WATER QUALITY
Buoy Profiling

A GUIDE FOR SELECTING HIGH-PERFORMANCE PROFILING SYSTEMS FOR RESEARCH AND MONITORING

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WHY DATA BUOYS?

Data buoys are used on lakes, reservoirs and other waterways around the world to monitor and conduct research on water resources. Buoy-based profiling permits both short and long-term high-frequency data collection on a large number of water quality parameters.

Applications of data buoys are broad, from basic and applied water research to water supply monitoring and water quality standards validation. Municipalities, management agencies, scientists, and others use data buoys for a wide range of applications, including both research and monitoring needs. Data buoys can be located on lakes, ponds, reservoirs, rivers, and streams of nearly any size, shape, or depth.

 Agencies can use data from temperature strings hung from buoys to appropriate the correct temperature water through dams. Managers can use contaminant readings from buoy sensors to get real time information on water quality parameters. Scientists can use buoy data to understand how lakes respond to land use changes and environmental disturbances. The applications of buoy-based profiling are nearly limitless.

This guide illustrates the components of most standard buoy platforms and describes how these buoys are built and deployed and how data from these buoys is accessed and managed.

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Located in the Lower Great Lakes and Ohio River Valley region, Fondriest Environmental sells and services environmental monitoring products from industry leading suppliers such as YSI, Hach, Thermo Scientific, In-Situ, Turner Designs, Sontek, Valeab, RM Young, Neusens, and many more...

The applications engineers and scientists at Fondriest Environmental specialize in designing and implementing real-time monitoring systems with data transmission via cellular, radio, landline phone, and satellite telemetry, as well as sharing data via the internet.

It is the company’s goal to supply equipment that provides high-quality data and years of service. Unlike many suppliers who carry every brand with every option, Fondriest seeks out vendors and products that meet stringent performance and quality standards. The company searches for advanced technologies that extend deployments and provide new methods of detection. The application engineers and scientists deploy many of the same products that they offer their customers.

Over the years, Fondriest Environmental has greatly expanded its product offering to provide environmental professionals with not only the finest measurement instrumentation, but also with a wide variety of equipment and accessories used extensively in day-to-day field work.

Fondriest’s commitment to customers and their projects ensure continued product support, resulting in long-lasting, value-added business relationships.

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Quality U.S. manufacturing experience coupled with hands-on knowledgeable and fast customer service provides customers with years of reliable buoy and sensor performance. Fondriest stands behind each buoy and sensor built and is a certified repair and calibration facility for other sensor manufacturers. Fondriest’s history of building and deploying buoy platforms throughout the U.S. means that customers benefit from experience.
Buoy-based profiling equipment for research and monitoring are easy to use, reliable, and capable of highly accurate performance. Additionally, the buoys are light enough to be mobile yet stable enough to withstand storms and high winds. Water quality research and monitoring entails the need for accurate and highly dependable data. As water supplies often serve as drinking water for many communities and research dollars are at a premium, buoy-based profiling can provide an ideal solution.

A typical buoy-based research station typically consists of several components, including a buoy platform, data logger, solar power, communications equipment, mooring hardware, temperature string, sondes, and sensors. By optimizing the form and features of a buoy platform, an ideal buoy can be created to match individual needs, applications, and budget.

**Data Buoys are flexible.** Buoy sensors are fully customizable and buoy platforms are designed to ensure that they can be adapted and modified as water quality research and monitoring priorities change. Buoys can house from one to hundreds of sensors, meeting the needs and applications of just about all water quality work.

**Data Buoys provide streaming data.** With buoy-based profiling, waterway sampling can occur as frequently as every minute, providing data 24 hours a day, 7 days a week, 365 days a year, providing consistent, high-quality streaming data. This continuous stream of data provides the ability to conduct adaptive sampling or understand water conditions in real-time.

**Data Buoys are independent.** With solar power or battery power options, buoys don’t require an AC outlet (although they can be AC powered if desired). With several telemetry options for remote data access and sensor control, buoy platforms can communicate with servers and online systems. With minimal maintenance requirements, buoy platforms can operate for whole seasons without interruption.

