ENVIRONMENTAL monitor

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Application and technology news for environmental professionals

LOOKING Beneath THE Surface

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FONDRIEST
ENVIRONMENTAL

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With publications covering a wide range of measurement parameters, instruments, and techniques, Fondriest's selection of online guides are ideal reference materials for environmental professionals. The Measurement Parameter Series covers a single monitoring parameter per guide, such as phosphorus, turbidity, or dissolved oxygen, and includes detailed information about their chemical characteristics, effects on the environment and human health, and how they are measured. The Sampling & Monitoring Series includes concise, practical monitoring advice. Each guide is geared toward a specific project type, such as monitoring turbidity at dredging sites, stream restorations, or buoy profiling. To access this library of environmental literature, click on "Guides" or "Parameters" under the "Media" tab on the Fondriest website.

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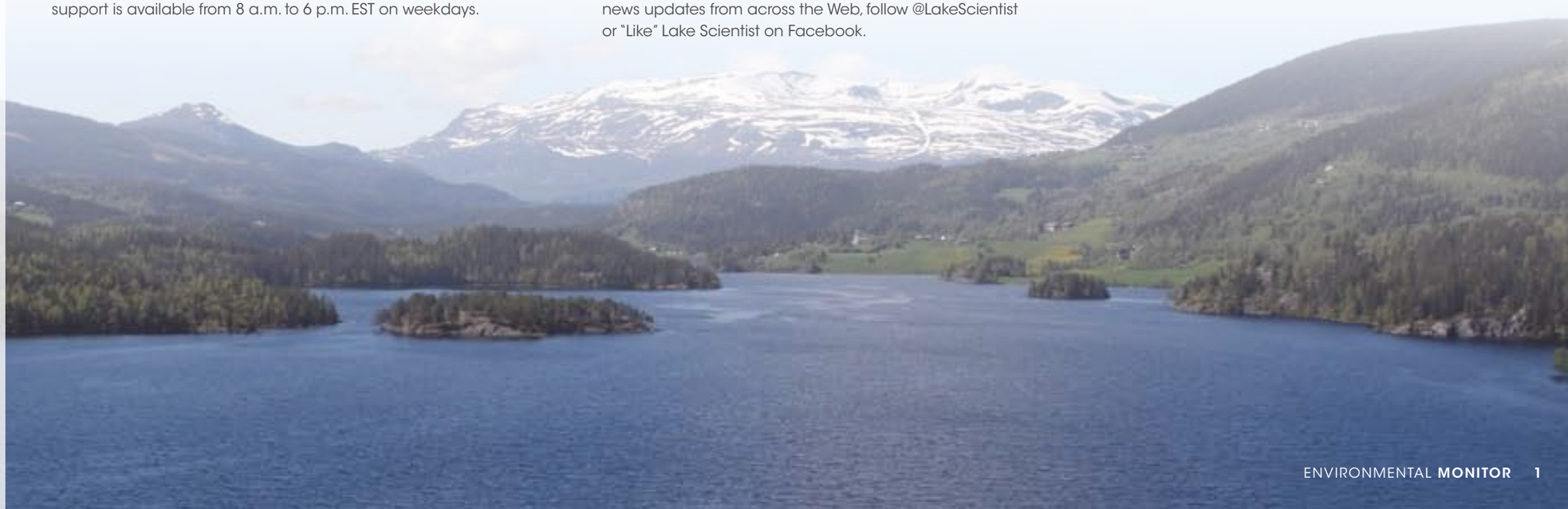
Lake Scientist
LakeScientist.com was launched this year to promote a greater consciousness about the pressing issues facing lakes and other freshwaters. The site was founded with the belief that research and education are critical to understanding and conserving the planet's water resources. The new website offers an educational database about lake science, while also covering the latest on topics that affect the world's freshwaters. Relevant and current news articles are posted daily, and a "Learn About Lakes" section is filled with educational curriculum that covers topics including what differentiates lakes, eutrophication, pollution, harmful algal blooms, water monitoring technology, aquatic life, how lakes form, and much more.



LOOKING Beneath THE Surface

Research team explores river morphology on Lake Erie tributaries

Researchers transect the Sandusky River for a bathymetric profile.

Fondriest Applications Engineer Greg Loughnane assists Wayne State civil engineering student Robert Feister with post-processing of bathymetric data.

As sediment transport and erosion alters portions of the Maumee and Sandusky rivers in northern Ohio, much of the bathymetric data collected for them has become outdated — by more than 50 years in some cases. A research team under the direction of Wayne State University's Carol Miller wants to understand how channel processes have shifted these river-bottom landscapes.

The team includes personnel from Wayne State University, the Great Lakes Environmental Center, and the U.S. Army Corps of Engineers. The researchers are using data from a series of bathymetric surveys and collection of sediment cores.

The survey is part of the team's larger effort to estimate the rate of sediment deposition behind the network of dams in the Great Lakes watershed that are tributary to federal harbors.

> "We hope to obtain historical bathymetry for all sites so that we can compare it to the new bathymetry to assist in the estimation of sedimentation rates."
>
> *– Adam Lacey, Wayne State University*

There are more than 100 federal harbors or federally maintained navigation channels in the Great Lakes, through which almost all of the precipitation falling in the Great Lakes Basin eventually passes. This results in a massive accumulation of sediment and contaminants. The U.S. Army Corps of Engineers spends approximately $40 million removing 2-4 million cubic yards of sediment from these channels annually.

Findings will be compared to historical data to establish predicted future rates of sediment accumulation, as well as remaining storage capacity. The team has collected bathymetry and sediment cores at five locations and plans to study a total of 10 to 15 sites over a three-year period.

"We hope to obtain historical bathymetry for all sites so that we can compare it to the new bathymetry to assist in the estimation of sedimentation rates," said Adam Lacey, a civil and environmental engineering student at Wayne State. "We are also trying to use sites with USGS sediment gages just upstream of the reservoir. This will allow us to develop sediment rating curves for the sites."

