STREAM AND RIVER MONITORING

A GUIDE TO UNDERSTANDING AND ESTABLISHING HYDROLOGICAL AND WATER QUALITY PARAMETERS IN STREAMS AND RIVERS

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WHY MONITORING MATTERS

Without water, no life could exist, and many essential and nonessential human activities wouldn't be possible without the use of healthy watersheds. These same activities can impact watersheds, in ways both large and small. Watersheds often span political and cultural boundaries; while neighbors separated by city, state or national borders may not live under the same legal and cultural guidelines as one another, both could be citizens of the same watershed. By this measure, ensuring the health of a watershed — or the lakes, streams and rivers within — is as much a responsibility to your fellow human as it is to your local, state or federal regulating agency. For this same reason, water quality regulations are increasingly focused on the watershed level rather than established by political boundaries.

Streams and rivers offer an above ground glimpse at the health and hydrology of a watershed, and function as a vital resource for human activity, as well as habitat for a host of non-human animals and plants. In the U.S. alone, there are over 3.5 million miles of streams and rivers flowing through many different landscapes. Despite this widespread reliance on waterways, the U.S. Environmental Protection Agency has found that over half of streams and rivers in the U.S. are in poor biological condition. If a stream or river may be impacted by your project, it is vital to establish a proper monitoring system to ensure that the waterway's hydrology and water quality are affected as little as possible, and so that any impact can be mitigated if it is detected.

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STREAM AND RIVER MANAGEMENT

Definition & Approaches

Much like arteries and veins in a body, streams and rivers pump invaluable lifeblood — that is, fresh water — throughout a landscape. In the U.S., management of these vessels, and, indeed, all water bodies, focuses on maintaining and expanding existing supplies of freshwater to keep up with growing demand. This demand is fueled by various uses, categorized broadly by the U.S. Geological Survey as commercial, domestic, industrial, irrigation, livestock, mining, public supply and thermoelectric power. While not all of these uses may draw directly from a stream or river, the water required for each will have almost certainly passed through a flowing waterway at some point.

Monitoring systems may be established in streams and rivers for reasons as varied as the water uses listed above, but your application will likely fall into one of two broad categories: research or practical. Research applications include systems designed to study one or more aspects of stream and river hydrology or water quality, whether to educate or provide a better understanding of human impact, animal use, habitat quality, etc. Practical applications include systems designed to monitor impact from your own project, or perhaps the project of a client. This could entail monitoring turbidity during a dredging project, discharge and flow rates at a fish hatchery, or nutrient loads near an agricultural operation, among others.