**Data Buoys provide real-time data access.** Data can be used to quickly understand what is going on in a drinking water supply, respond to changes in environmental conditions, or conduct adaptive sampling based on water conditions. Data can be shared with the public, creating greater awareness of water quality conditions, temperature, and water quality issues, or it can be private with appropriate data access controls.

**Data Buoy software provides data management tools.** As soon as a buoy is powered and deployed it can begin to provide data. With iChart and WQdata software, these data are managed and easily accessed with online tools for graphing, storing, and presenting. Additionally, software can be configured to alert manager’s cell phones or email if water quality parameters exceed certain thresholds, removing the need for someone to continuously monitor the data.

### Factors to Consider

**Number and types of sensors**
What do you want to measure? The number and type of sensors will determine the power requirements and buoyancy needed to support the sensors. More sensors will require more power and greater buoyancy. For most sensors, the standard MB300 buoy provides more than sufficient power and buoyancy.

**Location**
Buoys can be moored with a single, two, or three point mooring depending on the location, depth, and types of sensors on the buoy. Deeper, windier sites with more wave action may require a three-point mooring. Additionally, a meteorology system on buoy may require a three-point mooring to avoid listing and provide accurate wind speed and direction readings.

**Communications**
Options for a cellular modem require a wireless signal at the lake’s surface. Radio systems require a radio base within 5 miles of the buoy. In the rare instance that neither cellular nor radio signals will work, a satellite modem can be used to remotely access data or buoys can log data internally to be retrieved at user-specified intervals.
DATA BUOY TECHNOLOGY
NexSens Data Buoys

Buys serve as the physical platform to provide stability for data logging, sensor attachment, solar power production, and communication in offshore applications. There are several buoy sizes for to meet a wide variety of application needs. Most in-lake applications require less than 300 pounds of buoyancy, however some environments with high winds, large waves, and great depth may require larger, more durable buoys.

The standard NexSens data buoys have a foam hull with mooring and lifting eyes, a stainless steel counterweight, and a 20 lb ballast. The buoys consist of a cross-linked polyethylene foam hull with a tough polymer skin coating. A round center stainless steel underwater housing provides wave control, protection for sondes and sensors, and accommodates a wide variety of sensors. An above-surface aluminum housing accommodates a NexSens SDL500 submersible data logger and provides a mounting platform for solar power, light beacons, meteorology sensors, and other surface sensors. Top and bottom mounted stainless steel eye-nuts accommodate moorings and lifting rigs provide for quick and easy deployment and retrieval. Fondriest Environmental application engineers offer recommendations for deployment based on site conditions to ensure systems will remain in location. The buoy is moored to the bottom via anchors, chain, and shackles, typically with two or three point moorings. In a typical two point mooring, red marker buoys are spaced about 10 feet away from the buoy and prevent mooring lines from becoming tangled with underwater sensor lines.

Power

Three topside cutouts on NexSens data buoys 5-watt solar panels with a charge regulator and 8.5 Amp-Hour SLA battery housed in a watertight enclosure. These solar power kits charge 12-volt batteries efficiently and are rugged enough to survive the most extreme conditions. Solar power provided by these packs is enough to almost all but the heaviest-draw instrumentation. In cases of high-draw custom instrumentation, additional power packs can be adapted to a buoy.

In addition to the three solar power packs typically housed on a buoy, data-loggers also contain 8 D-cell batteries. This battery configuration provides for back up power should solar charging be insufficient or in environments where solar charging is not practical. A typical suite of water quality sensors can be powered for weeks to months using 8 D-cell batteries as communications equipment consumes most of the power.

Visibility

NexSens data buoys house a LED beacon on the top mast. The LED beacon is independently solar powered with 15 flashes per minute to ensure nighttime visibility to boaters and other individuals on the water. Additionally, data buoys are constructed with a “safety” orange-colored polymer skin to maximize visibility. Different colors can be applied to suite specific applications such as minimizing visibility in certain environments, if needed. At least two marker buoys are generally used in mooring; these bright red marker buoys add additional visibility to the buoy.