The research sites are intended to be representative of the overall conditions in the watershed. Selecting the appropriate locations, the researchers noted, is critical to ensuring the resulting findings can be applied to the watershed more generally. Most sites will be agricultural basins. A handful of forested and urbanized areas, however, will be used for comparison.

Dr. Mark Baskaran, geology professor at Wayne State, is in the process of dating the sediment cores to determine sedimentation rates in different areas of the reservoirs.

Additionally, to gather the needed bathymetric data, the team utilized a boat-towable SonTek RiverSurveyor M9 rented from Fondriest Environmental. The acoustic Doppler profiling unit emits ultrasonic acoustic bursts of known frequency to measure bathymetric data as well as information about river discharge.

A 500 kHz vertical beam allows for depth measurement as deep as 80 meters. Additionally, a real-time kinematic (or differential) GPS system records position data within ±3 cm accuracy.

Bluetooth connectivity provides a wireless link from the M9 to a laptop or smart phone. Bathymetric, GPS, and velocity data is then transmitted and displayed graphically in real time.

"The M9 worked great and was very easy to use," Lacey said. "The software, RiverSurveyor Live, is very user friendly, and it was easy to export into MATLAB and Excel before it was uploaded into ArcGIS." Lacey said the graphs generated by RiverSurveyor Live were also useful to the study, both in the field and for post processing.

Transported by backpack and assembled on site atop the Rocky Mountains, this modular buoy collected valuable research data on the remote Heart Lake. This alpine lake lies at an elevation of 10,350 feet and is surrounded by challenging terrain and thin atmosphere, meaning researchers had to devise a creative monitoring solution.

RESEARCH IN THE ROCKIES

Mountaintop lakes may serve as environmental sentinels

Stretched across the border between Wyoming and Montana lie the Beartooth Mountains, part of the central U.S. Rockies. Among these mountains are more than 3,000 lakes at elevations ranging from 5,000 feet to over 11,000 feet.

These lakes remain frozen for as many as 10 months of the year due to the extreme cold and deep snowpack that develops. Because of the severe climate, these lakes respond strongly to outside pressure.

They are sensitive indicators — sentinels — of both local and larger scale environmental changes. For example, while visitors to the region may remark about the pristine beauty of the lakes, research has demonstrated that nitrogen deposition from cities throughout the western U.S. has been falling on the mountains in snow and rain, slowly enriching the lakes with nitrogen.

This gradual nitrogen increase has stimulated greater algae growth and altered the underwater ecosystems in many ways. In nearby Red Lodge, Mont., records of snowfall date back many decades, highlighting dramatic changes the region has experienced. Since 1970, average annual snowfall has decreased from about 250 inches to about 100 inches per year. Such dramatic changes, common throughout the western U.S., affect everything from the prevalence of wildfires to the transparency of the lakes.

Scientists from Miami University of Ohio and the University of Maine are conducting research on a series of alpine and subalpine lakes throughout the Beartooth Mountains. Alpine lakes, lying above the tree line, are often cold and clear.

Kevin Rose is a PhD candidate in the Department of Zoology at Miami University working with Dr. Craig Williamson. Kevin's research focuses on understanding optical indicators of allochthony and carbon cycling in aquatic ecosystems.

In order to understand these sensitive ecosystems better, researchers from Miami deployed a data buoy this summer in Heart Lake, a remote alpine lake with an elevation of 10,350 feet located just inside Montana. Heart Lake lies in a small granitic watershed; steep walls shelter water that is deeper than 100 feet.

Despite its beauty, Heart Lake is unusual by alpine lake standards. While most lakes in the region are low in both dissolved organic carbon (DOC) and chlorophyll (an indicator of algal biomass), Heart Lake has unusually high chlorophyll, often as high as 15-20 µg/L. In contrast, the average chlorophyll concentration of many lakes in the region is about 1.5 µg/L. The high concentration in Heart Lake is more commonly found in Midwest agricultural reservoirs than Montana cold mountain lakes.

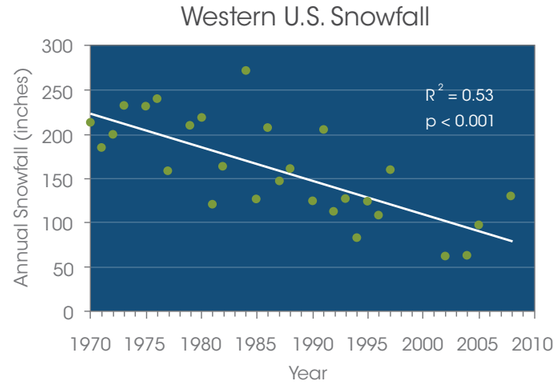
Challenging terrain, lack of roads, and thin air meant researchers had to think creatively in order to study Heart Lake. The remoteness of the lake meant all equipment had to be carried in backpacks. Additionally, since the deployment was in a National Forest, the buoy needed to have a low profile.

Working with Fondriest Environmental, graduate students at Miami designed a mobile buoy that was modular and lightweight. For example, anchors were fashioned from sleeping bag stuff sacks filled with shoreline rocks, instead of the more traditional 70-pound pyramid weights. The final buoy weight was 35 pounds (not including sensors). When scientists first visited Heart Lake in early July, several inches of ice remained. Warm summer temperatures, however, quickly melted the ice, and the buoy was deployed. Scientists visited the lake weekly throughout the rest of the summer, collecting manual samples, changing data logger batteries, and calibrating sensors.

Connected to the buoy was a YSI sonde with temperature, conductivity, dissolved oxygen, chlorophyll, and turbidity probes. Also suspended beneath the buoy was a Turner CDOM sensor (with Zebra-Tech wiper), Biospherical radiometers measuring transparency to both UV and PAR at two depths, and a temperature string to help understand the lake's thermal structure. Finally, a topside-mounted Vaisala weather station measured air temperature, wind speed, wind direction, relative humidity, barometric pressure, and rainfall. Sensors were powered and run by a NexSens SDL500 submersible data logger.