Regardless of the nature of your application, you should aim to develop a monitoring strategy that provides rapid feedback, allowing involved parties, if necessary, to responds to potential issues before they grow into larger problems. Before starting any project, consider any regulations that may be established by regional and federal agencies as well as your own clients or stakeholders. The U.S. Army Corp of Engineers has established a comprehensive set of guidelines to assist in dredging projects, but the portion of these guidelines dealing with monitoring are applicable to any project. The USACE recommends drafting a comprehensive monitoring plan that includes equipment and techniques to use, protocols for sampling, where to place sampling devices and details about how to interpret the monitoring data. Furthermore, the guidelines suggest creating a management plan that describes the specific actions to be taken based on the results of the monitoring. The most rapid and efficient management responses are achievable with real-time data.
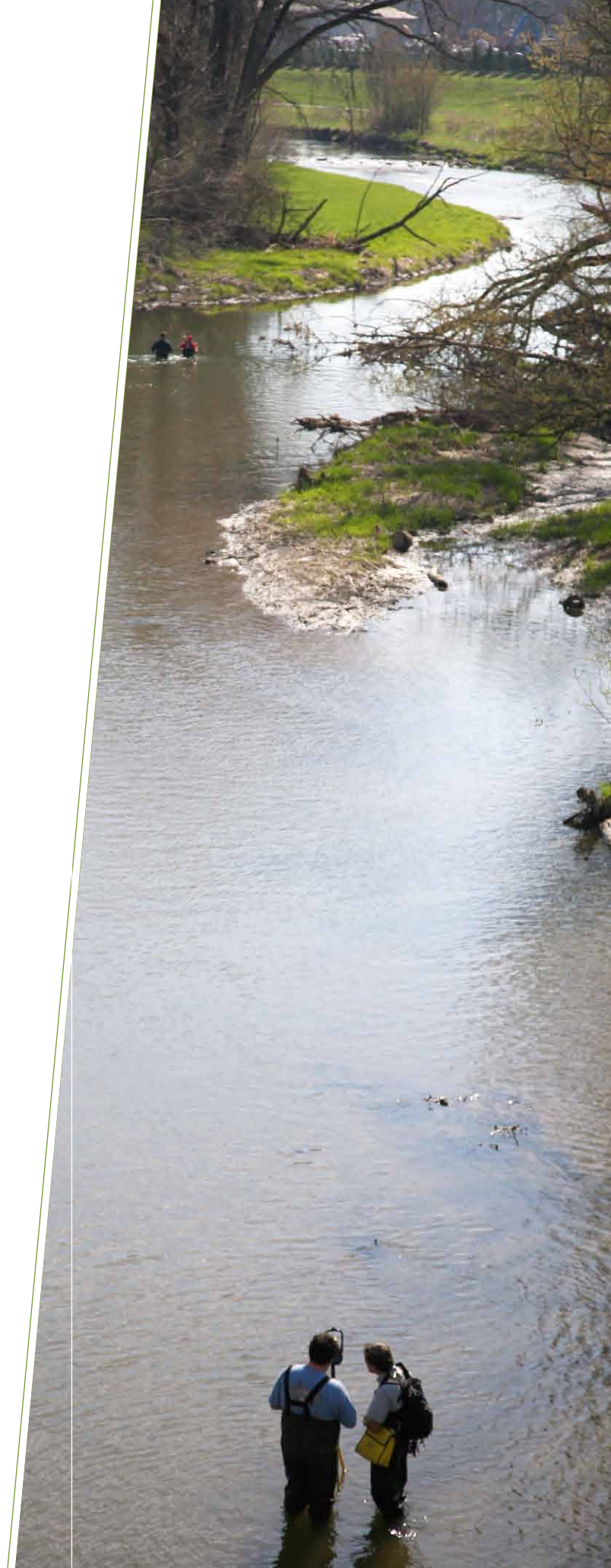
COMMON CONCERNS

A wide array of hydrological phenomena can manifest in streams and rivers, each as complex as the last, and, in many cases, are intertwined with one another. Natural resource managers responsible for waterway upkeep may need to keep a close eye on some or all of these phenomena, while specific monitoring projects may only aim to observe a particular effect of one. Even if your application only calls for monitoring of one parameter or process, understanding how that process affects others and fits into the overall health of the river will improve your ability to analyze data and respond appropriately.

Nutrient Pollution
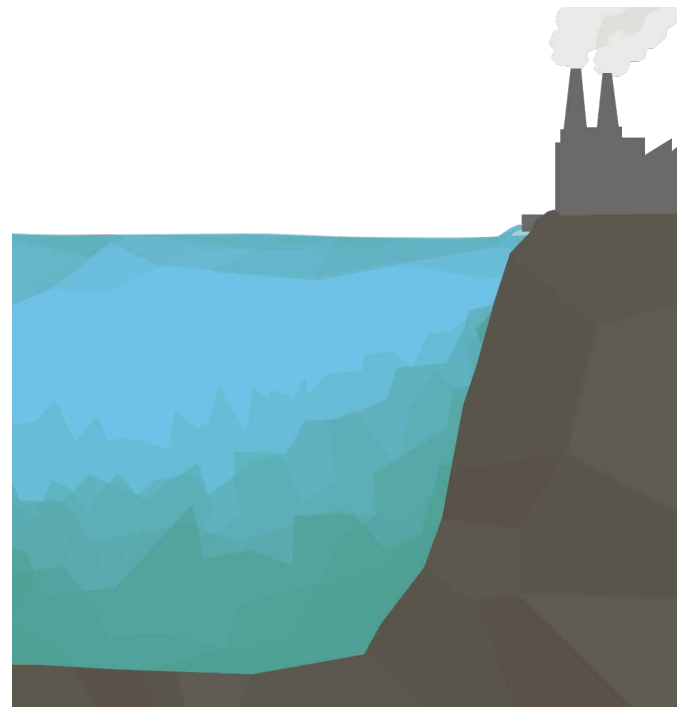
Contamination from any foreign source can spell trouble for streams and rivers, but sources that unbalance nutrient levels in the water often have especially far-reaching effects. Common sources of nutrient pollution include agricultural operations, sewage and industrial waste. A 2009 U.S. EPA survey found that 40 percent of streams and rivers in the U.S. suffer from excessive levels of phosphorous, while 27 percent have high levels of nitrogen. Excess nutrient loads can damage water quality in a number of ways, many of which are interconnected. High nutrient content can promote plant and algae overgrowth, reducing dissolved oxygen content in the water and stressing fish and invertebrates. Under the right conditions, nutrient pollution can lead to eutrophication.