Vandalism Deterence

Vandalism is often a concern when a data-buoy is located in public access locations. The MB data buoy series is designed to eliminate wire visibility and unintended access to sensors and data logger. For example, the above surface aluminum housing fully accommodates the SDL500 submersible data logger; thus the only thing that passing boaters see is an aluminum tube and flat solar power panels. In addition, small marker buoys kept at about 20 feet away from the main buoy discourage boaters from approaching the data buoy. In cases where a meteorological sensor is mounted on a data buoy, several precautions can take place. First, a mounting arm can be made sufficiently long to reduce access to the sensor. Second, warning signs can be placed on and around the data buoy. Finally, video systems can also be installed in high risk environments, either on-shore or on-buoy which can provide streaming video through the on-board communications system.
Regardless of the buoy and sensors used, periodic maintenance and calibration are required to ensure quality data collection. Maintenance intervals are largely dependent on sensor specifications, site location, and water quality conditions. Common maintenance intervals depend on water conditions. For example, waterways that are highly productive with high algal content are more susceptible to fouling and degradation of sensor reading quality. Each sensor usually has its own recommended calibration frequency; consult instrument specific literature for more details. Fondriest’s application engineers work with customers to recommend site specific maintenance and calibration frequencies.

Most buoys are removed from the water seasonally and kept out of water for the winter months when ice and inclement weather may damage sensors and ice may drag buoys from their moored positions. Before decommissioning a buoy for the season, mooring lines are first pulled and the solar power packs are disconnected from the power harness. This is followed by pulling the anchor and buoy lines. All components should be scrubbed to remove all fouling and stored in a clean, dry location. If possible, it is recommended that the solar panels are kept near a south facing window. This will keep the batteries charged while not in use and prevent premature battery failure.

Mooring

Buoy must be properly moored to ensure they remain in location. Ideally, buoys are moored in the deepest spot in a waterway to ensure that measurements can be made from throughout the water column and measurements best reflect whole lake characteristics. Top and bottom mounted stainless steel eye-nuts on NexSens data buoys accommodate moorings and lifting rigs for quick and easy deployment which can be done from a small boat by as little as 2 people. The buoy is moored to the bottom via anchors, chain, and shackles. Buoys are moored with one of three options – single, two, or three point moorings, with the mooring choice dependent on site depth, wind, wave action, and sensors used.

Single-Point Mooring

Single Point Moorings are used when buoy-based sensors are deployed within the buoy counterweight and do not hang down far into the water column. Within the buoy counterweight, sensors are protected and less vulnerable to damage caused by subsurface debris, high currents and entanglement from anchor lines. Because most buoy-based profiling occurs below the buoy counterweight, single point mooring is an atypical mooring procedure.

Two-Point Mooring

Two-point moorings are commonly used when monitoring sensors are deployed in the water column below the buoy. The mooring lines are held taut away from the buoy by two small marine marker buoys, freeing the water column for sensors to hang below the buoy. These small marker buoys are shackled to another mooring line that runs to the seafloor and connects via a bottom chain to an anchor.

Three-Point Mooring

Three-point moorings are commonly used in deep systems which can experience high winds and large waves. Additionally, however, on-buoy meteorological sensors require a three point mooring to reduce listing and turning of the buoy which alter wind speed and direction measurements.

System Maintenance and Calibration

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Sensors

There are literally thousands of possible sensors for buoy-based applications. Sensors are usually classified either by the parameter type that they measure (such as physical, chemical, or biological sensors) or by the technology that they use (e.g., optical). Here are highlighted the most common and popular sensors used in buoy applications in both research and lake monitoring.

Temperature Sensors

Monitoring the yearly evolution of temperature stratification is a critical component in many lake management and research programs. Temperature data is one of the most commonly reported lake measurements because it is extremely important in a number of other aquatic processes and is relatively inexpensive and easy to measure. Water temperature in many lakes is measured continuously using strings of temperature sensors that span the water column. Fisheries management, hydroelectric plants, selective withdrawal dams, and numerous aspects of aquatic and sediment research often depend on having water temperature data from throughout the water column.

Nexsen’s T-Node temperature sensors provide accurate temperature measurements with years of reliable performance. The 6 inch long NexSens T-Node connectorized water temperature sensor features an integral digital sensor secured in a protective housing for underwater deployments of up to 128 nodes down to 200 meters deep in fresh, brackish, or seawater. Each T-Node sensor is individually calibrated to +/-0.1 C for high-precision measurements with minimal sensor drift. The sensors can be connected in-series using UVW underwater cables and suspended vertically in a water column from a buoy. Double o-ring seals ensure a waterproof sensor connection.

