a number of state and local organizations are doing to make Baltimore Harbor "swimmable and fishable" by 2020.



Sensors placed near the Baltimore Inner Harbor Water Wheel on the Jones Falls River will gather real-time water quality measurements for the Village Blue research project.

Village Blue is designed to build upon EPA's "Village Green" project which provides real-time air quality information to communities in six locations across the country.

Who are the partners?
 EPA and USGS are collaborating on the project and establishing partnerships with state and local organizations in Maryland.

Where is the Village Blue project taking place?
 EPA and USGS staff are using a new monitoring site on the Jones Falls River in Baltimore to test, evaluate and develop new low-cost water sensors that are collecting real-time water quality data. These sensors are located near the Waterfront Partnership of Baltimore Inner Harbor Water Wheel (popularly known as Mr. Trash Wheel) which removes trash before it enters the harbor. USGS established the new monitoring site.

How does it work?
 EPA installed sensors near the Water Wheel to gather real-time water quality monitoring data that will be displayed on the Village Blue website, and will complement work that a number of state and local organizations are doing to make water quality data available to the public.

1 U.S. Environmental Protection Agency
Office of Research and Development