The data show that Heart lake changes rapidly once the ice cover melts. For example, the chlorophyll concentration, as estimated from the YSI probe, climbed rapidly from less than 5 µg/L to more than 11 µg/L within a week. It then quickly settled back down to a long period of about 2 µg/L until the buoy was removed in late August.

This suggests that the high chlorophyll concentration may be stimulated by nutrients in the watershed that enter the lake during snowmelt. Other data analyses are still being conducted, but these initial results suggest that alpine lakes exhibit clear signals of broader landscape phenomenon. This sentinel quality makes alpine lakes an ideal (and beautiful) place to study environmental processes and changes.



Records from Red Lodge, Mont. demonstrate the rapid decrease in snowfall over the last 30 years. These dramatic changes throughout the western U.S. affect everything from the prevalence of wildfires to the transparency of the lakes.

THE RIGHT **SOLUTION** for Stream Discharge Measurement

Advanced acoustic Doppler technology simplifies stream flow measurements and improves accuracy

River discharge is an important property in hydrology and is commonly measured in many rivers and streams. A river's discharge, or volumetric flow rate, is a measure of the amount of water that passes through a cross section of the water body per unit of time.

Estimating discharge has historically involved propeller-driven velocity sensors, rough estimates of cross sectional area, and labor-intensive computation. The introduction of modern Doppler technology, however, has significantly enhanced the accuracy and simplicity of acquiring reliable water velocity and discharge data.

Doppler sensors measure the shift in frequency of sound energy as it moves through a medium, also known as the Doppler shift. Specifically, the velocity sensors of today emit ultrasonic acoustic bursts of known frequency that are echoed back to the transducers by particulate matter in the water. The measured reverberation frequency is used to calculate the relative speed of the water, which is assumed to be moving at the same speed as the particles that reflect the sound.

Two general types of acoustic Doppler velocity sensors exist: ones that measure "point" velocities of extremely small volumes of water, and those that can produce a "profile" of water velocity over a range of depths. The former are high-frequency devices called acoustic Doppler velocimeters, or ADVs. The latter typically use lower frequencies that allow for a larger measurement range and are called Acoustic Doppler current profilers (denoted ADCPs or ADPs).

There are many variations of both types of sensors, but only a few automatically use velocity, bathymetry, and position measurements to calculate and directly output discharge data. For wadeable streams, the handheld SonTek FlowTracker consists of a side-looking Doppler probe and a mechanical wading rod. For open channels, the towable SonTek RiverSurveyor M9 combines advanced dual-frequency technology and precision GPS. Both are easily operated by one person and never require calibration.

Open Channels

The RiverSurveyor is a multiple frequency Acoustic Doppler Profiler (ADP) that measures water velocities over a range of depths.

Wadeable Streams

The FlowTracker is a high frequency Acoustic Doppler Velocimeter (ADV) that measures "point" velocities of extremely small volumes of water.

Open-Channel Discharge: RiverSurveyor M9

The RiverSurveyor M9 represents the latest in discharge measurement technology. It combines four 3 MHz beams and four 1 MHz beams with automated frequency-hopping and precision bandwidth control to provide shallow-to-deep (0-30 meter) velocity measurements. Additionally, a 500 kHz vertical beam helps extend the depth measurement range to 80 meters.

Real-time kinematic GPS allows for position data within ±3 cm accuracy. Bluetooth connectivity provides a wireless link from the M9 to a laptop or smart phone. Bathymetric, GPS, and velocity data can be transmitted and displayed graphically in real time when using a laptop within 200 meters or a smart phone within 60 meters of the M9.

The M9 requires no user-defined algorithms to change cell sizes mid-measurement. Onboard microprocessing automates cell size adjustments based on water depth. The M9 processes and stores all data independent of any other device.

Wadeable Streams: FlowTracker

The SonTek FlowTracker is an ADV designed for wadeable stream and river discharge measurements. 2D and 3D configurations are available to measure velocities down to 0.001 m/s in depths as shallow as 2 cm.

Users can set the FlowTracker to conform to either U.S. Geological Survey or International Organization for Standardization methods. The FlowTracker incorporates six velocity measurement and three discharge computation protocols.

Quality checks help ensure that erroneous data is not collected and used to estimate discharge. The waterproof handheld display even makes suggestions based on adaptive QC criteria to retake specific velocity measurements along a transect.

The FlowTracker automatically provides an uncertainty calculation for each discharge measurement that includes the uncertainty due to the instrument's resolution, the samples taken, and the propagation of error through the discharge computation.

Additionally, the ADV is outfitted with real-time velocity viewing capabilities, which make the instrument useful for spot sampling of water currents if general purpose velocity data is desired.

Hydrologist transects a stream with the SonTek FlowTracker and a USGS tagline. The FlowTracker is designed for discharge measurements in wadeable streams and rivers.

BLUE-GREEN blues

High temperatures, record-high phosphorus runoff, and frequent CSOs cause one of Lake Erie's worst algal blooms

Satellite imagery shows Lake Erie covered in the toxic blue-green algae that has swept across the Midwest this summer.

Lake Erie rose from the dead in the 1980s, but it appears to be in the midst of a relapse.

The lake is now under attack from algal blooms that rival the severity of those from the late 1960s and early 1970s, a time when the news media declared Erie a "dead lake" for its thick algal mats, low dissolved oxygen, and inability to support most aquatic life.

Algae foul shorelines, lower property values, and deplete the water of oxygen that aquatic life needs to survive. Worse yet, the lake is besieged by Microcystis, or blue-green algae, a toxic form of algae that is considered harmful to wildlife and humans. It can produce several liver and nerve toxins, and, unlike other algae, it is completely useless to the lake's food web. The blue-green algal blooms in western Lake Erie are so severe they can be seen from space.

