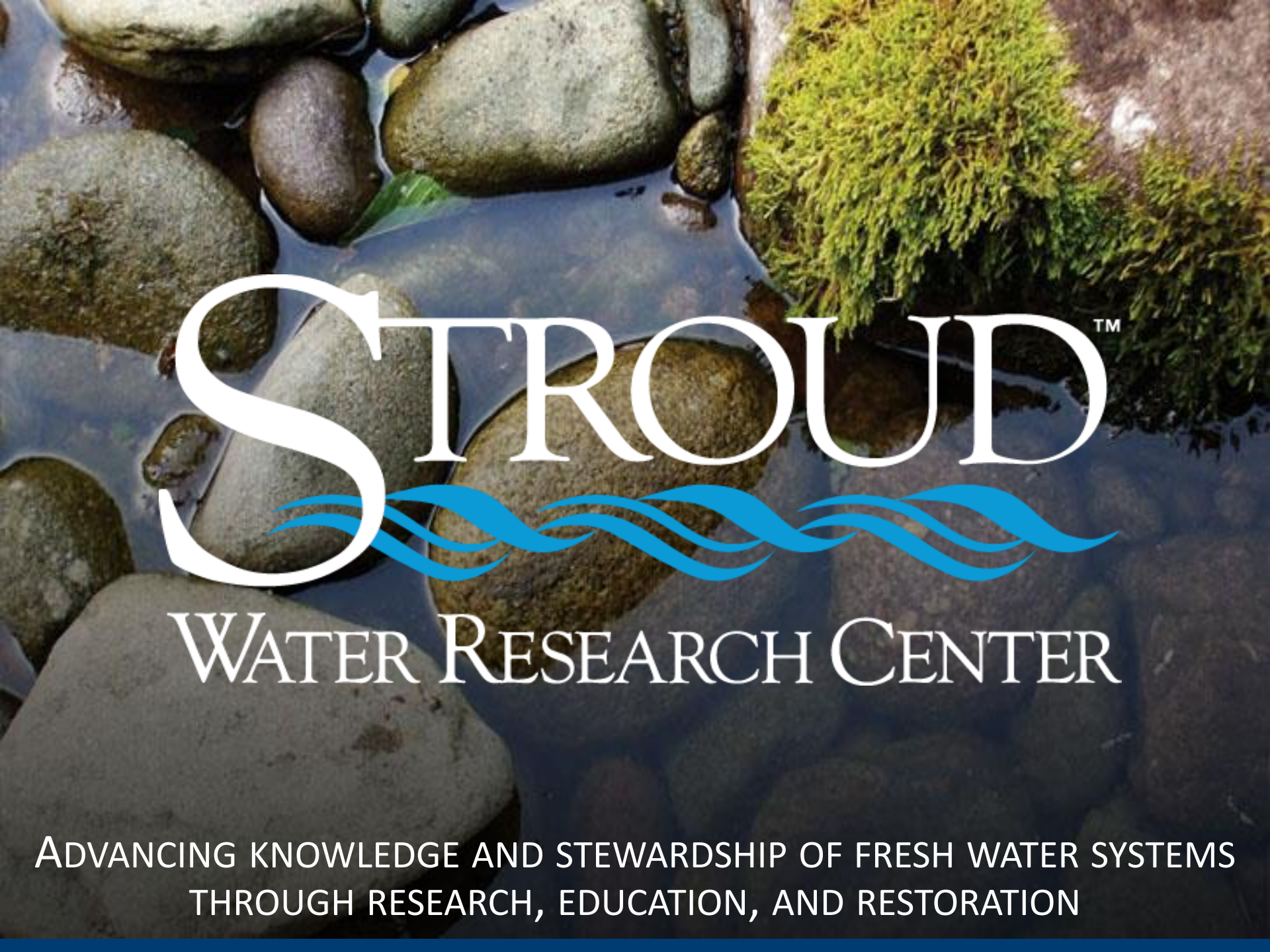


ADVANCING KNOWLEDGE AND STEWARDSHIP OF FRESH WATER SYSTEMS THROUGH RESEARCH, EDUCATION, AND RESTORATION

Watershed 101: Water Chemistry

Day 3

Learning Objectives

- What should I monitor?
- How should I monitor?
  - Quality Assurance and Quality Control
  - National Environmental Laboratory Accreditation
- What Low-Cost Monitoring Options Used?
  - National Survey of common monitoring
- Some low-cost tools
  - Colorimeter readers
  - EnviroDIY.org and Ardunio-based sensor station options
- Model My Watershed
  - Modeling hydrology and water quality at the landscape-scale and influences of best management practices

Water Chemistry – What should I measure?

- Why?
  - Should lead to WHAT?
    - Should lead to WHEN, HOW OFTEN, HOW LONG?
    - Leads to data management, QA/QC procedures
    - Leads to how to ANALYZE and INTERPRETATION
  - Good chemical monitoring requires significant attention to quality assurance and control…

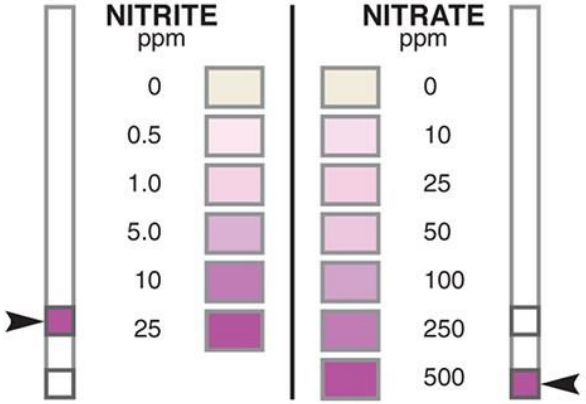
Water Chemistry – What should I measure?

- What? **Should link to why?**
- I have a handheld meter…that's why?
  - Temp, DO, specific conductivity, pH, turbidity,
- Other dissolved gasses (e.g., CO, CO_2, H_2S, CH_4) – probably not
- Dissolved major ions
- Dissolved nutrients (N, P, and Si)
- Dissolved organic matter (DOM) or dissolved organic carbon (DOC)
- Suspended particulates (TSS), including minerals and particulate organic matter (POM)
- Trace elements, both dissolved and particulate

Typical Chemical Analytes Monitored

- **Analytes Monitored By both Professional and Citizen Science/Volunteer Monitoring programs**
  - ***Usually* -** Temperature, dissolved oxygen, specific conductivity, pH, turbidity/total suspended solids
  - ***Sometimes* -** nutrients, major ions, alkalinity, dissolved and particulate carbon, biological and/or chemical oxygen demand
  - ***Rarely* -** specific metals, pesticides, pharmaceutical and primary care products, other suspected specific pollutant monitoring

PROCEDURES:
Remove one test strip from the container. Dip test strip into solution so that both pads are immersed. Hold for 2-3 seconds in test solution. Remove test strip, & shake off excess liquid. Read after 30 seconds by comparing test pads to color chart.



STROUD WATER RESEARCH CENTER
50 YEARS Est. 1967

Stream Water Chemistry Sampling Basics

- Notebook!
- ? Analytes ?
- Instr. calibrations
- Flow direction
- Hygiene
  - Sun cream?
  - DEET?
  - Perfumes?
- Triple rinse
- Bottle type
- Preservation?
  - On ice?
  - In dark?
- Holding times
- Filtering?

STROUD WATER RESEARCH CENTER

50 YEARS Est. 1967

Chemical monitoring considerations

- Natural variability – seasonal, daily, weather-related (hydrologically controlled)
- Landscape influence
  - Hydrological response to weather events
- Baseflow versus stormflow water chemistry
  - Informed by WHY, WHAT, HOW, WHEN, WHERE planning
- Point sources or spills are often very discrete in time (and space) and therefore can easily be missed by chemical monitoring (or diluted further downstream and increasingly difficult to quantify with increasing hydrologic distance from source)
- Some variables can be “easily” monitored with high frequency
  - Easy = inexpensive and/or quick and/or with sensors
- Some require grab samples or automated sampling and processing by water chemistry labs or with low-cost alternatives
  - Key is anticipating frequency of sampling need to detect differences

Concentrations versus Loadings?

- Concentration = how much of analyte is in a certain volume of water (mg/l, ppm)
- Loads = amount of analyte delivered through a stream cross section over a defined period of time, a.k.a. “flux” (kg/yr) and is a function of analyte concentrations and total discharge over time
  - Requires quantification of stream flow
    - requires monitoring stream stage height and development of “rating curve” to estimate instantaneous discharge – cfs or m^3/s
  - Requires quantification of concentration over many different discharges to develop analyte specific rating curves
  - This is a challenging monitoring effort – made easier by the thousands of USGS gaging stations throughout the U.S.)

Water Chemistry – What should I measure?

- What ever you choose to measure and whatever method choose…
  - Good chemical monitoring requires significant attention to quality assurance and control!

Quality Assurance, Quality Control, and Quality Assessment Measures

- Activities undertaken to demonstrate
  - **accuracy** (how close to "real" result you are) and
  - **precision** (how reproducible are your results?)
- QAPP – Quality Assurance Project Plan
  - Broad plan for maintaining quality in ALL aspects of your program. Documentation of:
    - Procedures
    - Training volunteers/staff
    - Study design
    - Data management and analysis
    - Specific quality control measures

https://archive.epa.gov/water/archive/web/html/132.html

QA versus QC

- QA and QC are closely related concepts, but they are fundamentally different in their focus:
  - **QA is the process of managing for quality;**
  - **QC is used to verify the quality of the output;**
- Sound monitoring data requires both QA and QC.
- **Quality Assurance** – a set of processes and documentation that assures that standards, processes, and procedures are appropriate for the project and are correctly selected and implemented. But the delivered solution itself is never actually quality-checked…
- **Quality Control** – a set of tests to verify measurements (helps understand/quantify repeatability

https://www.dialog.com.au/open-dialog/the-difference-between-quality-assurance-and-quality-control/

QC Internal Checks

Performed by project field volunteers, staff, and lab.

- ***Field Blanks***. Deionized water treated as a sample. Identifies **errors or contamination** in collection and analysis.
- ***Field Duplicates***. Duplicate sample collected at the same time & place. Estimates sampling and lab analysis **precision**.
- ***Lab Replicates***. A sample split into subsamples at the lab. Each subsample is then analyzed and the results compared. Used to test **precision of the laboratory measurements**.
- ***Spike Samples***. Known concentration of the variable being measured is added to sample. Increases the concentration by a predictable amount. Used to test **accuracy of the method**.
- ***Calibration Blank***. Deionized water prepared and processed in the lab and treated like a sample to "zero" the instrument. Typically the first "sample" analyzed and **used to set the meter to zero**. Different from the field blank in that it is "sampled" in the lab. Used to check instrument periodically for **"drift"** (instrument should always read "0" when this blank is measured). Can be compared to field blank to **pinpoint where contamination might have occurred**.
- ***Calibration Standards***. Used to **calibrate a meter**. Consists of **one or more "standard concentrations"** (made up in the lab to specified concentrations) of the variable being measured (one of which is the calibration blank).

QC External Checks

Performed by non-volunteer field staff and a lab (also known as a "quality control lab"). Results are compared with those obtained by the project lab.

- ***External Field Duplicates.*** Duplicate sample collected and processed by independent (e.g., professional) sampler or team at same place/time as regular river samples. Used to estimate **sampling and laboratory analysis precision**.
- ***Split Samples.*** Sample that is divided into two subsamples at the lab. One subsample is analyzed at the project lab and the other is analyzed at an independent lab. The results are compared.
- ***Outside Lab Analysis of Duplicate Samples.*** Internal or external field duplicates can be analyzed at an independent lab. The results should be comparable with those obtained by the project lab.
- ***Knowns.*** Quality control lab sends samples for selected indicators, labeled with the concentrations, to the project lab for analysis prior to the first sample run. Samples are analyzed and results compared with the known concentrations. Problems are reported to the quality control lab.
- ***Unknowns/Blind.*** Quality control lab sends samples to the project lab for analysis for selected indicators, prior to the first sample run. The **concentrations of these samples are unknown** to the project lab. These samples are analyzed and the results reported to the quality control lab. Discrepancies are reported to the project lab and a problem identification and solving process follows.

QAPP and Chemical Methods References

APHA. 1992. *Standard Methods for the Examination of Water and Wastewater.* 18th ed. American Public Health Association, Washington, DC. https://www.standardmethods.org/

Intergovernmental Task Force on Monitoring Water Quality. 1994. *Water quality monitoring in the United States.* 1993 report and technical appendixes. Washington, DC.