The NexSens T-Node Temperature Sensors provide for the integration of other environmental measurement sensors anywhere along the string. This versatility means that other sensors to be located along the temperature string throughout the water column. In addition, the cabling architecture allows for replacement of single sensors within the chain should one fail or finer depth resolution becomes required.

For most applications, a string of sensors is hung below a buoy such as the MB300 buoy and connected to the on-board SDL500 data logger. Temperature sensors are often put close to one another near the surface of the lake, about every 1.5 feet (0.5 meter), so that high-resolution temperature data is collected. Farther down in the water column below where water is regularly mixed, sensors are spaced out more widely, every 3-6 feet (1-2 meters) or more because temperature changes usually occur more slowly and more predictably deeper in the water column.

Meteorology Sensors

Meteorology sensors are used in a wide range of applications when information on weather related parameters is needed. Typical meteorology measurements made include wind speed, wind direction, precipitation, barometric pressure, air temperature, and relative humidity. Meteorology parameters have important impacts on waterways. For example, high winds can break down thermal stratification in lakes, altering the water temperature and dissolved oxygen concentration throughout the water column.

Meteorology sensors can be mounted directly on a Nexsens data buoys or they can be mounted on-shore and independently solar powered. On a buoy, meteorology sensors provide better data when comparing atmospheric readings to in-lake processes. However, buoy based readings usually require a three-point mooring and can still be slightly affected by buoy listing and wave action.

The Vaisala WXT520 is a multi-parameter meteorology sensor. The WXT520 simultaneously measures wind speed, wind direction, liquid precipitation, barometric pressure, air temperature, and relative humidity. The WXT520 can be mounted directly on the Nexsens MB buoy series or located on-shore. All these measurements are done in a single unit making this instrument ideal for buoys. The WXT520 can interface directly with the Nexsens SDL500 data logger and the MB buoy series solar power packs, providing a common power supply, data management, and real time access to meteorology data. A number of optional features are offered for the WXT520, including a bird spike kit, USB connection, and surge protector. The bird spike kit helps to deter birds from the WXT520 when placed on a Nexsens buoy.
Light and water transparency are two of the most fundamental properties of aquatic ecosystems. The amount of light exposure can regulate the heating and cooling of a given water body. Transparency regulates a number of in-lake processes, including the maximum depth of photosynthesis and oxygen production as well as changes in temperature throughout the water column. Above surface, atmospheric sensors measure incident light. Additionally, above surface sensors can measure light reflected from a lake’s surface (termed albedo) by pointing a sensor down at the lake’s surface.

Below water, light sensors can be used to measure transparency. Typically, two light sensors are placed below water at different depths. These sensors provide data on changes in light with depth thereby providing an estimate of transparency. Underwater light sensors are typically located on an arm away from the buoy to reduce or eliminate potential shading effects from the buoy above.

Many different light sensors exist depending on the wavelength(s) of interest. Sensors exist to measure visible light (400 – 750 nm), PAR (photosynthetically active radiation, 400 – 700 nm), ultraviolet light (UV), infrared radiation, total shortwave radiation, total long wave radiation, and total global radiation. PAR sensors are generally the most common light sensors because PAR wavelengths are important in aquatic ecosystems as they are used by photosynthesizing algae.

For both atmospheric or underwater applications, the LI-COR LI-192SA underwater light sensor is a popular choice for buoy-based applications. The LI-192SA light sensor accurately measures PAR in freshwater or saltwater. The sensor can be easily integrated in with a NexSens MB series buoy platform. The NexSens SDL500 data logger interfaces with the LI-192SA for power supply, easy downloading, and real-time access to light data. Additionally, the LI-192 is cosine corrected and features corrosion resistant construction and it can withstand pressures up to 800 psi or 560 meter depth.

Multi-Parameter Sondes and Sensors

Sondes are used to house, protect, and connect to many underwater sensors. Sondes provide a single connection for a variety of sensors to a data logger and store sensor calibration information. In most typical buoy applications, sondes hang underwater and are connected to the on board data logger. The data logger stores the sensor data, controls the sensors through the sonde, and transmits the sonde-based sensor data to a central server. Additionally, on board buoy solar power packs supply power to the sonde and sensors through the data logger.