This was the third summer in a row of excessive blue-green algae in the lake, according to Tom Bridgeman, a researcher at the University of Toledo's Lake Erie Center. Some scientists and lake advocates worry it's a warning sign; the Great Lake that once rose from the grave is sliding backwards.

The resurgence of algal blooms has again worsened the lake's dead zone — a hypoxic area devoid of dissolved oxygen that appears in the central basin during late summer. The Ohio Division of Wildlife Sandusky Fish Research Unit even suspects the toxic Microcystis could be part of the reason Lake Erie walleye hatches have been poor in recent years. Walleye thrived when algal blooms weren't an issue, but the last major hatch occurred in 2003. They've been mostly below average since then.

Nutrient loading, or eutrophication, that feeds the algae has worsened due to record-high phosphorus runoff and a rising number of sewage overflows. Moreover, the summer's hotter-than-average temperatures exacerbated the situation and increased the rate of algal growth. This combination of factors created something of a perfect storm in the vulnerable western basin, which lies sandwiched between Detroit and

Harmful algae and combined sewer overflows resulted in an increased number of beach closures along Lake Erie.

Toledo and collects sewage overflows from both large municipalities as well as agricultural runoff from surrounding farmland.

Two of the lake's major tributaries — the Maumee and Sandusky rivers — showed some of their highest-ever phosphorus levels this summer, according to a report released in July from scientists at Heidelberg University's National Center for Water Quality Research.

Researchers took three samples per day from April through June and measured 261 tons of dissolved phosphorus in the Maumee River, which is the highest level the university has recorded in its 33 years of monitoring the river. Additionally, levels in the Sandusky River during the same period were at their second highest rate in 35 years.

> "Some scientists and lake advocates worry it's a warning sign; the Great Lake that once rose from the grave is sliding backwards."

Dissolved phosphorus entering the Maumee and Sandusky rivers has more than tripled since 1995, according to the Ohio Lake Erie Phosphorus Task Force. Palpable examples of this worsening nutrient loading can be seen elsewhere within the Lake Erie watershed. Take for example Grand Lake St. Marys, Ohio's largest inland lake, which experienced a massive blue-green algal bloom that was so intense the lake had to be completely shut down.

Runoff from farms is the leading source of this phosphorus pollution. Lake Erie's drainage basin covers 30,140 square miles, and much of this land is used for agriculture. Excess phosphorus-based fertilizer is commonly applied to farmland, and rain washes it into nearby waterways.

Phosphorus levels were particularly high this year because heavy rainfall in the spring and early summer generated greater than usual farmland runoff, according to Ken Krieger, director of the National Center for Water Quality Research at Heidelberg. Many scientists associate these weather fluctuations with global climate change. In fact, research by the University of Illinois and Texas Tech University for the Chicago Climate Action Plan indicates that precipitation could increase by as much as 20 percent by the end of the century.

Adding to the mess, the Great Lakes are in the midst of what some have termed a "sewage crisis." Combined sewer overflows, or CSOs, have worsened thanks to the heavy rainfall and increased urbanization.

Combined sewer systems collect stormwater runoff, along with raw sewage and industrial wastewater. They normally flow into a water treatment plant. During a sewer overflow, however, this toxic brew is released directly into nearby surface waters.

Not only does the overflowed sewage create a productive breeding ground for harmful bacteria, such as E. coli, it also serves as another source of excessive nutrient loading that feeds algae.

From January 2009 through January 2010, five U.S. cities — Detroit, Cleveland, Buffalo, Milwaukee and Gary, Ind. — discharged a cumulative 41 billion gallons of untreated sewage and stormwater into the Great Lakes from combined sewer systems, according to a new report from Healing Our Waters-Great Lakes Coalition.

Toledo alone has released raw sewage into Lake Erie tributaries, such as the Maumee River, during every month for the past year, including the winter, according to The Toledo Blade. Two incidents during the summer lasted more than 24 consecutive hours. In May, there were 127 Toledo-based overflows, and June had 112.

Increased funding from sources such as the $475 million Great Lakes Restoration Initiative is helping to support projects that aim to mitigate or at least predict harmful algal blooms. Many experts warn, however, that significant widespread reductions in phosphorus runoff and CSOs are needed to cure Lake Erie of its algal affliction.

NexSens

MB-100 DATA BUOY

Able to deploy in under 10 minutes — with one person — and for a fraction of the cost of any other system available, the new ultra portable NexSens MB-100 data buoy is changing how people think about water monitoring. Together with the NexSens SDL submersible data logger, it forms a reliable, easy-to-use, and cost effective real-time water monitoring solution in both surface and sub-surface applications.

The MB-100 is designed to suit open-water and near-shore water monitoring applications. It is small and lightweight, but not at the expense of quality or durability. With an inner core of cross-linked polyethylene foam, heavy polymer skin, and an indestructible stainless steel frame, this unit can withstand the roughest of seas and provide years of service.

All sensor connections are concealed below the surface with ruggedized waterproof connectors. A wireless transmitter can be positioned above the water but hidden and protected under the buoy hood. Depending on application needs, sensors can be suspended from the buoy along a mooring line in order to make water column measurements, or they can be positioned just beneath the buoy, providing greater protection.

A fully-loaded system (with data logger and batteries) weighs just over 30 pounds and is easily deployed by one person from any vessel. Simply attach a single-point mooring assembly and throw it overboard. The buoy will right itself and begin logging data immediately.

Weighing just over 30 pounds as a fully-loaded system, the MB-100 is easily deployed from any boat by one person.

The MB-100 is the perfect platform for a NexSens SDL submersible data logger, which supports nearly every environmental sensor interface and can transmit data wirelessly in real time. It can withstand even the harshest conditions and run for months on alkaline batteries. The SDL consists of the data logging hardware and communication module housed in a fully-submersible, five-inch-diameter round enclosure.