Mattson, M. 1992. The basics of quality control. *The Volunteer Monitor.* 4(2) Fall 1992.

USEPA. 1983. *Methods for chemical analysis of water and wastes.*EPA600/479020. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH. March.

USEPA. 1984. *Guidance for preparation of combined work/quality assurance project plans for environmental monitoring.* ORWS QA1, U.S. Environmental Protection Agency, Office of Water Regulations and Standards. Washington DC, May.

USEPA. 1996. *The Volunteer Monitor's Guide to Quality Assurance Project Plans.* EPA841-B-96-003. Environmental Protection Agency, Office of Water, Washington, DC.

USGS. Water Quality Monitoring Information web site: http://water.usgs.gov/owq/

USGS. National Field Manual for the Collection of Water-Quality Data: http://water.usgs.gov/owq/FieldManual/

Certified Labs – NELAP

- National Environmental Laboratory Accreditation Program (NELAP) is a national accreditation program developed by the NELAC Institute
  - 501(c)(3) non-profit with mission to foster generation of E data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community
- Organizes NELAP Accreditation Process at state level – i.e., programs are certified through state-specific programs
- Not all states have accreditation programs
  - Fl, Ill, KS, LA, MN, NH, NJ, NY, OR, PA, TX, UT, VA
- Thus lab accreditation is by state, but a lab may choose to gain accreditation via multiple states

http://www.nelac-institute.org/content/NELAP/accred-bodies.php

Certified Labs – NELAP

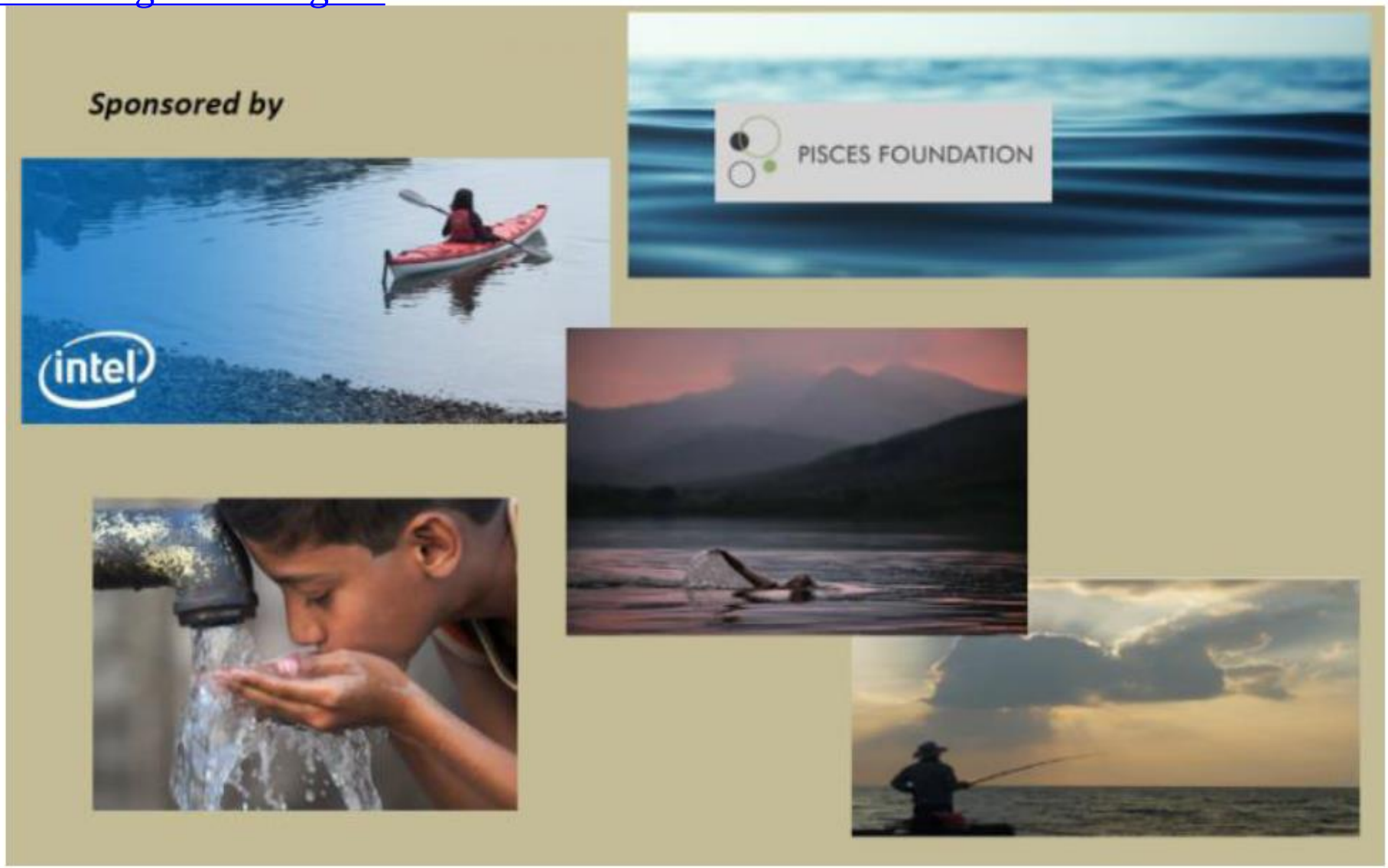
- Certified Labs
  - Accreditation is method/analyte specific
- Just because a lab/method/analyte is NELAP certified does not mean that the accuracy, precision, and detection limit is sufficient to detect the concentration or the “change” that you may be interested in quantifying, so…
  - You must understand the limits of the methods you’ve chosen and compare to your needs
- If you choose a lab/method that is not certified – it is critical that you adopt, document, and quantify QA/QC metrics (i.e., utilize field blanks, field and lab duplicates, calibrations, standards, etc…)
  - Especially if you have legal or regulatory requirements to your monitoring program

With EVERY Choice of Analyte – Choose Method Wisely

- What are the expected concentrations that need to be measured?
- How variable is the concentration of the analyte?
  - i.e., diel, seasonal, stormwater influences, point sources?
- How large or small of a “change” in concentration do you need to detect?
- Leads to choices informing needs for:
  - Method detection limit, accuracy, precision, QA/QC plans/demands (documentation and data management is not trivial!)

LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

http://piscesfoundation.org/empowering-the-public-with-a-suite-of-water-quality-monitoring-technologies/



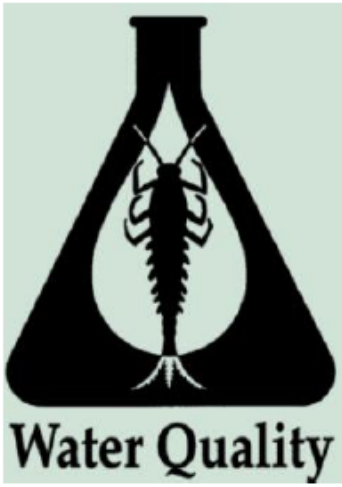
LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

Background

- 2015: Pisces Foundation & Intel Corporation project leaders agree to sponsor a survey of selected groups doing water resource monitoring to better understand gaps between their current and desired:
  - ✓ **Water monitoring practices**
  - ✓ **Reporting**
  - ✓ **Information sharing technologies**

- Goal was to empower citizens to protect their water through information gained or managed with *the use of low cost technologies*

- National Steering Committee of non-profit, business, academic and government experts guided survey development & distribution



LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

Survey Audience Profile

- Key Characteristics:
  - ✓ **130 respondents—all but 3 in U.S.**
  - ✓ ***Very knowledgeable*—50% monitoring program leads & 78% were either staff, volunteers, or had strong program knowledge**

- ✓ **Several respondents represented their regional/national staff network**
- ✓ ***Geographically broad* representation—42 states**
- ✓ **Mostly non-profits (72%) & govt. (16%) respondents**
- ✓ **50% answered a *watershed* was their service area**

LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

Monitoring Program Profile

- Rivers and streams (89%) are monitored most, followed by a distant (32%) for stormwater or wastewater discharges. Yet, only a few monitored drinking water supplies (6%)

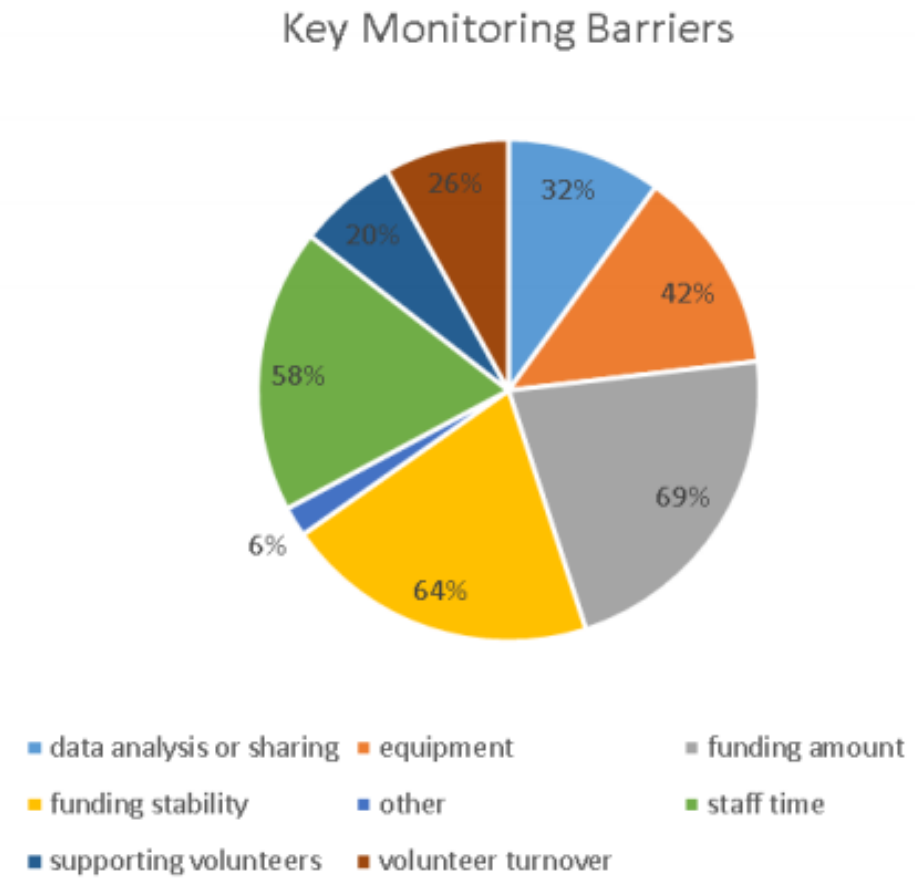
- Top 5 of 15 monitoring program objective areas were:
  - ✓ **Create long term data sets (77%)**
  - ✓ **Education (75%)**
  - ✓ **Target problem areas (59%)**
  - ✓ **Report pollution incidents (51%)**
  - ✓ **Change community behavior (50%)**

- **Remaining program objective areas scored below 50%**

LOW COST WATER QUALITY MONITORING NATIONAL SURVEY-- Monitoring Program Profile

- Top 4 of 8 program barriers
  - ✓ **Funding amount (69%)**
  - ✓ **Funding stability (64%)**
  - ✓ **Staff time (58%)**
  - ✓ **Equipment (41%)**
- Considering funding and people resources are the top two barriers, it is significant to note that ***equipment*** emerges as the third leading barrier.