Sensors for data buoy based management and research are manufactured by a number of companies for a wide range of applications. Simple sondes typically measure just pH and conductivity, but sondes can house up to six sensors for simultaneously measurement of all parameters. Four of these sensors can be optical based sensors.

There are a wide range of sensors that utilize many different types of technologies. Some typical sonde based sensors include: temperature, conductivity (salinity), pH or pH/ORP, dissolved oxygen (% saturation and mg/L), turbidity, chlorophyll, blue-green algae (phycoerythrin), nitrate/nitrogen, ammonium/ammonia, and chloride.

Other Sensors

The wide array of additional sensors that manufacturers make provide for many different parameter measurements. The NexSens SDL500 data logger is configured with five sensor ports for connection to sensors that provide industry-standard digital and analog interfaces including RS-485, SDI-12, 1-wire temp string, 0-2.5 VDC, pulse count, and more. Sensors that are independent of sondes can be integrated along a T-Node temperature string and located throughout the water column. Additionally, if sensors are equipped with a different or proprietary interface, custom built connections and iChart control software can be developed.

Some of the most common sensors include: temperature, dissolved oxygen, chlorophyll, blue green algae (phycoerythrin), chromophoric dissolved organic matter (CDOM), turbidity, optical brighteners, crude oil, and refined oil and fuels.
Data Logging and Communications

Data loggers are used to store and transmit data from sondes and sensors as well as control sampling frequency and power to sensors. The Nexsens SDL500 submersible data logger is rugged, self-powered, and completely waterproof, making it ideal for use in data buoy applications; each sensor port offers a UV underwater receptacle with double O-ring seal for a reliable waterproof connection to sondes and sensors. In addition, internal circuit boards and communication modules are shock mounted and all access ports incorporate redundant sealing. The SDL500 withstands extreme wave action, drops, floods, and long-term deployment on buoy platforms. It is 18.25” long by 5.5” in diameter and weighs approximately 14 lbs.

The SDL500 is configured with five sensor ports for connection to industry-standard digital and analog interfaces including RS-485, SDI-12, 1-wire temp string, 0-2.5 VDC, pulse count, and more. Common sensor connections include multi-parameter sondes, water quality sensors, temperature strings, doppler velocity meters, water level sensors, rain gauges, and weather stations. Custom or other third party sensors can also be integrated to work with the SDL500. With this sensor interface versatility, the measurement possibilities are limitless.

Housed in a NexSens data buoy, the SDL500 data logger is typically charged via the buoy’s 5-watt solar power system. In situations where solar power is not possible or reasonable, the SDL500 can also be powered autonomously by eight internal D-cell alkaline batteries, providing up to a year of remote power. The SDL500 data logger communicates wirelessly, providing for easy remote data access via a cellular modem or, in locations where wireless phone services are not available, radio transmission, satellite, or purely internal logging. In addition to data access, the SDL500 data logger can be controlled remotely, providing for data interpretation or modulation of sensor sampling frequency, allowing for adaptive sampling from literally anywhere in the world.

Telemetry

Cellular, radio, or satellite telemetry options permit real-time updates on water quality during a buoy deployment.

Radio telemetry allows a buoy-based SDL500 data logger to communicate wirelessly with an on-shore Nexsens radio base station when equipped with a license-free spread-spectrum radio kit. Communication can occur as far as five miles line-of-sight from the buoy. The base station can serve as a central hub for one or more remote data loggers and can connect directly to a base computer or relay data to a remote server.

Cellular telemetry requires the additional cost of a cellular data plan, but it offers greater geographic flexibility. With this method, data transmissions are possible from anywhere that receives a cellular phone signal. A cellular-based buoy does not need to be in proximity to an on-shore base station; instead, buoy data can be accessed wirelessly over the Internet. Fondriest works to ensure the security and fidelity of buoy data communications; options exist to stream this data into secure servers or display the data publicly. The SDL500’s cellular modem can use data plans from many U.S. providers, such as AT&T, Verizon, or Sprint Nextel; data plans are inexpensive and often cheaper than a typical cellular phone plan.