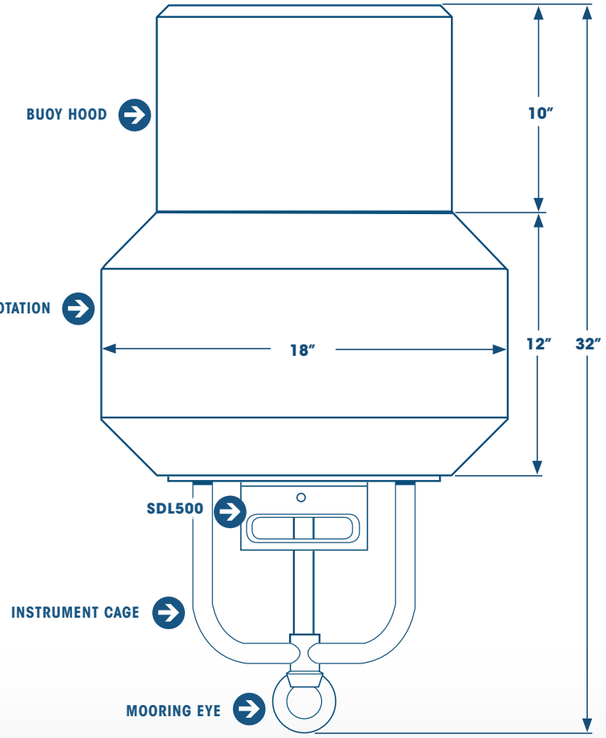
A **LIGHTWEIGHT** *and* **DURABLE** **data buoy** for open-water monitoring projects

The SDL can be outfitted with a spread-spectrum radio, cellular, or Iridium satellite modem and antenna for real-time communication with an off-site project computer. It is able to interface with multi-parameter sondes, water quality sensors, temperature strings, Doppler velocity meters, and many other sensors. It is configured with five sensor ports for connection to industry-standard communication protocols, including SDI-12, RS-485, 1-wire, 0-2.5 VDC, pulse count, and digital I/O. With this interface versatility, the measurement possibilities are endless.

With iChart software and the WQData web service, posting online data is quick and convenient. Data can be presented on a public portal or password-protected website and is accessible with any desktop, laptop, or smart phone. Moreover, HTML and text-based applets make it easy to incorporate the latest data on other websites.

At an affordable price point, building a network of multiple buoys is now an option for many projects.

Learn more
Scan this with a smart phone using free software from neoreader.com for online product details.
bit.ly/mb100



To the passerby, the MB-100 appears to be a simple marker buoy. Safely hidden beneath its hood, though, is the powerful SDL submersible data logger with wireless transmission options.

Product Spotlight:
Water Quality

MULTI-PARAMETER Water Quality Meter

Field-rugged meter simultaneously measures dissolved oxygen, conductivity, pH, ORP, temperature, and more

YSI's Professional Series handheld instruments are designed specifically for water quality professionals, and the product line's development was based heavily on their input.

The new field-rugged YSI Professional Plus is the flagship of the Pro Series and the most flexible. It provides measurement possibilities for a variety of water parameters, including sensor options for dissolved oxygen, conductivity, specific conductance, salinity, resistivity, total dissolved solids (TDS), pH, ORP, ammonium, nitrate, chloride, and temperature.

It's possible to use lab or field probes with the Pro Plus and quickly switch between the two. It can even function as a lab BOD instrument with the proven self-stirring BOD probe.

A variety of cable and probe options are available, with cable lengths of 1m, 4m, 10m, 20m, and 30m. Additionally, lengths of up to 100m are possible for dissolved oxygen-only cables.

The Pro Plus instrument is rated to IP-67 standards even without the battery cover on. Other tough features include a three-year display warranty, MIL-spec connectors, rubber over-molded case, and a two-year cable warranty.

In-house testing procedures also include 1m drop tests from all angles to ensure expected field durability.

The Pro Plus' features include password protection, backlit display and keypad, graphic display with detailed help functionality, recalibration prompts, user-defined fields, detailed GLP, auto stable, Hold All Readings function, USB connection, auto buffer recognition, and flexible folders and site lists for logging data. The included software allows users to download data, configure instruments, and conduct real-time studies.

In addition to the versatile Pro Plus, other meters in the series include the ProODO optical dissolved oxygen meter, Pro20 polarographic/galvanic dissolved oxygen meter, and the Pro2030 dissolved oxygen and conductivity meter.

Learn more
Scan this with a smart phone using free software from neoreader.com for online product details.
http://bit.ly/ysiproplus

Product Spotlight:
Water Quality

POCKET Colorimeter

Portable water chemistry meter provides quick and easy field measurements of ammonia, chlorine, nitrate, and phosphate

Hach's Pocket Colorimeter II Filter Photometer is a true go-anywhere instrument. It is lightweight, battery operated, and suitable for extended field work or quick, on-the-spot process monitoring.

The instrument is now waterproof, meaning it can stay submerged at three feet for 30 minutes and remain fully functional. It is so lightweight (only 8 ounces) that it actually floats. The low-cost Pocket Colorimeter II has accuracy comparable to a lab instrument yet is simple enough to use that anyone can obtain reliable results.

Each colorimeter measures 1-2 parameters, with a total of 35 parameters available, including ammonia, chlorine, nitrate, and phosphate. Many of the methods are EPA approved or accepted. Additionally, a long-lasting LED light source allows for expanded ranges and reduces the need for dilutions.

These portable units come factory calibrated for Hach chemistry. No manual calibration is ever required. Simply zero the instrument with a blank, insert the reacted sample, and read the result. User calibrations are possible, providing the option to create custom calibration curves or perform a standard adjustment. Hach also manufactures wavelength-specific "generic" instruments, allowing users to enter their own methods using from two up to 10 standards.

The upgraded instrument features a new data logging function that allows users to store and recall the 10 most recent data points, eliminating the need to record data manually.