Algal Blooms

Algae and algal blooms should not be regarded as inherently harmful to water quality in a waterway. In fact, algae are an important part of stream and river ecosystems. Algae oxygenate water, convert inorganic matter into organic matter, and act as the base of the waterway's food chain. Slow-moving rivers are far more susceptible to algae blooms than those with high streamflow. In these rivers, blooms may occur in regular intervals, usually every summer, when temperature, sunshine and low wind speeds provide ideal conditions for growth.

Nutrient loads are the primary determinant of algae growth in rivers, and therefore it is vital to monitor nutrient levels — especially phosphorus and nitrates — in rivers that exhibit an overabundance or lack of algae. Water temperature, turbidity, and competition from other plants and animals can also influence the growth of algae. High levels of algae can contribute to eutrophication, turbidity, and hypoxia in rivers. Because many algal blooms form on the surface of a river, most monitoring can be done by sight alone, though aerial observation may be useful for particularly large rivers.

Turbidity and Sediment

| GRAVEL | SAND | SILT | CLAY | ALGAE |
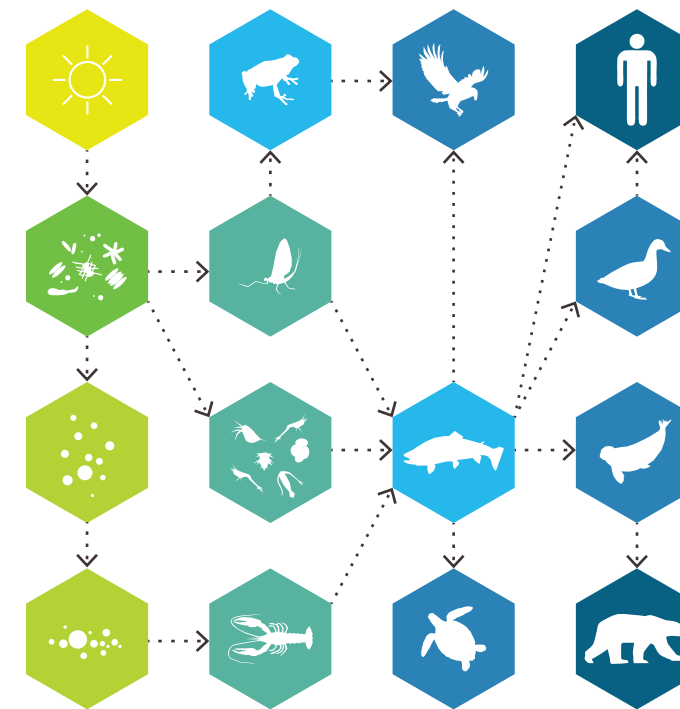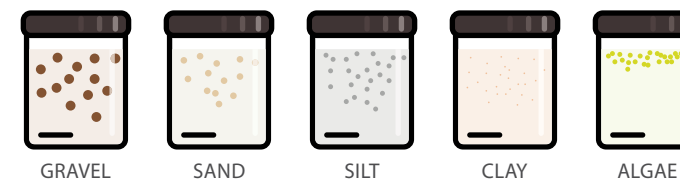
Turbidity is a measurement of water clarity. Turbidity can be influenced by a number of factors present in water bodies, including the presence of mud, silt, algae, or chemicals in the water. Industrial activities, such as mining, logging and — perhaps most commonly — dredging often contribute to turbidity levels in streams and rivers.

Turbidity is a closely related to streamflow and should be measured near stream gage sites when possible. Turbidity often varies with the seasons, as ice and snow drastically affect flow and the presence of sediment that can cloud the water. Rivers covered in ice during the winter usually exhibit very low turbidity, but will develop high levels of turbidity following spring snowmelt as mud and dirt are washed into the water. The growth of algae and other organisms in the summer can also cause a boost in turbidity.