▪30% monitor water volume, 64% do not and 6% are unsure



LOW COST WATER QUALITY MONITORING NATIONAL SURVEY--Monitoring Program Profile *continued*

Data collection

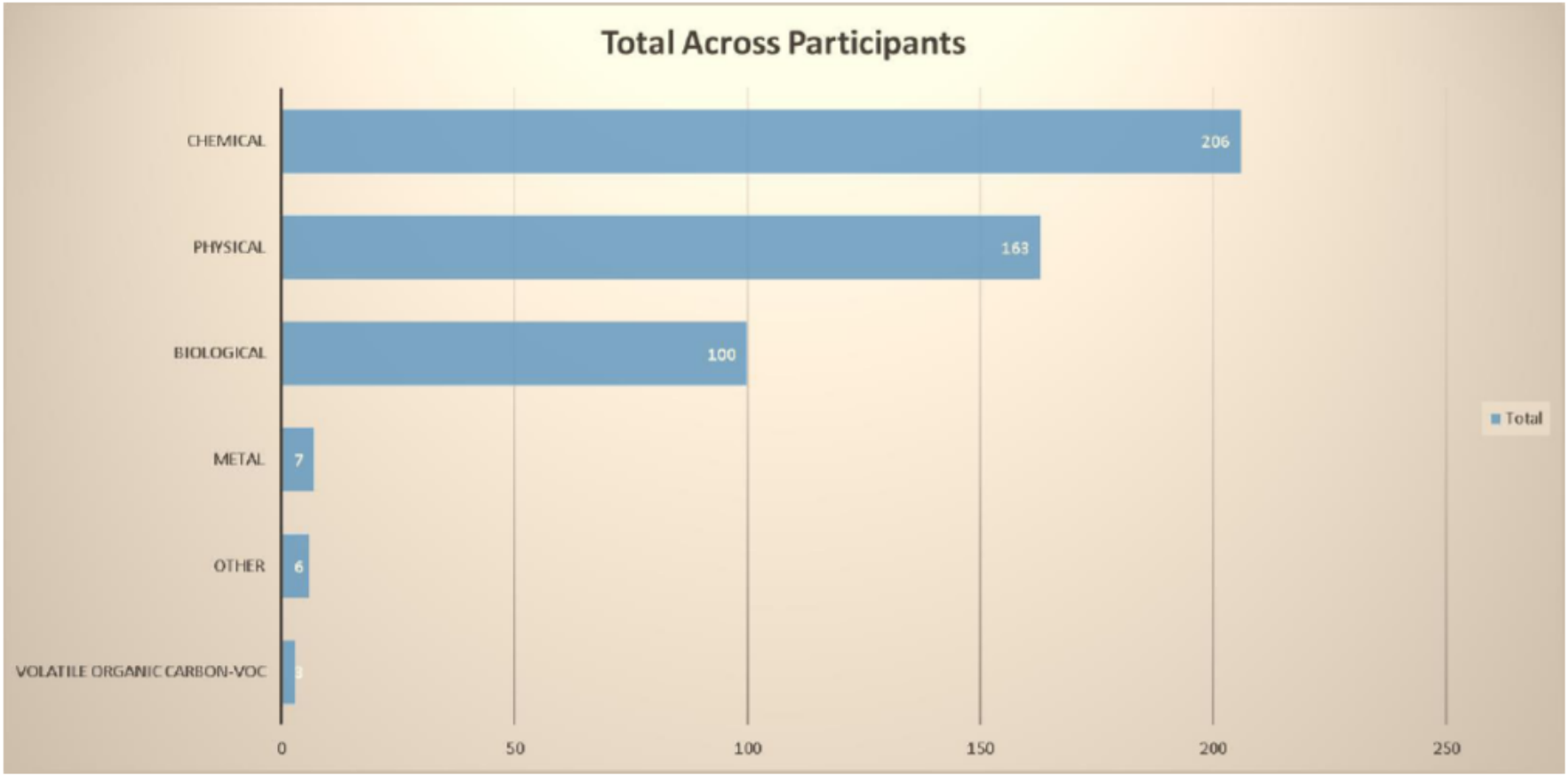
- Of the 13 possible answers for data collection methods--3 are deployed by most organizations:
  - ✓ **Field test kits** **74% (59)**
  - ✓ **Grab samples & lab analysis** **69% (55)**
  - ✓ **Multi-parameter meters/sensors** **49% (39)**

- Notably, only a few organizations make use of various types of monitoring stations or cell phone

grab samples and lab analysis	68.75%	55
prepared samples and lab analysis	23.75%	19
field test kits	73.75%	59
lab test kits	16.25%	13
single parameter electronic meters or sensors	28.75%	23
multi-parameter meters or sensors	48.75%	39
other	8.75%	7
custom assembled sensors	7.50%	6
unattended monitoring stations without telemetry	13.75%	11
unattended monitoring stations with telemetry	5.00%	4
long term fixed stations with flow controls without telemetry	1.25%	1
long term fixed stations with flow controls with telemetry	3.75%	3
cell phone reporting	13.75%	11

LOW COST WATER QUALITY MONITORING NATIONAL SURVEY--Monitoring Program Profile *continued*

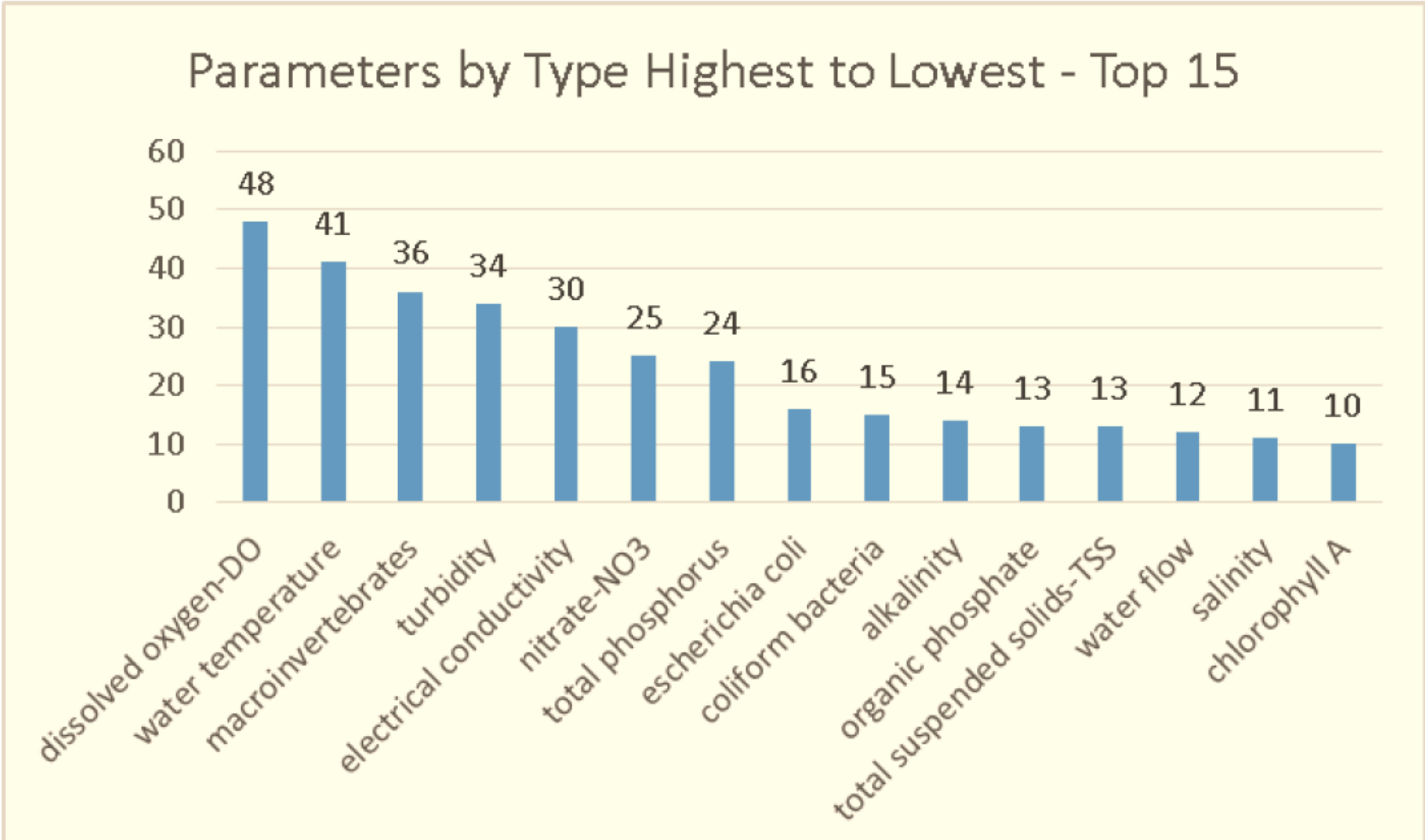
Parameters*



* Respondents completing at least: 1 parameter = 97; 3 p's = 63; 5 p's = 46; 7 p's = 32; 9 p's = 22; 10 p's = 20

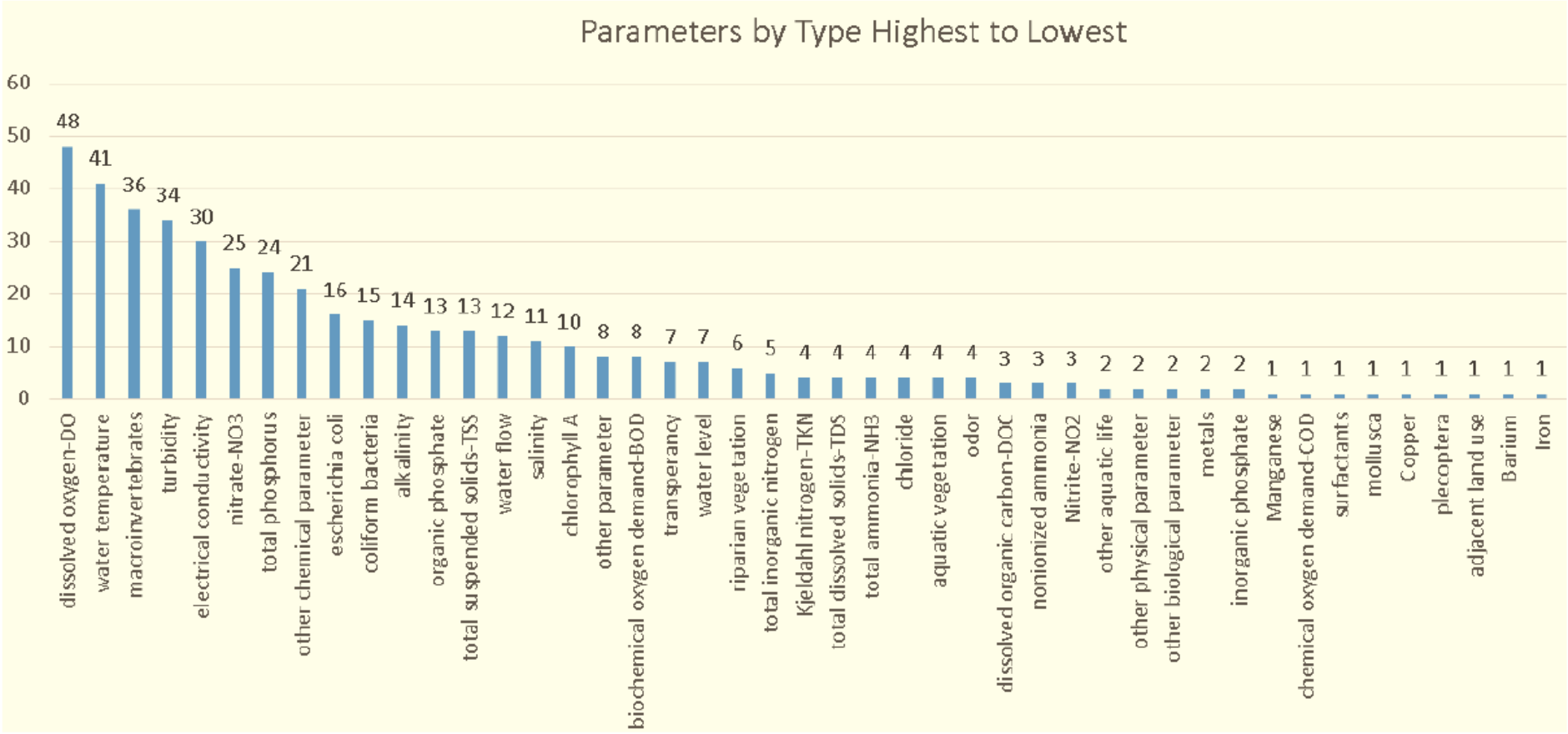
LOW COST WATER QUALITY MONITORING NATIONAL SURVEY--Monitoring Program Profile *continued*

Parameters



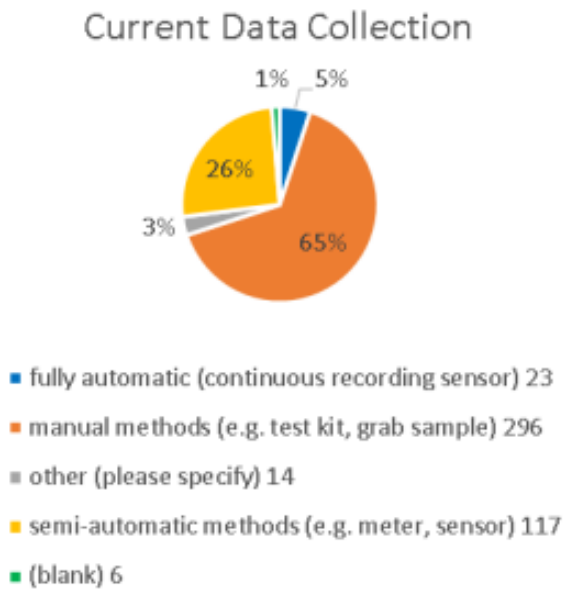
LOW COST WATER QUALITY MONITORING NATIONAL SURVEY--Monitoring Program Profile *continued*