A larger display with backlit capability improves readability in low light conditions. The Range Indicator icon on the display of the colorimeter indicates either the instrument range or the parameter being tested. For many parameters, the instrument can measure in two different ranges. New to the display is the battery icon, which indicates the charge level and need for battery replacement.

Each Pocket Colorimeter II Instrument comes complete as a ready-to-use kit that includes a reagent set (premeasured unit dose reagents), sturdy custom carrying case, and manual.

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http://bit.ly/hachpocket

Product Spotlight:
Hydrology

WATER LEVEL Logger

Titanium construction offers years of reliable service in a compact and affordable package

In-Situ has released a new line of low-cost, titanium water level sensors. The durable, corrosion-resistant Rugged TROLL instruments monitor and record changes in water level, pressure, and temperature.

Rugged TROLL instruments withstand harsh conditions and can monitor groundwater and surface water levels, coastal environments, landfills, flood events, storm surges, and more. Additionally, these sensors can be used to automate crest-stage gages.

Two versions of the Rugged TROLL are available. The Rugged TROLL 200 provides easy top-of-well access with RS485 or SDI-12 communication via a direct-read cable. It is designed for applications that require real-time data access via a telemetry system, PLC system, PC, or RuggedReader handheld PC. If needed, the Rugged TROLL 200 can be deployed on a suspension cable.

The Rugged TROLL 100 is built for long-term deployments that require minimal data access. Users deploy the Rugged TROLL 100 on a backshell hanger from a suspension wire to run unattended and download data via a docking station upon retrieving the instrument.

Both models have completely sealed bodies that contain an absolute (non-vented) pressure sensor, temperature sensor, real-time clock, microprocessor, lithium battery, and internal memory.

For optimum accuracy and to correct for barometric pressure changes, the titanium Rugged BaroTROLL instrument can be deployed along with a Rugged TROLL.

The Rugged BaroTROLL monitors and logs barometric pressure. Rugged TROLL units are compatible with In-Situ's user-friendly Win-Situ 5 software platform, which simplifies programming and data downloads.

Use the docking station to program and download data from the Rugged TROLL 100 or 200 or from the Rugged BaroTROLL. The docking station is available with either a USB or RS232 communication interface. USB communication allows fast data transfer to a PC. The RS232 version is used with a PC or a RuggedReader handheld PC.

In-Situ is the only manufacturer in the water monitoring industry that offers such affordable titanium water level loggers.

Learn more
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http://bit.ly/ruggedtroll

Product Spotlight:
Air Quality

ENVIRONMENTAL CO_2 Sensor

Diffusion-based design eliminates the need for bulky and power-consuming gas sampling systems

The Vaisala GMP343 Carbon Dioxide Probe is an accurate and rugged instrument for CO2 measurements. With a short warm-up time, compact build, and low power consumption, it is suitable for a wide range of monitoring needs, including soil respiration measurements, ambient CO2 monitoring, plant growth chambers, and OEM applications.

Using a diffusion-based design, the GMP343 eliminates the need for bulky and power-consuming gas sampling systems. The use of diffusion aspiration also avoids measurement error caused by pressure differences, which are often present in pump-aspirated measurement systems. With ultra-low power consumption — below one watt — the unit is ideal for battery- and solar-powered applications. A flow-through unit is also available.

Each probe is factory calibrated using 0.5% accurate gases at seven points, ranging from 0 to 2% CO_2. This calibration is also performed at four temperature points ranging from -30° C to 50° C. For recalibration, the multipoint calibration feature supports up to eight points. The GMP343 offers internal temperature compensation and user-defined relative humidity, pressure, and oxygen compensation.

The GMP343 can output both numerically filtered and raw measurement data, and it also compensates readings with an internal temperature measurement and user-set relative humidity, pressure, and oxygen values.

The body of the GMP343 is completely field rugged. It is IP67-classified, making it suitable for harsh environments. The sensor's membrane filter protects it from dust and dirt, and heated optics prevent the formation of condensation.

In combination with an MI70 indicator, the GMP343 provides an ideal tool for accurate spot measurements. The MI70 is used as a display, communication, and data logging device. To achieve most accurate measurements, a Vaisala HMP75 humidity probe can be connected to the MI70 indicator for automatic humidity compensation.

The GMP343 offers the precision, versatility, and ruggedness needed for long-term deployment and reliable data collection in many ecological research applications.

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Pursuing Ecology's 'Digital Revolution'

Real-time water quality and flow stations allow Cleveland Metroparks to study urban streams and wetlands in ways previously impossible

Cleveland Metroparks Aquatic Biologist Michael Durkalec examines a YSI multi-parameter water quality sonde at a wetlands monitoring site in the 2,600 acre Rocky River Reservation.

Cleveland's metroparks are at the receiving end of heavy runoff from surrounding communities. The parks have become catch basins for stormwater, which is impacting aquatic habitat, eroding hundreds of miles of riverbanks, and flushing sediment into Lake Erie.

A study underway by Cleveland Metroparks within the Rocky River watershed is examining the hydrology of the vulnerable headwater streams affected by the runoff, as well as the effectiveness of small wetlands for water storage and water quality improvement. Unlike previous studies, though, researchers are utilizing real-time flow and water quality sensors to attain precise, short-interval hydrograph and water quality data.

Instead of the daily or monthly samples and level measurements used in existing research, the continuous monitoring network provides data every 15 minutes. This level of detail has generated some findings that defy conventional wisdom.

Unforeseen Results

Being able to turn up the unexpected is one of the key advantages to having the continuous, real-time data, noted John Mack, Metroparks' chief of natural resources.

"With the flow meters, we're getting actual quantities of water. That level of detail allows us to find stuff that we couldn't before," he said. "We sometimes don't know what we're going to find, because no one has ever been able to collect this kind of data."

In fact, after monitoring stations were installed last winter, something about the initial measurements seemed entirely backwards. Existing hydrology literature would suggest flashy hydrographs are more common in urbanized streams than in pristine areas. The data indicated the opposite.