The significance of turbidity in a waterway depends on the season, the morphology of the channel and the ecosystem within. Highly turbid waters prevent the passage of light necessary for plant growth, which can also diminish the survivability of other organisms that rely on plants for food. Algae-related turbidity is often associated with eutrophication and hypoxia. Very high turbidity can actually cause fish and other organisms to suffocate, impact their ability to catch prey, and even bury fish eggs on the streambed. Particles responsible for turbidity may carry bacteria or other contaminants that can harm water quality. Regular turbidity monitoring can help detect early erosion.

Eutrophication

When overgrown blooms of algae die and decompose, the increased loads of organic matter — and the organisms responsible for decomposition — consume available oxygen in the water, causing hypoxic "dead zones" to form. These dead zones reduce the liveable space in a river, and can increase competition and kill off other organisms, such as fish. The process is natural in most water bodies, but anthropogenic activity, such as agricultural fertilization, can speed it up.

While eutrophication is mostly a function of nutrient loads, temperature can have a major impact on the phenomenon. Higher temperature can increase biomass production, therefore contributing to the overall rate of oxygen depletion. Streams and rivers are less vulnerable to eutrophication than standing waters such as lakes and ponds, because turbulence and streamflow prevents stratification from occurring, but they are by no means immune from the phenomenon.

STREAMFLOW MEASUREMENTS

While streams and rivers may be monitored for many qualities and parameters that they share with lakes, ponds and basins, they possess one quality that sets them apart from other freshwater bodies: movement. Streamflow is a keystone parameter that impacts many other aspects of a river's hydrology and water quality. Although these other aspects may be just as vital to a river's health — or just as applicable to your particular project — they may be shared with other types of water bodies, and in many cases will be covered in other guides provided by Fondriest Environmental. For this reason, this application guide will focus primarily on establishing streamflow through stage discharge measurement.

Calculating Streamflow

Streamflow is a measurement of the amount of water flowing through a stream or river over a fixed period of time. Streamflow cannot be measured directly, say, by plunging an instrument into a river. Instead, it must be calculated in a process known as stream gaging. The USGS has been doing this since 1889, when it established its first stream gage on the Rio Grande River in New Mexico to determine how much water was available for irrigation as the nation expanded westward. Today, the USGS operates more than 7,000 stream gages across the U.S., which provides streamflow information used widely for flood prediction, water management, engineering and research, among other uses.

The USGS splits stream gaging into a three-step process: measuring stream stage, measuring discharge and determining the stage-discharge relation.

Measuring Stream Stage
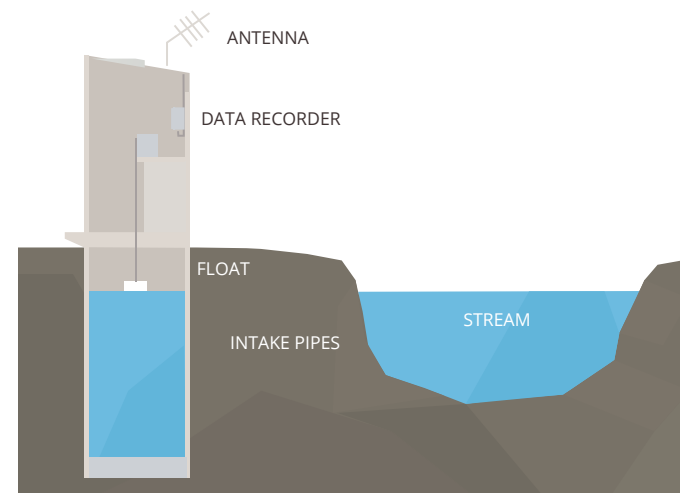
The first step in calculating streamflow involves measuring stage, which is the height of the water surface at a particular point in a stream or river. Stage is sometimes known as gage height, and can be measured several ways. Among the most common of these approaches uses a stilling well installed in the river bank or attached to a stationary structure such as a pier or bridge support. An underwater intake allows water into the stilling well at the same elevation of the river's surface. A float or a sensor — whether pressure, optical or acoustic — then measures the stage inside the well. An electronic recording device or data logger records stage measurements at regular intervals; in the case of the USGS, usually every 15 minutes. A telemetry system may also be present in a stilling well, allowing data to be transmitted remotely to a host computer in real time.