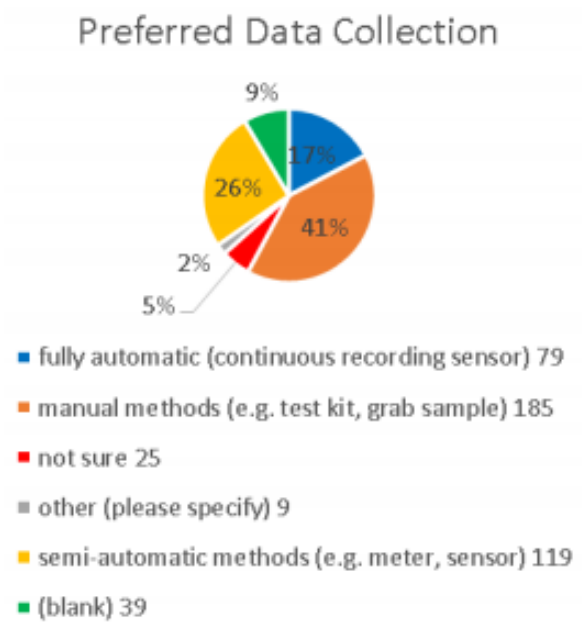
Parameters



LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- All Monitoring Parameters

- most use manual data collection methods, yet fewer prefer this approach
- Some are unsure what they prefer, while more want a fully automatic approach
- Differences become more apparent with some individual parameters





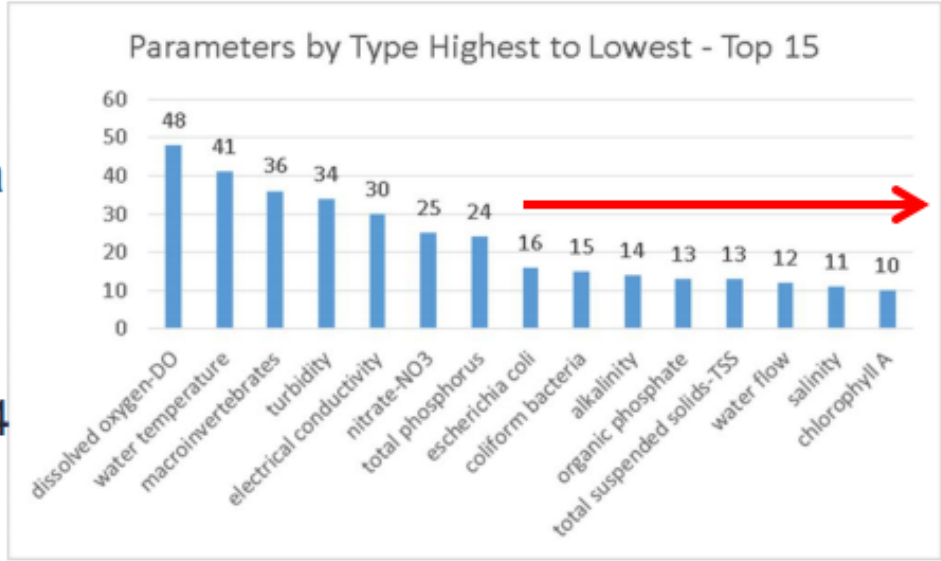
LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Analysis: Data Collection & Precision

- Nitrate-NO3 ranked #6 and total phosphorous ranked #7: no clear trends for future collection & precision

- Yet, respondents say parameters that are *most useful to monitor but can't now, are nutrients e.g. nitrogen & phosphorus* in various forms, especially:
  - ✓ **in real time**
  - ✓ **with sensors and;**
  - ✓ **continuous monitoring**

- Parameters ranked below total phosphorus were briefly examined. Note that E. coli & coliform bacteria are used as contamination indicators

❖ Nutrients & bacteria are in the top 4 parameters in need of low-cost monitoring improvement



LOW COST WATER QUALITY MONITORING NATIONAL SURVEY –KEY FINDINGS

- **84% of respondents believe widespread availability of low-cost equipment could affect major improvements in water quality**

- **Top 4 perceived needs for low-cost monitoring equipment:**
  - ✓ target problem areas
  - ✓ use as a screening tool for advanced/expert level monitoring/investigation
  - ✓ report pollution incidents
  - ✓ As part of monitoring & verification protocols for nutrient trading programs, BMPs, restoration projects, etc.

- **Top 4 parameters for low-cost** (under $100) **monitoring improvements:**
  - ✓ nutrients (N and/P forms)
  - ✓ bacteria (fecal coliform, E. coli, etc.)
  - ✓ dissolved oxygen
  - ✓ turbidity

LOW COST WATER QUALITY MONITORING NATIONAL SURVEY –KEY FINDINGS

- **Top 4 most desired features in new equipment:**
  - ✓ equipment durability
  - ✓ in-field data entry
  - ✓ remote sensing & data loggers
  - ✓ automatic metadata capture

- **78% of respondents lack knowledge of beneficial low-cost data access & sharing technologies that could benefit their program**

- **Top 4 perceived needs for low-cost** (less than $50) **data access and sharing technologies:**
  - ✓ quality and reliability of the data
  - ✓ low unit cost of the data
  - ✓ sharing of water quality information with environmental advocates
  - ✓ sharing of water quality information with local government officials

Low Cost Water Quality Options

- Rapidly expanding set of tools
- Need to focus on YOUR NEEDS for accuracy, precision, detection limits, etc…

- Example: colorimeters…

Specifications MSDS Manual Literature

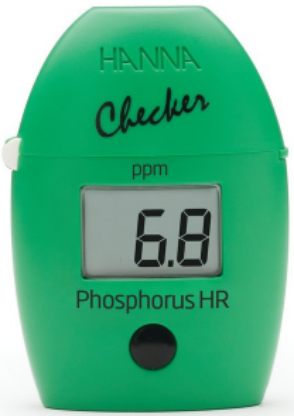
Phosphorus High Range Checker®HC - HI706 $49.00

☆☆☆☆☆Write a review

Qty: 1 Add to Cart

Ships within 1-2 Business Days

Free Shipping on Orders over $50*



The Hanna Phosphorus High Range Checker® bridges the gap between simple chemical test kits and professional instrumentation. Chemical test kits have limited accuracy and resolution since they rely upon the human eye to discern differences in color. Professional instrumentation incorporates a light source such as an LED or tungsten lamp with a filter and a light sensing detector to precisely determine ion concentration. Professional instrumentation offers greater resolution and accuracy but can cost hundreds of dollars. The Hanna Phosphorus High Range Checker® uses a fixed wavelength LED and silicon photo detector to provide the accuracy of professional instrumentation at the affordable price of a chemical test kit.

Compact, Portable Design

Built-in Timer

One-Button Operation

More Views

The Checker®HC is simple to use

1 "Zero" the Checker®HC as required in specific procedure

2 Add reagent to your water sample

3 Place the vial into your Checker®HC

4 Press the button and read the results.

It's that easy!

STROUD WATER RESEARCH CENTER
50 YEARS Est. 1967

Specifications

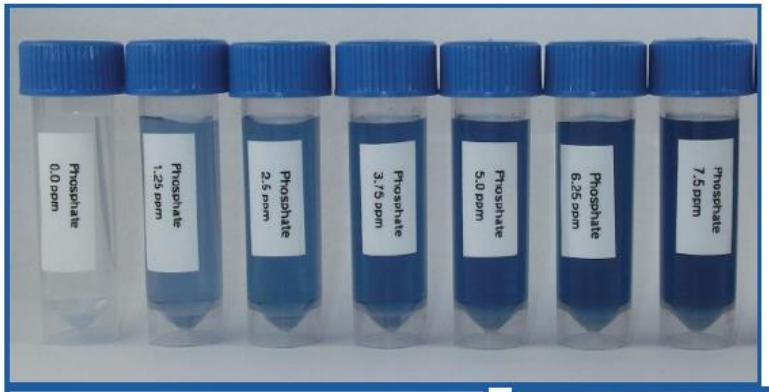
Range	0.0 to 15.0 ppm
Resolution	0.1 ppm
Accuracy @ 25°C/77°F	±0.03 ppm ±5% of reading
Light Source	LED @ 525 nm
Light Detector	silicon photocell
Method	adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, Heteropolymolybdenum Blue method
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Battery Type	(1) 1.5V AAA
Auto-off	after ten minutes of non-use
Dimensions	81.5mm x 61mm x 37.5mm (3.2" x 2.4" x 1.5")
Weight	64 g (2.25 oz.)
Ordering Information	HI706 Checker® is supplied with (2) sample cuvettes with caps, phosphorus HR reagent starter kit for 20 tests (1 bottle of phosphorus reagent A, 20 packets of phosphorus HR reagent B), battery, instructions and quick start guide.

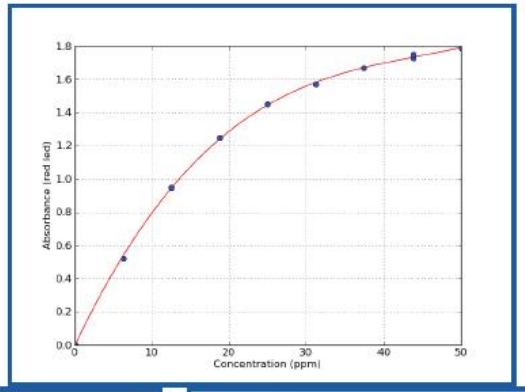
Colorimeter Kits

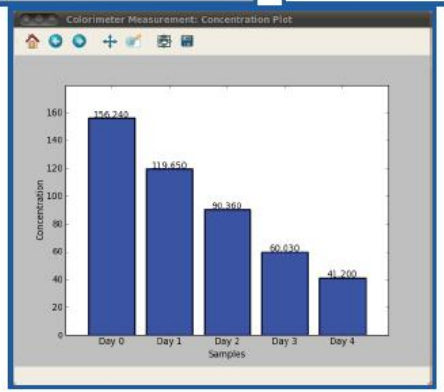
Open source hardware/software (Arduino)

IO Rodeo
Smart Lab Technology

Full documentation of the colorimeter project is located on our documentation site at http://public.iorodeo.com/docs/colorimeter







Analyte and Method Lists
https://sites.google.com/site/colorimeterwiki/
pH
Hardness
Salinity
SO4, K, Pb, Fe,
Ca+Mg,
NO_3, NO_2, NH_3
Phosphate

STROUD WATER RESEARCH CENTER
50 YEARS Est. 1967

Exploring Equipment, Data Loggers, Sensors

- Intro to Stroud's EnviroDIY efforts for "lower-cost", do-it-yourself monitoring systems

- Intro to a few of the more "not so low cost" options
  - ISCO – automated "grab" sampling
  - S::CAN
    - Spectrophotometer in a can

Do-It-Yourself, Open-Source Wireless Monitoring Stations

Sensor Networks: Cost vs. Coverage

- Campbell Scientific data-loggers & radios

CR1000 Measurement & Control Datalogger

$1400

+

AM16/32B 16 or 32 Channel Relay Multiplexer

$500

+

RF430 spread spectrum radio

$600

Total = $2500

EnviroDIY Mayfly Data Logger Board

Bee Module Socket (Xbee/WiFi/Cell)

microUSB port

FTDI programming port

Power switch

Solar panel connector & charging circuitry

MicroSD/SPI connector

Red & Green LEDs

User-defined pushbutton

LiPo battery connectors

MicroSD socket (horizontal)

DS321 Real Time Clock with battery backup

20-pin header for analog pins and 2 UART ports

20-pin header for digital pins

5V boost converter

Auxiliary 16-bit, 4-channel Analog-to-Digital Converter

I²C port

Grove digital ports


Power
Activity
Ethernet
XBee
PRO S2B
Digi International
XBee
S2
www.digi.com
XBee
PRO S2B
Digi International
XBee
S2
www.digi.com
Digi International
XBee
S1
www.digi.com
XBee
PRO S2B
XSTICK
Digi

Sensor Networks: Cost vs. Coverage

- Open-source data-loggers & radios

$10

$5

EnviroDIY Mayfly
Microprocessor & Datalogger
$60

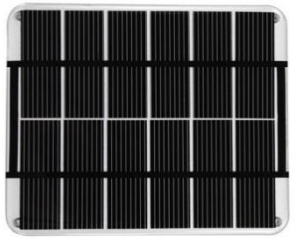
Based on Arduino platform

\+

$25

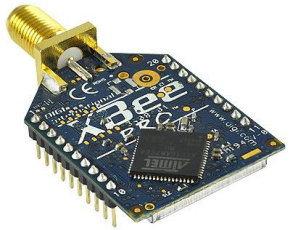
Accessories
(vary depending on need)

$30-90



Solar Panel
$10-35

\+



Cell Phone or Radio Modules

$20-40

Total = $90-$220

Sensor Networks: Cost vs. Coverage

- Focus resources on bare-wire commercial

Decagon, Sensorex, Vaisala, Keller America, Apogee

Soil moisture, conductivity, redox, carbon dioxide, water depth, oxygen

Mayfly: Available on Amazon.com

amazon Prime

Computers

Departments | Browsing History | Anthony's Amazon.com | Today's Deals | Hello, Anthony Your Account

Computers | Laptops | Tablets | Desktops | Monitors | Computer Accessories | PC Components | PC Gaming

Electronics › Computers & Accessories › Computer Components › Motherboards

EnviroDIY Mayfly Data Logger Board, Arduino Compatible

by Stroud Water Research Center

Be the first to review this item

Price: $60.00 Prime

Earn **3% Back** (worth $1.80 when redeemed) with your Amazon.com Rewards Visa Card. Learn more

In Stock.