Satellite telemetry provides for real-time data access and sensor control from anywhere in the world. Telemetry is provided by an Iridium satellite modem synched with the on board data logger to support up to 8 analog inputs and 4 digital inputs for multi-sensor data logging.
Software and Data Access

Once a buoy system is set up, it will log data at a user-defined interval (maximum rate of 1 minute). The user also sets the interval at which data is transmitted via radio or cellular telemetry. A typical buoy setup may log data from sensors every 20 minutes and transmit the data to a central server every hour. Limitations on logging and communications frequency are often at the discretion of the buoy manager; however, power consumption during logging and communications may sometimes limit very high frequencies of logging and transmittance.

iChart Software

iChart Software is an easy-to-use Windows-based software program designed to interface with the industry’s most popular environmental monitoring sensors and systems. A large multi-vendor instrument library makes setup quick and easy. iChart automates much of the tedious programming, data collection, and manual data processing common with other environmental data collection systems.

The computer or server that is set to receive buoy communications requires software to acquire, process, and analyze sensor data. NexSens iChart can fulfill these needs, serving as the centralized interface and control system for all incoming data and sensors. All data and sensor configuration settings are stored in a single iChart database. The software is designed with an open architecture and offers a straightforward interface, making it easy for individuals at any level of technical expertise to configure and customize a buoy water quality profiling system.

The iChart software offers a unique historical report creation tool that can generate customized reports with data from all sensors in an iChart database. When creating a report, users can include specific information about the monitoring site, location, sensors, and project. After creation, reports can be converted to PDF files, exported to Microsoft Excel, sent to interested parties via e-mail, uploaded to a web server, and more. The report template can also be saved and automatically generated, further automating the reporting process.

WQData

iChart software provides the user with a data interface and sensor control. The data that is generated, however, needs a central server to where it can be downloaded from the buoy. NexSens WQData is a secure web datacenter providing an online interface for viewing buoy data. It offers 24/7 instant access to project data using any web browser and is accessible from literally anywhere with an internet connection. Further, WQData is guaranteed not to lose data, ensuring the fidelity of your buoy measurements.

iChart can export data directly into WQData. The WQData project datacenter sites can be password-protected or publicly accessible. Using WQData, site visitors can view dynamic project area maps overlaid with weather data, recent and historical data, time series graphs, statistical summaries, and project-specific information.

An administrator login provides an intuitive interface for setting up a buoy system, modifying data views, and adding relevant project information. Administrators can select from a library of predefined themes, enter site descriptions, set up data filters, and graph scales and other data attributes. Also included with WQData is the NexSens embeddable Web-Data Applet. This HTML code can be added to any web page to present visitors with a quick snapshot of project data that also links back to the complete project datacenter.

Alarm Notifications

A key component of buoy-based profiling monitoring and research is the ability for end users to respond rapidly to sensor readings that exceed predefined thresholds. For example, dredgers using turbidity sensors may have to respond to high suspension levels quickly to reduce sediment loads and deterioration of downstream water quality. NexSens iChart software can send automated alarm notifications allowing for buoy operators to receive immediate alerts when sensor readings exceed their predefined thresholds. This technology can facilitate adaptive sampling of water quality. Abnormally high or low values may signal sensor failure or calibration drift; thus iChart can notify buoy operators of the need to check sensor function and fidelity.

Additionally, NexSens data loggers can temporarily change their sampling frequency as a response to exceeded parameter limits. For example, a data logger can change sample and log intervals to take more readings during a period of high turbidity.

NexSens WQData software displaying area maps, historical data, and current readings for a project site.

iChart will automatically issue the alert via text message or email.
Anti-Fouling Technology

The most common problem for in-situ measurements of any kind, especially for extended sensor deployments, is fouling. Either biological (active) or non-biological (passive) fouling can occur. Active fouling refers to the growth of plants and animals over the optics of a measuring instrument, whereas passive fouling results from substances such as silt, clay, and organic residue accumulating on sensor lenses. Fouling can have a substantial effect on sensor readings. For example, for many optical sensors such as dissolve oxygen, chlorophyll, CDOM, or turbidity sensors, fouling material can block the passage of light from the source beam to the light detector. In the interest of long-term deployments, particularly those in high-fouling waters, many in-situ sensors now possess anti-fouling equipment to increase the accuracy and deployment time of sensors. Many sensors have the option of mechanical wiping devices that sweep fouling agents from the sensor surfaces prior to measurement. Additionally, some sensors have an anti-fouling copper ring around the sensor face. For sensors that do not have the option of a mechanical wiper, an after-market third-party wiper can sometimes be installed on the sensor or an anti-fouling paint can be applied.