It may not always be cost-effective or space-efficient to install a stilling well where stream gaging is necessary. In these cases, stage can be measured with a vented pressure transducer installed within a PVC or metal pipe along the stream bank. In locations where a bridge or overhead structure is available for instrument mounting, a non-contact radar or ultrasonic water level sensor can also be used.

Stage must always be measured relative to a constant reference elevation, or datum. Depending on the duration of your project, it may be necessary to routinely survey the elevation of your stream gage structure and its datum, to ensure that elevations have not shifted due to settling or natural erosion.

Measuring Discharge
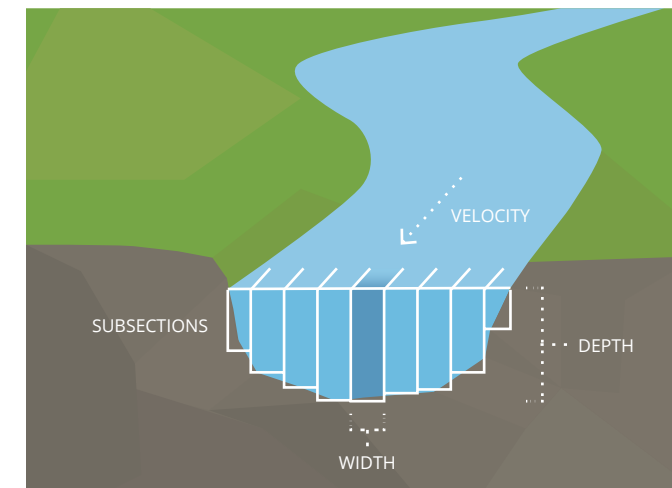
In addition to stage, discharge must also be established before streamflow information can be computed. Discharge is the volume of water moving down a waterway per unit of time. It is most commonly expressed in cubic feet per seconds or gallons per day. To calculate discharge, multiply the area of water in a channel cross section by the average velocity of water in that cross section. In short: discharge = area X velocity

The simplest way to measure discharge is to divide the channel cross section into vertical rectangular subsections. Once the area (width X depth) of each of these subsections is established and multiplied by velocity to determine subsection discharge, the results can be added together to calculate total discharge.

Subsection width is best measure with a cable or steel measuring tape, while depth can be measured by a wading rod in shallower channels and suspended sounding weights in deeper waters. Velocity, on the other hand, should be measured with a current meter. Many current meters rely on a

wheel formed of several cups revolving around an axis. Each revolution generates an electronic signal that is counted and timed by the meter, which translates to water velocity.

A faster, but more expensive method to measure velocity involves the use of an Acoustic Doppler Current Profiler (ADCP) which can be mounted in a small watercraft. The ADCP sends a pulse of sound into the water and measures changes in the pulse's frequency as it returns to the instrument. The ADCP speeds discharge calculations by measuring velocity and depth at the same time. Width is also measured as the boat-mounted ADCP is navigated across the channel. Though somewhat more limited in capability, rod-mounted Acoustic Doppler Velocimeters allow similar functions to be performed while wading through shallow streams.

Determining the Stage-Discharge Relation
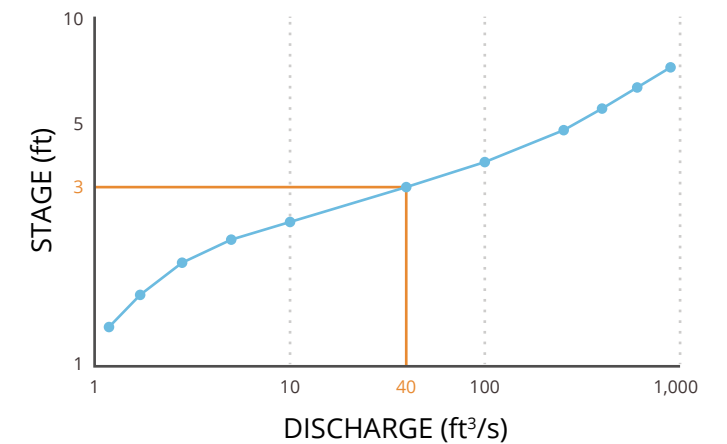
Stage-discharge relation, or "rating," is a dynamic variable that is determined by comparing stage at a stream gage to discharge at the same point. Accurate stage-discharge relations can only be developed by measuring discharge across many ranges of stage. Furthermore, channels should be continually surveyed for changes caused by erosion, sediment deposition, vegetation growth and ice formation.