Want it tomorrow, July 27? Order within **7 hrs 56 mins** and choose **One-Day Shipping** at checkout. Details

Sold by Stroud Water Research Center and Fulfilled by Amazon

EnviroDIY Mayfly Data Logger Arduino Compatible Board and Starter Kit

by Stroud Water Research Center

Be the first to review this item

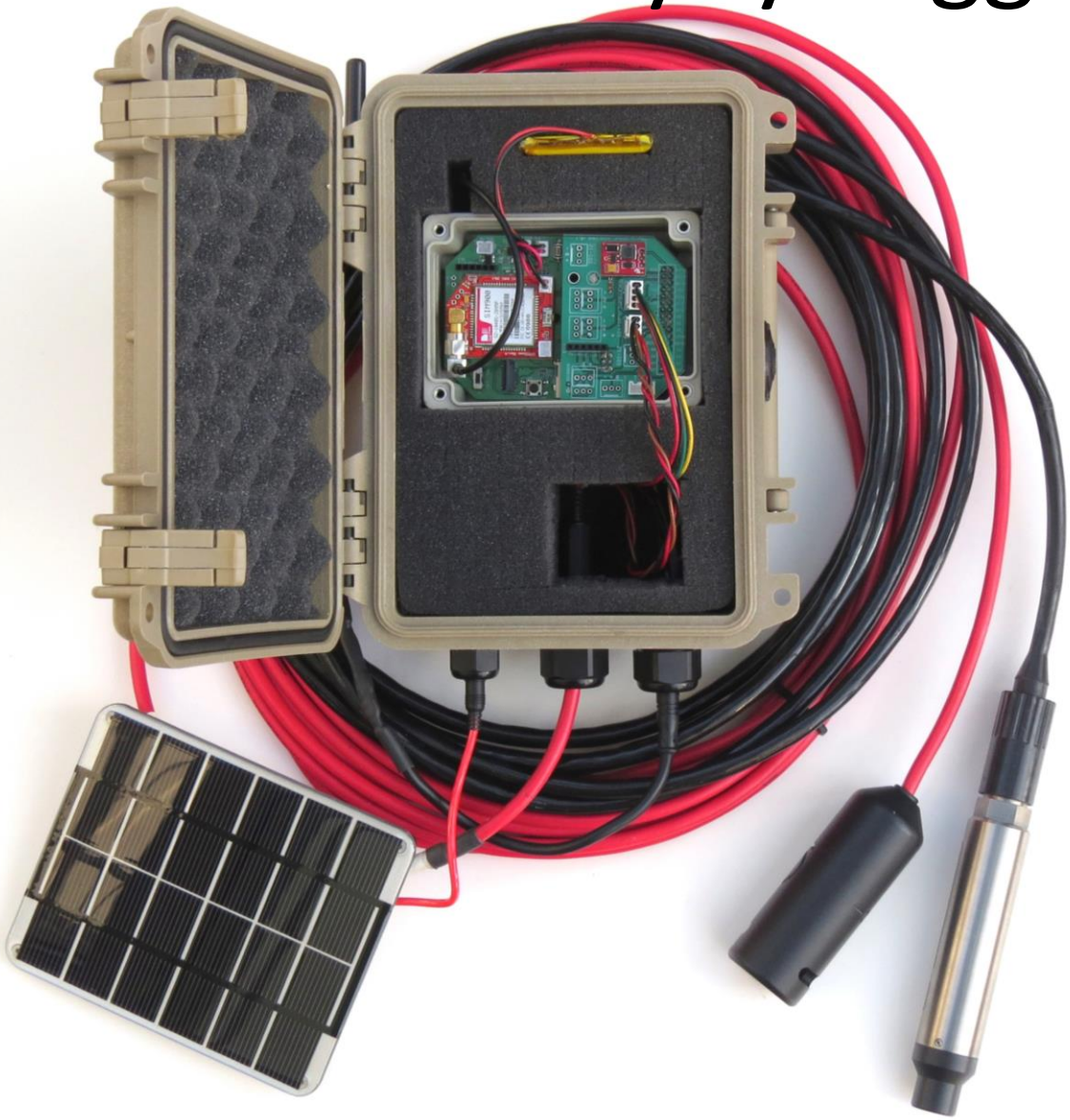
Price: $90.00 Prime

Only 6 left in stock.

Sold by Stroud Water Research Center and Fulfilled by Amazon. Gift-wrap available.

Eligible for amazonsmile donation.

EnviroDIY Mayfly Logger









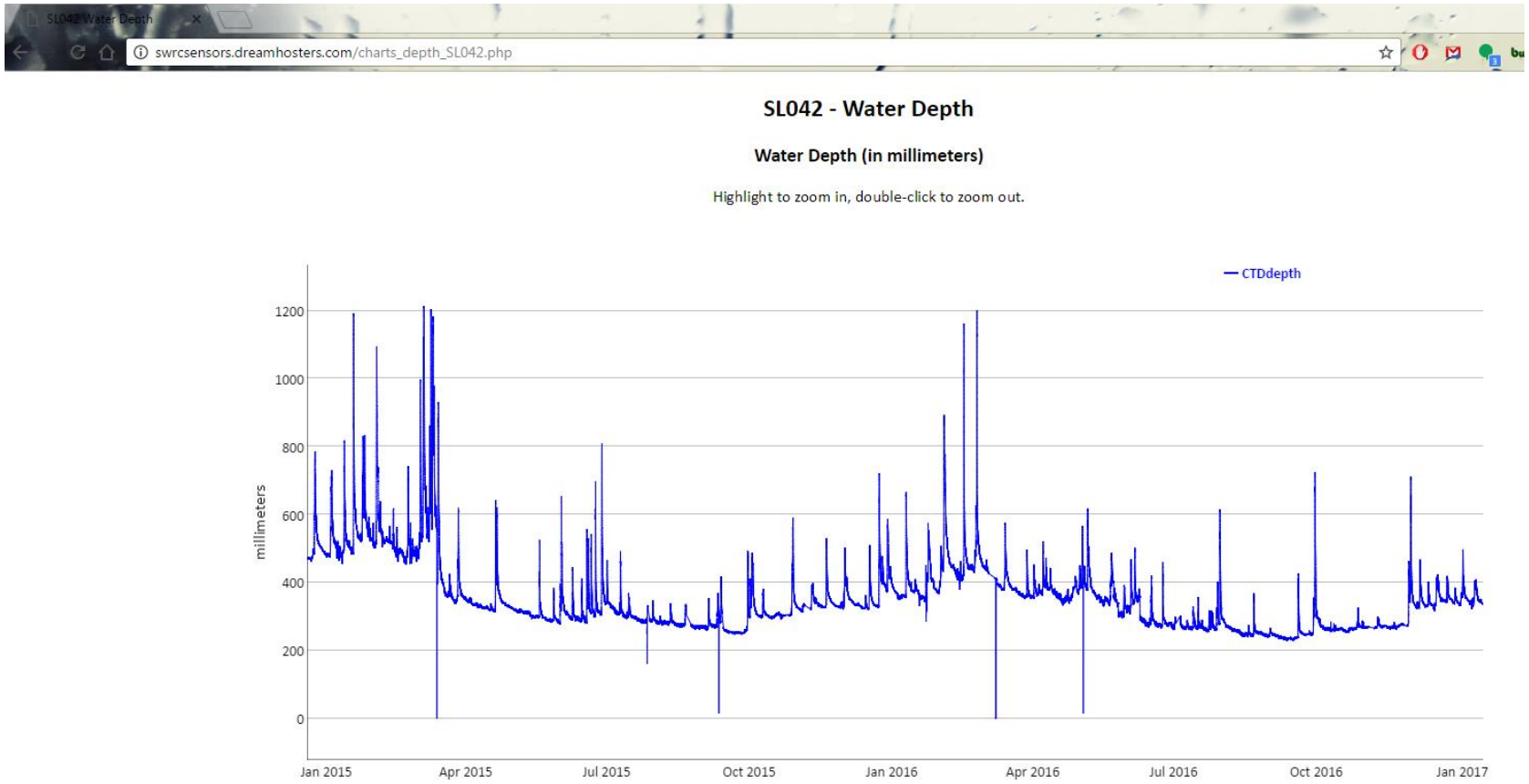
Wireless Real-Time Data Online

swrcsensors.dreamhosters.com

SWRC Datalogger Portal

SL031: WCC19 - Turbidity/CTD	SL041: WCC40 - Turbidity/CTD/Oxygen	SL066: WCD1139 - Flow/Stage	SL032: WCC300 - Turbidity/CTD
			
SL044: WCC720 - Turbidity/CTD/PAR	SL043: WCD700 - Turbidity/CTD/PAR	SL025: WCC Ag field - Soil Moisture	SL053: SWRC - Rain
			
SL050: Schuykill Center, Philadelphia	SL034: Chestertown, MD - Turbidity/CTD	SL042: Thouron - Turbidity/CTD	SL038: Thouron - Rain Gauge

Wireless Real-Time Data Online Visualizations



STROUD WATER RESEARCH CENTER 50 YEARS Est. 1967

Moqzilla

http://moqups.com

My Sites | **Register a Site** | Browse Sites | Logout

Register a Site

Enter a Site Code *

Site code

Enter a Site Code *

Site name

Enter the Latitude of the Site *

Latitude

Enter the Longitude of the Site *

Longitude

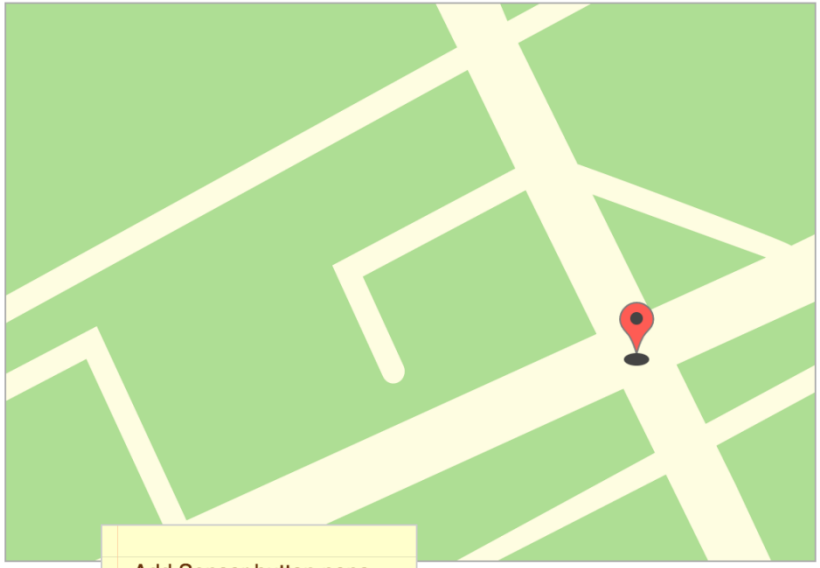
Enter the Elevation of the Site (optional)

Elevation

Choose the datum for the site's elevation (optional)

Elevation Datum

Click on the map to update site coordinates and elevation



Add Sensor button pops up a modal window to add a new sensor to the site

Sensors deployed at this site

Add Sensor

▾ Equipment Model	▾ Measured Variable	▾ Units	▾ Sampled Medium
Sensor 1	Temperature	Deg. C	Liquid aqueous
Sensor 2	Temperature	Deg. C	Soil
Sensor 3	Dissolved oxygen	mg/L	Liquid aqueous
Sensor 4	pH	SU	Liquid aqueous

UD Center

50 Years Est. 1967

Contribute to EnviroDIY!