"The first data that came in showed that the more pristine streams tended to be flashier, and more urbanized ones exhibited more of a sustained, drawn-out flow," said Cleveland Metroparks Aquatic Biologist Michael Durkalec. "We thought, 'Well this isn't what we were expecting or hoping to see.'"

The more familiar trend appeared in the spring, as did a hypothesis for the unexpected winter results. The same impervious surfaces that cause stormwater to surge in the summer also act as giant heat sinks. The research team conjectured that the warm surfaces, along with road salt and other urban inputs, help snow and ice melt as it falls rather than melting all at once when temperatures rise like at pristine sites.

"It makes sense, but that relationship, as far as we know, hasn't been recognized elsewhere because people aren't using this kind of equipment with this kind of resolution," Durkalec said. "It's a trend we continue to find and make some correlations. It's kind of a unique find between summer and winter in urban streams that we didn't really expect."

Monitoring Technology

Isco 2150 Area Velocity Flow Meters monitor precise water flow data at six primary headwater streams with similar geology, catchment size, fall, and channel width but of varying hydrologic intactness. The sites include two moderately degraded, two severely degraded, and two reference streams.

Furthermore, four water quality and quantity monitoring stations are installed throughout wetlands in the 2,600 acre Rocky River Reservation, with three sites at inlet locations and one at the outlet. Two additional sites are located at wetland outflows in West Creek Preserve, a 500-acre natural park. Each of these sites is equipped with an Isco flow meter and a YSI 6920 multi-parameter sonde with temperature, pH, conductivity, ORP, dissolved oxygen, and turbidity probes. Sensors connect to a NexSens data logger with real-time cellular telemetry. By comparing the inlet and outlet data, the research team is able to quantify the wetlands' exact levels of water storage and effectiveness at reducing pollutants.

The stations are part of a pilot project for monitoring larger watershed restoration projects, Mack said.

"The ultimate goal is to do urban watershed restoration using real short-interval data to track performance," he said. "We're trying to figure out how to use the equipment and work out the kinks before using it on a larger scale."

A "Normal Hydrograph"

Durkalec noted that a primary goal for the project is to gather reference data for small headwater streams in the area, which are often "under the radar" versus monitoring programs for larger waterways.

"A question we're trying to answer is what a normal hydrograph is for a stream with a three-mile drainage area in our watershed," Durkalec said. He added that all of the monitoring sites were deliberately placed within the Rocky River watershed so the data would be as comparable as possible.

(Continued on next page)

Claire Weldon, Cleveland Metroparks aquatic research coordinator, runs diagnostics on an Isco flow meter at a wetlands monitoring station.

A wetland monitoring station in the 500-acre West Creek Preserve transmits weather, water quality, and hydrology data via real-time cellular telemetry.

(Continued from previous page) "We're trying to come up with a baseline that we can compare other data to as far as what is a healthy hydrograph," he said. "Interestingly, it looks like it's going to be seasonally variable. But just having that benchmark, we're starting to come up with some general curves as to what is normal versus what is a more impaired hydrograph for these streams."

Urbanization's Impact on the Metroparks

Increased stormwater runoff resulting from urban development has had a number of undesirable consequences for the parks system and overall watershed health. The unnaturally high flow rates overwhelm headwater streams, which serve as tributaries for larger streams and rivers.

Under normal circumstances, headwaters moderate flow from heavy rains, process nutrients, and reduce sediment. They also provide habitat for unique native flora and fauna in the water and in surrounding riparian habitats. With heavier runoff, however, they are subject to channelization, culverting, and pollution. Additionally, stream bed scouring destroys the habitat used by many native species.

"You often see drastically decreased diversity in these streams," said Claire Weldon, Metroparks aquatic research coordinator. "Then you have an increase of really tolerant taxa — things like scuds, isopods, and chironomids."

As a stream becomes urbanized, flashy water can cause increased scouring of substrate and potentially destroy the interstitial spaces within substrate where invertebrates live. Sensitive species like those in the indicator EPT taxa (stoneflies, mayflies, and caddisflies), which require undisturbed habitats to survive, begin to disappear.

Urbanization also introduces chemical changes to these fragile streams. Durkalec identified sodium chloride as a particularly insidious and pervasive pollutant.

"Salt is very persistent in the environment," he said. "It doesn't degrade, and it will basically work its way into the water. There are some studies corroborating that it really does have adverse affects on macroinvertebrates in streams."

Isolated Wetlands and Ecology's "Digital Revolution"

Mack said he believes that one of the key solutions to the region's stormwater problem is use of smaller wetlands that are hydrologically isolated, which are highly effective at water removal.

In a previous study he conducted while working for the Ohio Environmental Protection Agency, Mack and colleagues found that small isolated wetlands were capable of removing three to four times the amount of water compared to riverine wetlands.

The isolated wetlands, he said, are capable of retaining water until it is removed through transpiration and evaporation, whereas water can move out of riverine wetlands before this occurs.

The current project's focus on wetlands is in essence a follow-up to the investigation he conducted with the EPA, Mack said. The previous study lacked a continuous monitoring system and instead involved using portable water level recorders and precipitation data from a local airport. The new level of detail afforded by digital monitoring systems, he said, marks a giant leap in ecological studies.

"This is happening all through ecology," he said, citing what many are calling the "digital revolution" in the field. "Ecologists are suddenly able to ask questions they never could have asked before."

Technology Update

The BENEFITS of Ultrasonic Wind Sensors

Sonic anemometers require less maintenance, respond better to rapid wind gusts

Accurate measurements of wind speed and direction from reliable equipment are more important than ever in today's competitive North American wind industry. New high-tech sensors using ultrasonic signals to measure wind conditions are in wider use as traditional mechanical sensors are found unreliable in some cases. Following in the footsteps of the National Weather Service, a new generation of wind industry forecasters and production engineers are viewing ultrasonic technologies as a real option.