When discharge has been established across enough stages, stage-discharge relation can be visualized in the form of a graph. When this relation is properly maintained through periodic updates, it can provide useful streamflow information for a given stream or river.

A REAL-TIME SOLUTION

The specifics of your stream or river monitoring system will depend largely on the requirements of your project, as well as site conditions at the waterway. While every stream or river monitoring system may not require a full stream gage installation with stilling well and associated instruments, it may be helpful to consider what such a system should entail as determined by the country's preeminent river monitoring agency: the USGS.

Stream Gage Standards

USGS standards insist that river stage should be measured to an accuracy of 0.01 inches. This level of accuracy can be attained by any of the methods previously described, using floats in a stilling well, pressure transducers, or with radar.

The USGS mandates different measurement intervals based on the purpose of the stream gage. For instance, ALERT (Automated Local Evaluation in Real-Time) stream gages used for flood warnings only transmit data when water levels reach a certain depth, or change drastically within a particular interval. Partial record stream gages only operate during particular flow regimes, indicating high flow, peak flow or low flow, for example. Standard USGS stream gages must operate at least 355 days per year and transmit data via telemetry at 1 to 4 hour intervals.

Water Quality Measurements

A stream or river monitoring project can also require the observation and measurement of water quality. In these situations, a multi-parameter water quality sonde is recommended.

Multi-parameter sondes differ from brand to brand and model to model, but they are unified by a few common traits. As would be expected, multi-parameter sondes usually feature an array of ports for attaching conductivity, temperature, depth, pH, dissolved oxygen, turbidity, and level sensors and probes. Ideally, these sensors should be replaceable in the field for off-the-cuff maintenance and system modifications. Some sondes will feature built-in sensors, leaving more sensor ports free for additional measurements. Most sondes contain an internal battery and memory so they can be deployed for long periods without regular attendance. Data logger and external power connectivity allow for even longer deployments, especially when data is accessible in real time via wireless telemetry.

TYPICAL RIVER MONITORING SYSTEM

There are many hydrological and water quality parameters that can be measured in a stream or river, but the needs of one monitoring project can differ widely from another. The number of monitoring sites, their locations, and the instruments used at each will vary from project to project, but a common solution is based around at least one stream gage site and related instruments.

To be effective, measurement data should be provided in real time. The easiest and most efficient way to do this is with a stream gage station installed on a riverbank or standing structure, such as a pier or bridge support. A stream gage built around a stilling well can contain other instruments, such as multi-parameter sondes equipped with an array of sensors, as well as data loggers and telemetry systems. With multiple telemetry options to choose from, continuous real-time data are available from any computer. This ensures that the project runs smoothly, and any control measures can be implemented immediately if parameter limits are exceeded.

Telemetry
Telemetry provides access to data in real time. The wireless communication can be radio-to-shore, cellular, or satellite based.

Integrated Data Logging System
An integrated data logging system is a real-time monitoring station that houses the data logger, telemetry module, and power/charging supply. Since it is generally cost-prohibitive to run AC power to the monitoring location, integrated solar panels are used to continuously charge the 12VDC battery for autonomous operation.

Deployment Pipe
PVC or metal deployment pipes are installed to protect the sondes and sensors in the water. The pipes are perforated near the sensors to allow adequate water flow for a representative measurement. In addition to shielding the sensors from debris, the pipes help secure the equipment in a fixed position for quality data and offer easy removal for calibration.
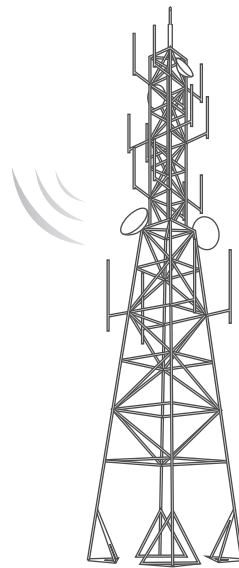
Live Data
Instant access to project data is available 24/7 through a cloud-based data center. Monitoring data can be viewed in real time, or as a graph to identify trends. Real-time automated alerts can be sent via text or email when specified parameters exceed predefined limits.