EnviroDIY. org is community-built

We encourage you to help us build it!

- Learn and Share at http://envirodiy.org/
- Contribute at https://github.com/EnviroDIY

STROUD WATER RESEARCH CENTER 50 YEARS Est. 1967

EnviroDIY: A Vision for Do-It-Yourself Environmental Science & Monitoring

1. Crowd-source development by DIY Enviro-Sensing community results in …
2. Open-source hardware & software solutions that are low cost, easy to learn and easy to use, leading to …
3. An explosion of high-quality real-time data that transforms the practice of resource management, watershed protection and environmental science.

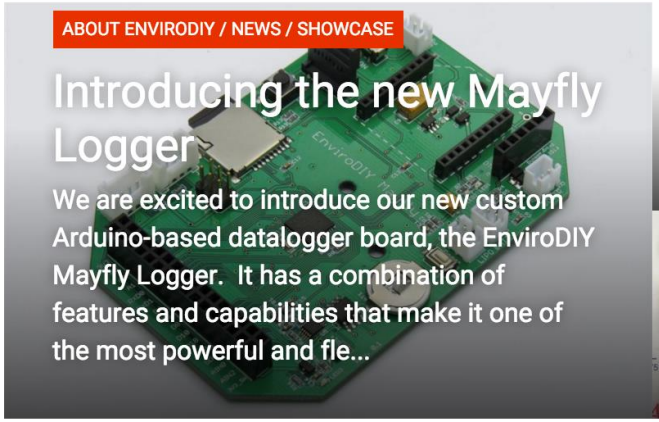
EnviroDIY

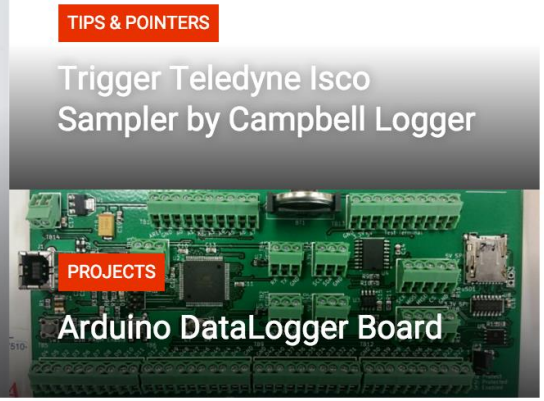
WELCOME TO ENVIRODIY™!

We're a community of enthusiasts sharing do-it-yourself ideas for environmental science and monitoring. This is the place to showcase your gadgets, share your ideas, ask and answer questions, and network with interest groups. Find out how to get started.

Latest Posts

See All Items >





MEMBERS NEWEST ACTIVE POPULAR

Jdeere78
active 14 hours, 8 minutes ago

Heather Brooks
active 16 hours, 28 minutes ago

Ethan Canup
active 17 hours, 8 minutes ago

FORUM SPOTLIGHT

Never miss a post.

Sign up for a daily or weekly digest. You'll only get an email when there's activity and you can unsubscribe at any time.

Subscribe now

RECENT FORUM TOPICS

Large Particle Velocity Measurement by neilh

Graphing Software by prairietech

oceanography by Angel

Custom Arduino-based sensor, off-the-shelf SDI-12 datalogger by Danny Wasielewski

RECENT FORUM REPLIES

Andrew on **Large Particle Velocity Measurement**

Wes Lauer on **Large Particle Velocity Measurement**

Steve Roberts on **Seeeduino Stalker v3.0 discussion**

neilh on **Flood Network – Level Sensor Network**

GitHub, Inc. [US] https://github.com/EnviroDIY

This organization Search Pull requests Issues Gist

EnviroDIY

Do-It-Yourself Environmental Science & Monitoring

Stroud Water Research ... http://envirodiy.org/ info@envirodiy.org

Repositories People 6 Teams 0 Projects 0 Settings

Search repositories... Type: All Language: All Customize pinned repositories New

EnviroDIY_Mayfly_Logger

Sketches and documentation for Arduino-compatible EnviroDIY Mayfly data logger

Arduino 1 1 Updated 6 days ago

Libraries

Arduino libraries used with the Mayfly board

C++ Updated 14 days ago

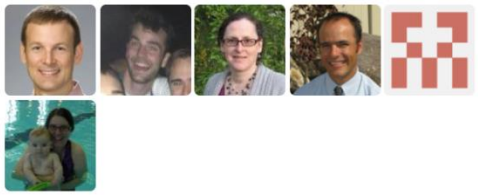
Arduino_boards

Updated on Oct 18

Top languages

C++ Arduino

People 6 >



Invite someone

Automated Samplers (ISCOs)

Automated Samplers (ISCOs)

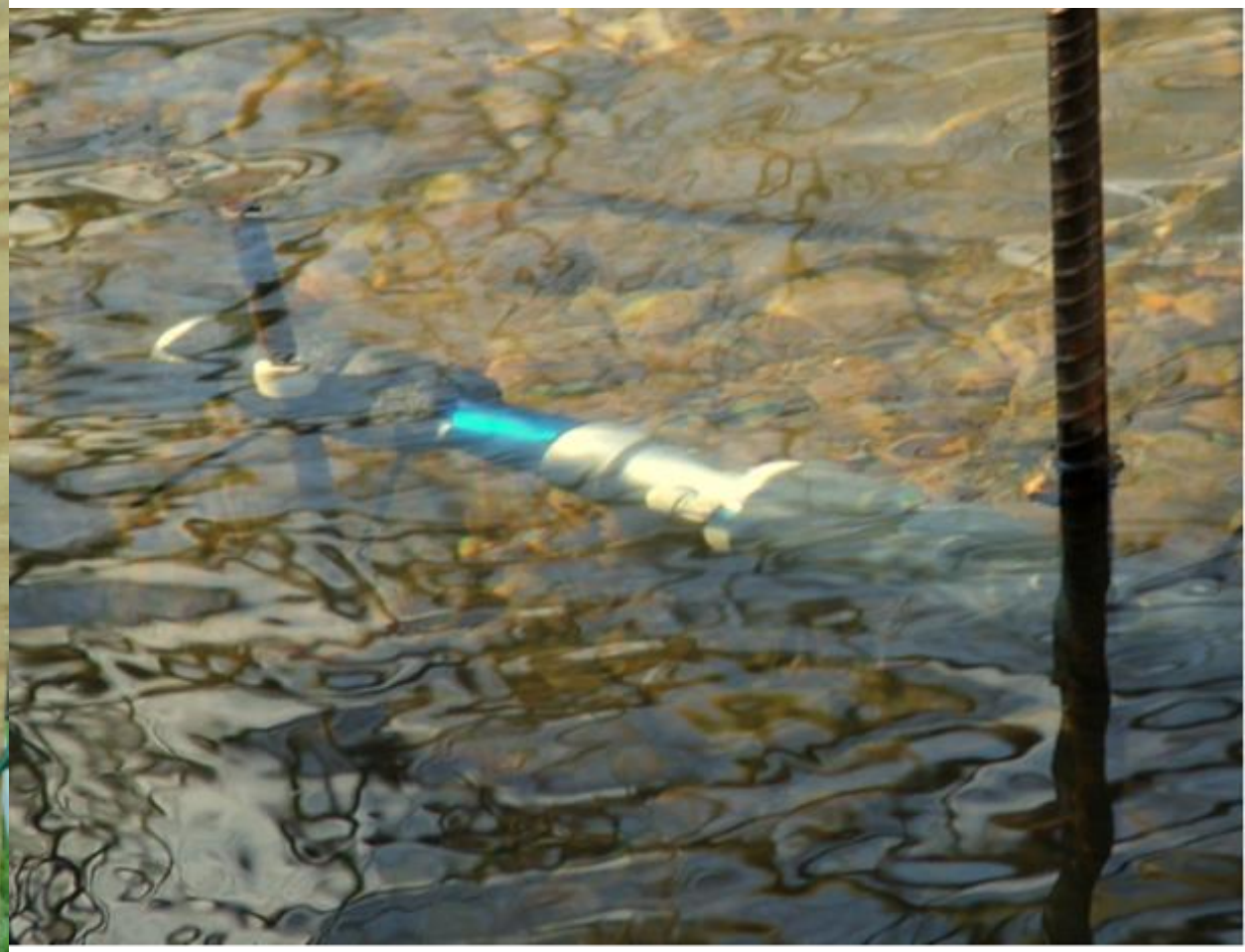
Automated Samplers (ISCOs) and Hydro-chem Monitoring Station

Automated Samplers (ISCOs)

In Situ UV-Vis Spectrophotometer

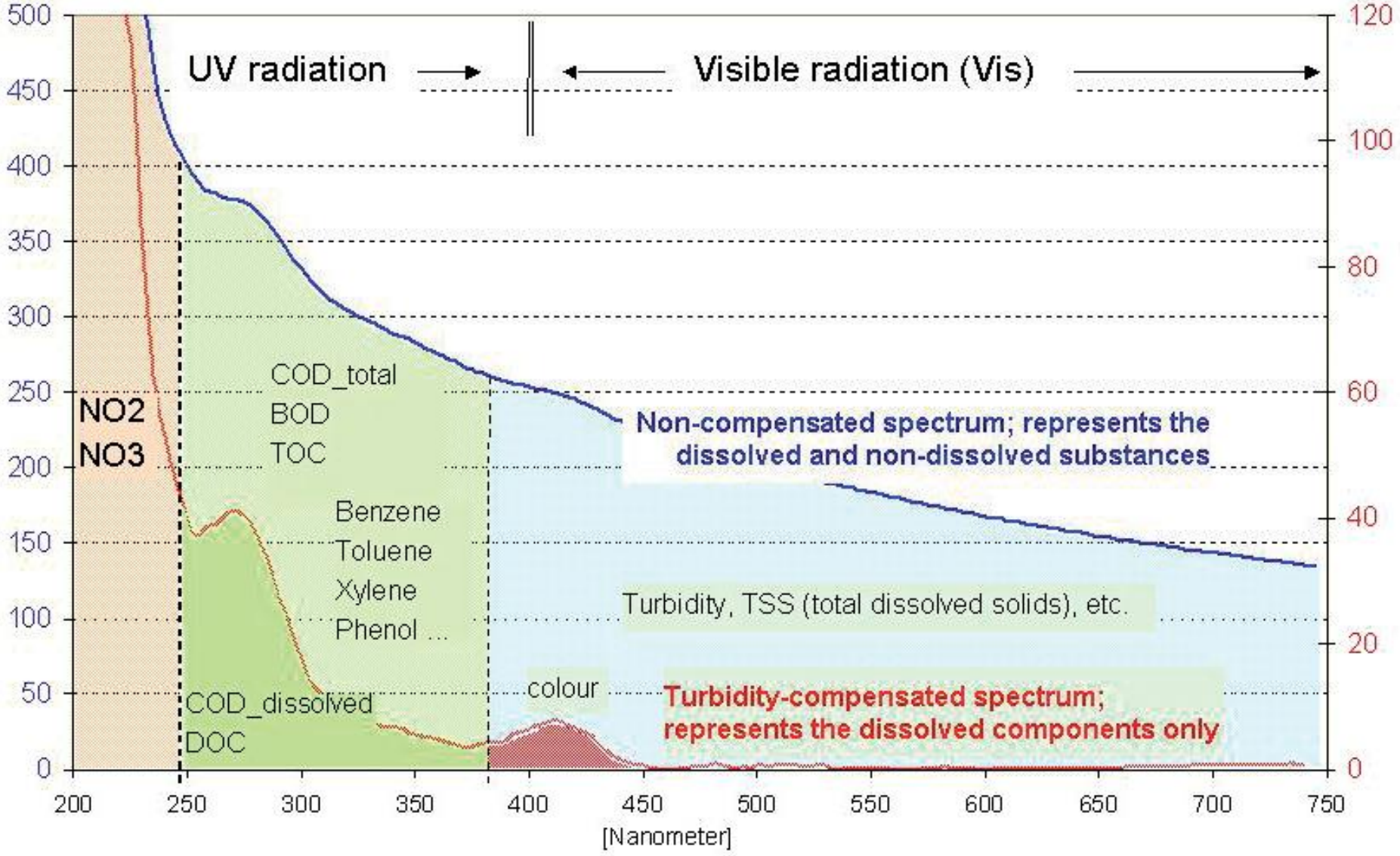
s::can spectro::lyser

- Full spectrum UV-visible absorbance
  - 256 measurements from 220 nm to 720 nm
- Dual beam; Xenon flash lamp with 10-year life
- Automated cleaning w/ compressed air every 10-60 min
- Multiple path lengths
  - 5 mm path length; Sapphire window
  - 35 mm path length; Quartz window