A Comparison

Mechanical sensors use moving parts — "cups" for speed and a "vane" for vectoral change physically move with changes in the wind and give accurate speed and direction readings.

Ultrasonic sensors operate without moving parts. On a typical sonic anemometer, a transducer sends a pulse of ultrasonic sound from the "North" facing side of the sensor. A microprocessor measures the time it takes to travel to the "South" transducer. Wind speed is calculated from the time it takes the ultrasound to travel to the opposite transducer. Measurement times are affected by the wind speed and direction blowing along the line between the transducers. Without moving parts, measurement is immediate and precise.

Lufft WS600 with Ultrasonic Wind Technology

When averaged over time, ultrasonic and mechanical measurement accuracies are comparable. Mechanical sensors, however, will not always reflect turbulence and gusts due to the physical limitations of its moving parts.

Observed differences occur in measured wind speed because of the time it takes a mechanical sensor to physically start up or register a change in wind direction. For example, if a storm blows through and the wind suddenly changes direction, the sensor must slow, stop, and restart with the change in wind direction. It will take several seconds to register and report the change.

An ultrasonic sensor, however, will immediately measure a change in wind direction or a high gust. This is what spurred the National Weather Service to update its 883 Automated Surface Observation Systems from mechanical to ultrasonic sensors. ASOS systems serve as the nation's primary surface weather observation network. The NWS conducted the weather sensor upgrades from 2000 to 2005, following a new Federal Aviation Administration requirement that all sensors must be able to measure variable gusts at three-second intervals. Mechanical sensors can commonly only measure wind speed changes of five-second gusts.

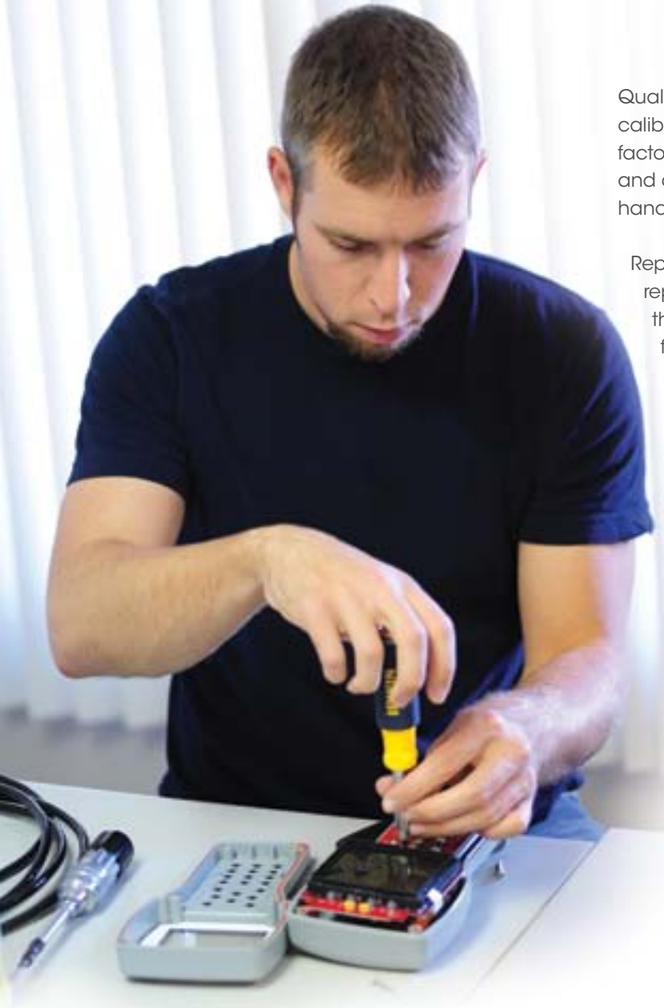
Reliability was another stated reason the NWS made the switch.

"Freezing was always a problem. When the sensors froze, they became inoperable or inaccurate. This is a huge problem when directing aviation," said Al Wissman, acting Operations Division Director of the NWS. Although ultrasonic sensors are often heated, the ultrasonic pulse is often sufficient to prevent the formation of ice.

Until recently, ultrasonic sensors were the second choice for wind profilers. This is partially due to the perceived high cost and low concern for long lifecycles in the profiling and assessment market. With no moving parts, ultrasonic sensors cost less to maintain and have longer life cycles than traditional cup and vane sensors. Sonic sensors are also ice resistant. In a recent test, some were proven to function in extreme freezing rain and high winds as per MIL standard 810F, the U.S. military standard for ice resistance. New ultrasonic anemometers with intelligent interfaces deliver added values, such as electronic compasses and barometric pressure sensors. Learn more at **www.fondriest.com/vendor/lufft.htm**

Content courtesy of Ann Pattison / Lufft USA.

Sensor Repair and Calibration



Quality data depends on monitoring equipment that is routinely calibrated and repaired. Fondriest Environmental offers a unique factory-certified maintenance program for YSI 6-Series sondes and displays, YSI 556 multi-parameter meters, and all other YSI handheld water quality meters.

Repair technicians will perform a free evaluation, send a repair quote via email to the point of contact, and repair the instrument based on the user's feedback. Fondriest's factory-certified repair center is staffed by trained technicians who have performed thousands of calibrations and maintenance procedures. Their experience guarantees that equipment will be efficiently and correctly repaired, allowing for the continued delivery of reliable data.

Instrument check-up, characterization, and certification are recommended on a semi-annual basis. In addition to improved data quality, the useful life of the monitoring instrument is extended with regular service.

When the peak sampling season winds down, it's a prime opportunity to have instruments inspected. That's why Fondriest offers winter tune-up specials on YSI 6-series sondes, YSI 556s, and all other handheld meters. Call **(888) 426-2151** or email **customercare@fondriest.com** for more information.

Fondriest's service and repair center offers excellent turn-around times and low service costs on instrument repairs and annual maintenance services. Technicians can also visit the field to repair and calibrate equipment on site.

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