Multi-Parameter Sonde
Multi-parameter sondes offer a versatile platform for deploying several sensors at a common site. These sondes can also act as an interface between sensors and a data logger or power source.

Submersible Pressure Transducer
A submersible pressure transducer measures the combined pressure exerted on it by the atmosphere and the head of water above it. A vent tube in the cable automatically corrects for atmospheric pressure influences.

MONITORING LOCATION

The monitoring objectives will determine the approximate location of the stream or river station. Site-specific characteristics must also be considered to ensure a successful project. Physical constraints of a site, the time required to reach the location, legal and physical access to a site, and safety issues must be considered when making site selections.

Site Considerations

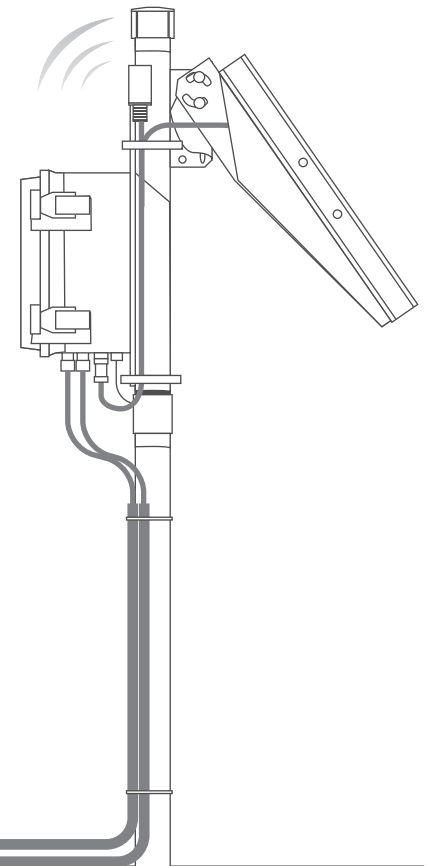- The monitoring location should be relatively accessible for carrying in equipment to perform periodic calibration and maintenance.

- If using telemetry, determine whether there is sufficient cellular coverage to get a signal from the site. If not, satellite telemetry will likely be required.

- The installation site should be selected so that flow conditions are reasonably constant over the physical area occupied by the beams.

- The sensor should be located in a straight section of channel, away from curves that can cause variations in the flow distribution.

- Avoid man-made control/flow structures upstream or downstream of site that may change flow profiles erratically, as this will make rating development difficult.

Installation Considerations

- Make sure data logging and telemetry equipment will be installed sufficiently above the high water mark to prevent it from being flooded or otherwise damaged by high water.

- Install the sensors based on lowest expected stage. Also consider whether ice will form in winter months. If so, try to keep sensors installed below the freeze line.

- Consider sediment issues and try a vertical stilling well whenever possible.

- Sensor mounting pipes should be securely attached to the stream or river bank with a bottom pin so that the sensor is always redeployed at the same location.

- Any potentially exposed sensors cables near the ground should be run through conduit to the data logger box to protect from animals.