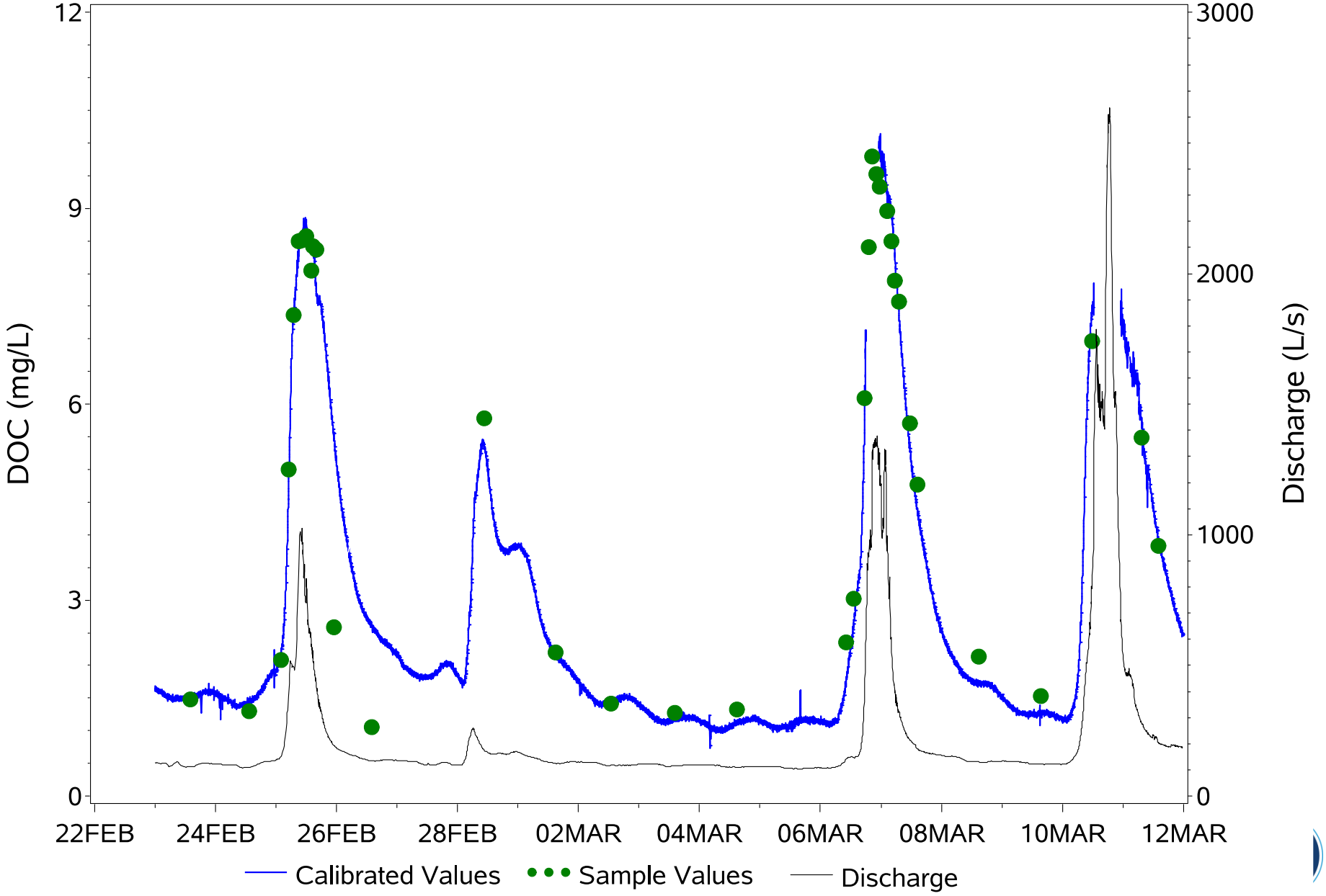


STROUD WATER RESEARCH CENTER
50 YEARS Est. 1967

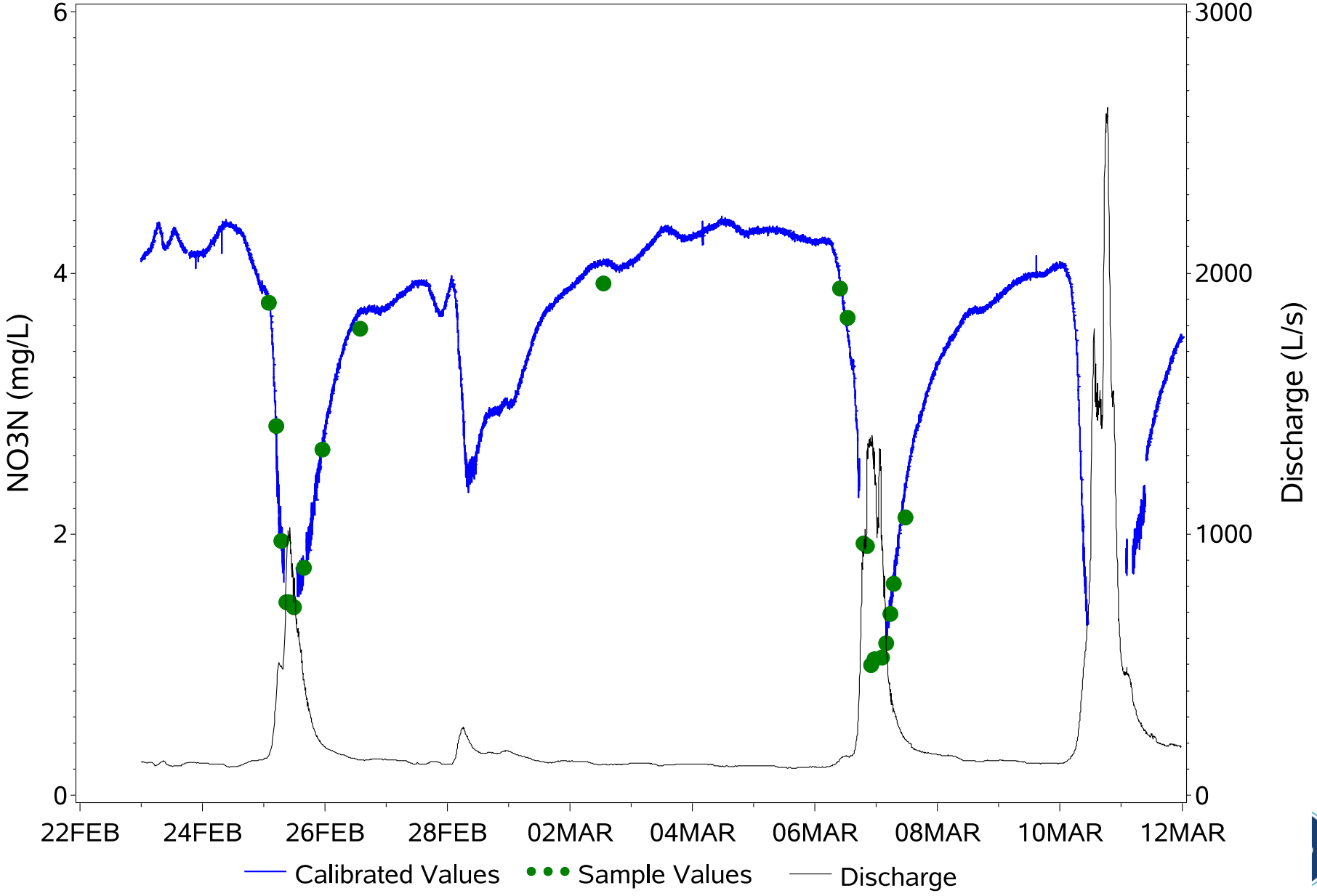
In Situ UV-Vis-Derived Parameters



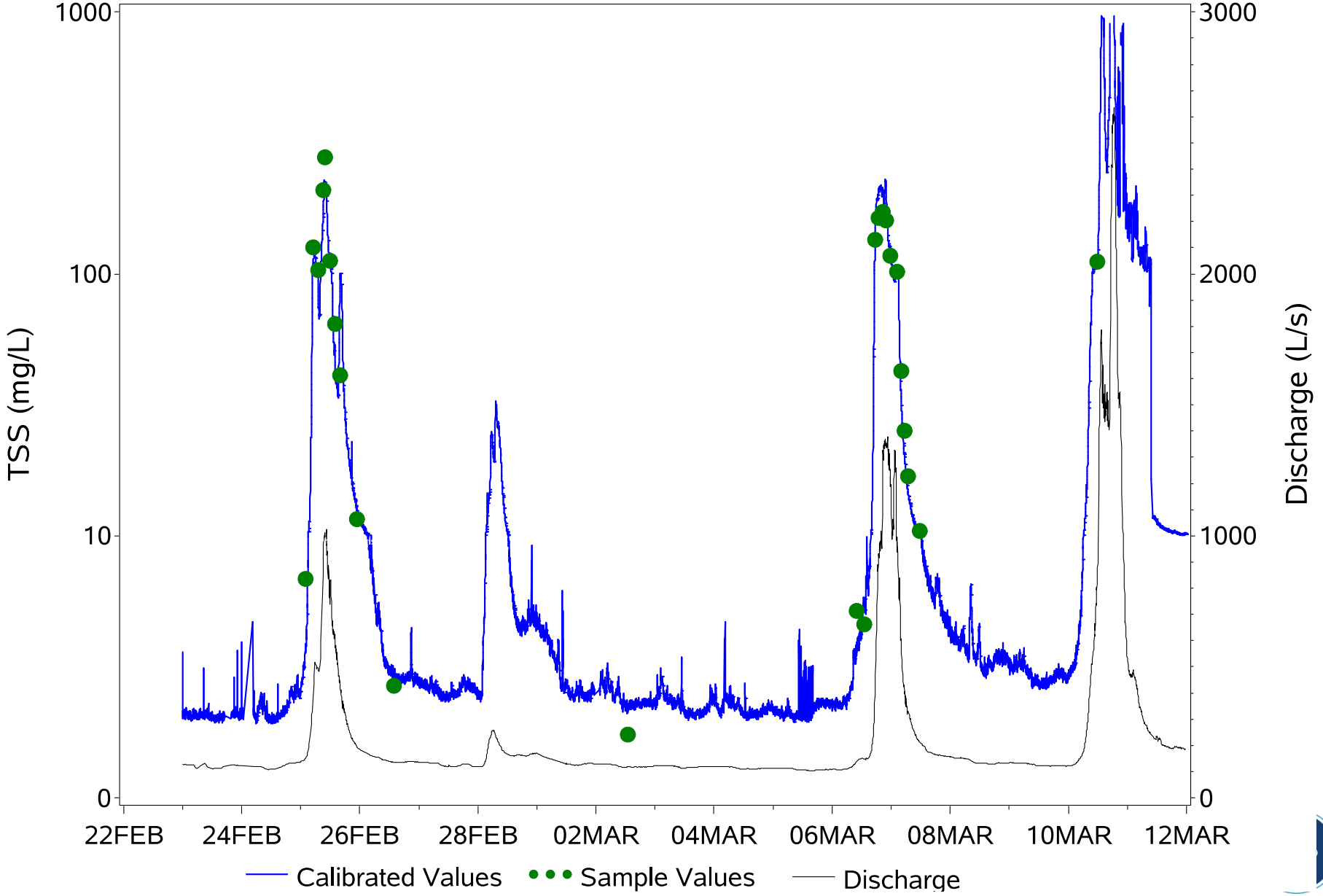
DOC w/ Drift-Correction & Local Calibration



Nitrate w/ Drift-Correction & Local Calibration



TSS w/ Drift-Correction & Local Calibration



Online Professional & Education Toolkit

David Arscott, Melinda Daniels, Steve Kerlin,
Tara Muenz, Dave Bressler, Susan E. Gill (retired),

Anthony Aufdenkampe, LimnoTech
Barry Evans, Penn State U., Stroud Center
David Tarboton, Utah State U.
Jeffrey S. Horsburgh, Utah State U.
Scott Haag, Academy Nat. Sci., Drexel U.
Robert Cheetham, Azavea
Emilio Mayorga, U. Washington

Nanette Marcum-Dietrich, Millersville U.
Carolyn Staudt, Concord Consortium

Funding from:

- William Penn Foundation, Delaware River Watershed Initiative
- NSF DRK12 Grant No. DRL-1417722 “Teaching Environmental Sustainability - Model My Watershed” 4-year Project
- Stroud Water Research Center

- Funded by:
  - William Penn Foundation, Delaware River Watershed Initiative
  - NSF DR-K12 “Teaching Environmental Sustainability - Model My Watershed” Project

- Available via:
  - http://wikiwatershed.org
  - https://app.wikiwatershed.org

Current Resources

A Web toolkit to support citizens, conservation practitioners, municipal decision-makers, researchers, educators, and students to collaboratively advance knowledge and stewardship of fresh water.