YSI sondes have become the preferred sonde for many environments with high fouling. Before taking a reading, a mechanical wiper cleans the sensing optics to ensure that the measurement is not affected by fouling. Extended deployments with these multi-parameter water quality monitoring sondes have exhibited stable and accurate readings for long deployment periods. Additionally, YSI’s also feature a corrosion-resistant titanium wiper shaft and replaceable seals.
In spring 2010, a research and monitoring buoy was purchased with a grant to Miami University and Kent State University to study lake ecology to understand how landscape level processes and land use affect water quality. The buoy was also to be used for a long term monitoring program. A Fondriest Environmental MB300 buoy was selected for the application. The buoy was placed at the deepest point in the lake (25 feet or 8 meters) near the dam and moored with a two point mooring system. On the buoy, a SDL500 data logger with cellular communications was selected. A meteorology station was located on shore near the buoy. Sensors include a T-Node temperature string, and a YSI multi-parameter sonde with pH/ORP, conductivity, dissolved oxygen, optical chlorophyll, phycocyanin, and turbidity sensors.

The data logger transmits data back to the university so that scientists can observe changes in water quality parameters in real time. Additionally, scientists have made the streaming data publicly available so that people visiting the lake can be aware of the water temperature, weather, and water quality conditions. This real time data access means that scientists can now conduct adaptive sampling. For example, when a recent harmful algal bloom occurred, the phycocyanin sensor detected the bloom. Harmful algal blooms can be toxic to humans and other animals. Pre-determined settings in the iChart software text messaged researchers as the bloom grew. In response, scientists were able to visit the lake to conduct more intensive research on what was occurring underwater because of the buoy notification.

The Acton Lake buoy platform continues to provide streaming real time data, providing an unprecedented level of insight into lake physics, chemistry, and biology. The ongoing research and monitoring has stimulated new avenues of research for scientists and allowed them to observe environmental phenomenon in real time. In addition, public access to data from the buoy has fostered a greater public understanding and commitment to the need to conserve freshwater resources.
Buoy

If the total number of check marks is under 12, the MB300 buoy coupled with the SDL500 data-logger is usually sufficient to provide adequate buoyancy, power, and data handling capability. However, if the total number of sensors exceeds 12, the MB500 or MB1000 may be recommended. Fondriest application engineers will work with you to optimize buoy selection.

☐ MB300  ☐ MB500 or MB1000

☐ Multi-Parameter Sonde

Communications

Does the proposed site have cellular or radio access at the lake's surface? If you can answer yes to either option, data can be managed and accessed remotely. Generally, cellular phone modems are preferred in most applications where cell signals are available.

Check the communications system preferred:

☐ Cellular  ☐ Radio  ☐ Satellite  ☐ None (internal logging)

iChart software and WQData web hosting is recommended with every buoy purchase. iChart software provides for the access, control, and interpretation of buoy data. WQData provides a secure database for data management, web access, and web hosting of buoy data.

Check these services below, unless another form of data access and management has been determined:

☐ iChart  ☐ WQData  ☐ Other

Mooring

How deep is the proposed site?

☐ Under 30 feet (10 meters)  ☐ Over 30 feet (10 meters)

Does the site have high winds or waves?

☐ No  ☐ Yes

Does the site require a meteorology sensor mounted on the buoy?

☐ No  ☐ Yes

If you answered ‘No’ to the previous questions, your buoy can most likely be moored with a two-point mooring system. If you answered ‘Yes’, however, a three point mooring will be recommended. A single point mooring is typically only recommended in shallow sites where there are no sensors (e.g. temperature string or sonde) hanging below the buoy.

Choose a Mooring system:

☐ Single-Point  ☐ Two-Point  ☐ Three-Point

Additional Comments

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