- **Model My Watershed®** – Watershed-modeling Web app to analyze real geo-data, model storms and compare conservation or development scenarios in your watershed.

- **Model Micro Site Runoff** – Animated simplified version of site storm model of Model My Watershed.

- **EnviroDIY™** – Community of do-it-yourself enthusiasts sharing open-source ideas for environmental science and monitoring. Includes discussion about low-cost data loggers (Mayfly version loggers available from Stroud Center).

Stroud Water Research Center 50 Years Est. 1967

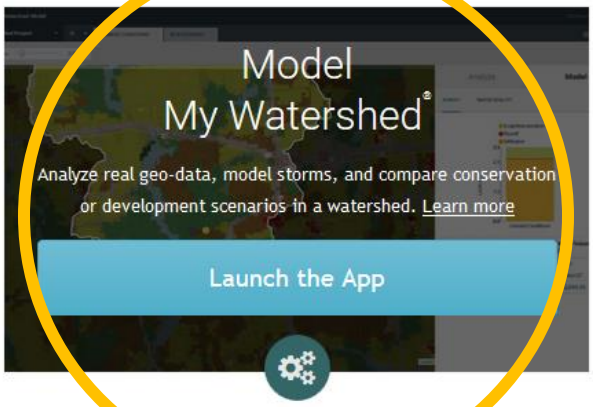
Current Resources

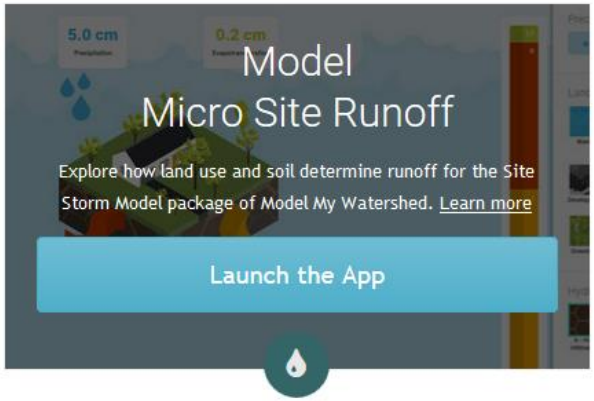
- **Monitor My Watershed®** – Envisioned Web app for interactive map-based discovery, visualization, and sharing of data from federal, state, academic and citizen sources; and resources to assist citizens to monitor their watersheds using low-cost monitoring approaches based on sound science.

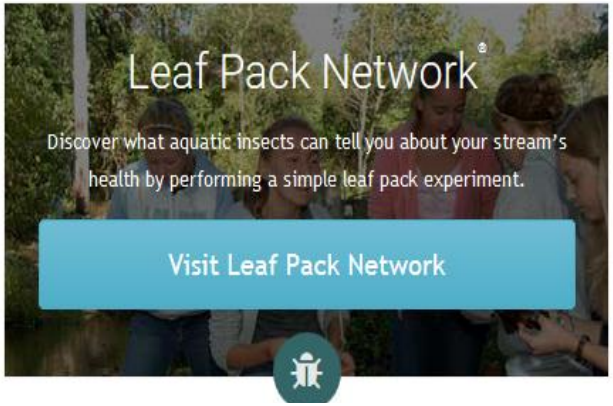
- **Leaf Pack Network®** - International network of stream macroinvertebrate monitoring data and accessing resources.

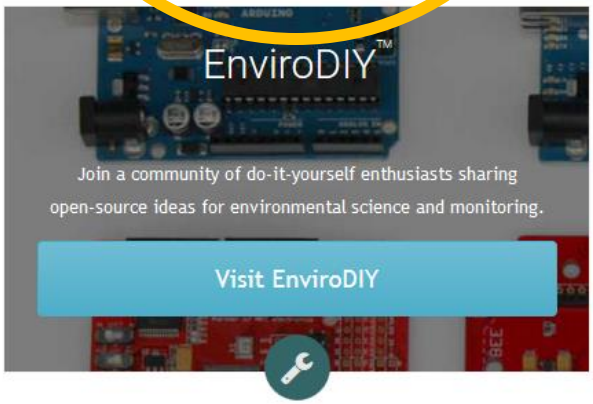
- **Water Quality App™ -** Data collection tool for tablets and smartphones with digital field guide to basic macroinvertebrates, ability to make sense of chemical and physical stream data, record site profile information, calculate macro PTI, and export data. Send data to a spreadsheet and geo-reference your site. Available at from Google Play and iTunes.

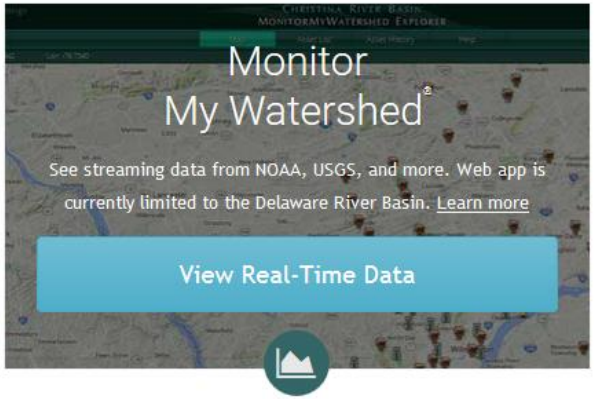
WikiWatershed®

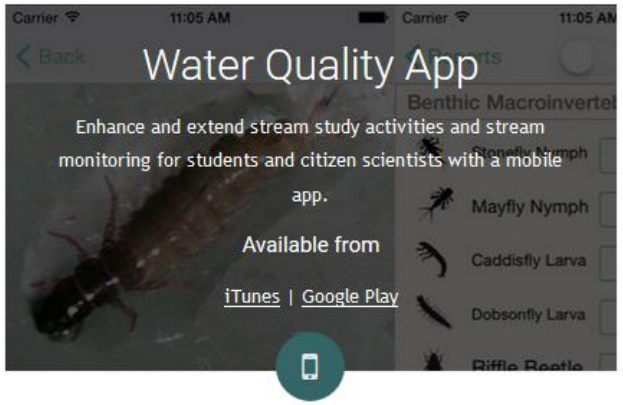












STROUD WATER RESEARCH CENTER
50 YEARS Est. 1967

Web Demo

- http://wikiwatershed.org
- https://app.wikiwatershed.org

Model My Watershed Features

- Satellite, Street, & Terrain Basemap Layers
- National & Delaware River Basin Stream Network Visualizations
- USGS HUC Watershed Units, County Lines, Congressional Districts, School Districts, PA Municipalities Boundary Overlays
- National Land Cover Database, Hydrologic Soil Groups, PA Urbanized Areas Coverage Overlays
- Data from USGS, DRB Point Source, and Other Sensor & Collection Stations as Observation Layers
- Ability to Free Draw and Area or Select 1 Square Km
- Rapid Watershed Delineation (using TauDEM)

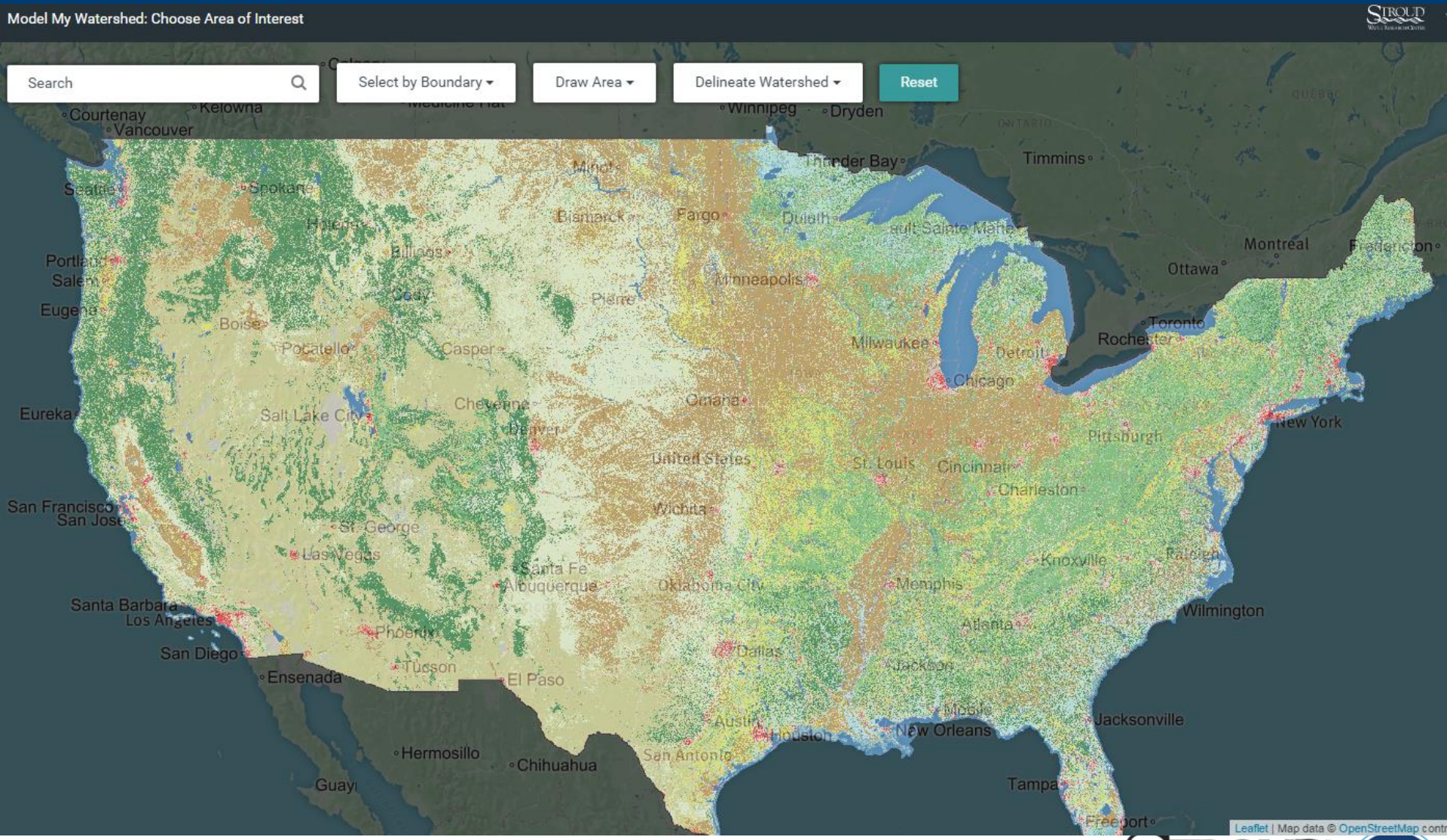
Model My Watershed Features

- Analysis of Land Cover, Soil, Animals, & Point Source Data for Selected Areas
- Community: Save, Share & Compare work as “My Projects”
- Site Storm Model Package
    - *Runoff* from TR55 + Robert Pitts’ urban small storm algorithms in WinSLAMM
    - *Water Quality* from EPA STEP-L
- Watershed Multiyear Model Package
    - New GIS layers, *Hydrology & Water Quality* data from MapShed
- Ability to Create & Compare Scenarios of Modeled Changes to Land Cover and Conservation Practices

MMW Future Features

- Stream Network Analysis outputs
  - Stream Network stats
  - Riparian Buffer characteristics
- Additional Map layers for visualization & analysis
- Import/Export Model work to other software
- Watershed Multi-Year model (MapShed) power functions
- & More…

Wiki Watershed®



STROUD WATER RESEARCH CENTER

50 YEARS Est. 1967