CELLULAR TELEMETRY COVERAGE

NO MAN-MADE CONTROL STRUCTURES

STRAIGHT SECTION OF CHANNEL

MONITORING SITE LOCATION

PROTECTIVE CONDUIT

HIGH WATER

FREEZE LINE

LOW WATER

SECURE ATTACHMENTS
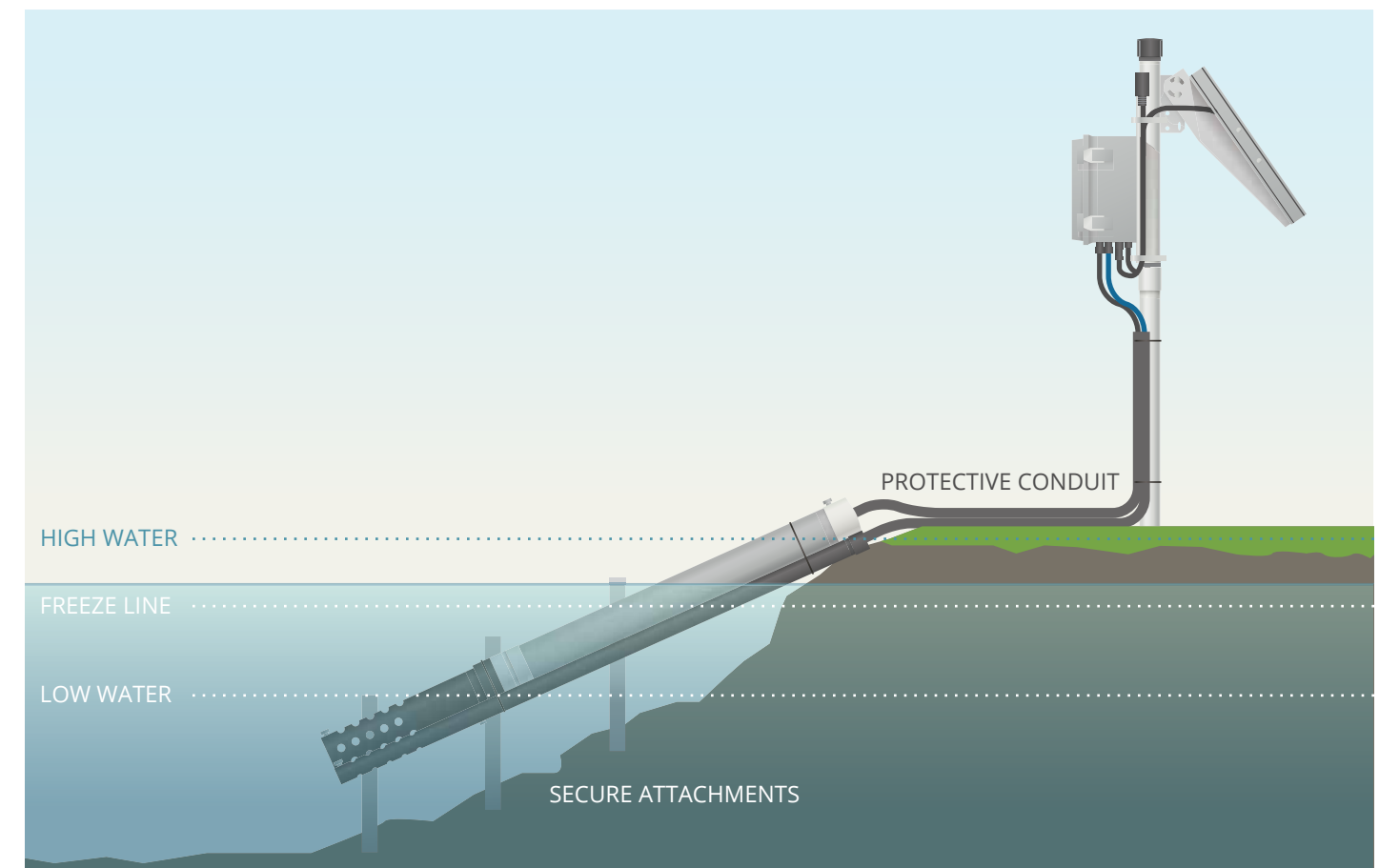
DATA MANAGEMENT

A major part of any monitoring project is collecting and accessing the data. While it is possible to simply record measurements onsite, the ability to log, send and view monitoring data in real time is far more efficient.

Data Logger

As the name implies, a data logger is an instrument that stores data. In environmental monitoring applications, data loggers can be used not only to collect data from sensors and sondes, but to control sampling rates and transmit data to a central location in real time.

While some water monitoring instruments have the ability to log their own data, a separate, dedicated data logger can gather all data from any and all attached sensors ensuring that no data are lost. If telemetry (wireless communication) is available, the logger can remotely control sensor sampling rates and transmit collected data to a central project computer. Data loggers with telemetry technology can provide real-time hydrological profile data and remote access via a cellular modem, radio transmission or satellite modem.

When housed in a data buoy, a data logger is charged by the buoy's solar power system. If a solar panel system or external battery is not available, the logger can be self-powered using alkaline batteries. Data loggers can be configured with a number of sensor ports for connection to industry-standard digital and analog interfaces, including RS-485, SDI-12 or 0-2.5 VDC. A data logger can also support water quality sensors and sondes, weather stations, and other instruments to complement the hydrological profile data.

Telemetry

Telemetry, or wireless communication, is a useful tool for monitoring rivers and streams in real time. Common telemetry options are cellular and radio, though satellite telemetry can be used in more remote locations. The deciding factor when determining the most cost-effective telemetry option should be the local site conditions and proximity to a project computer. All three of these options permit real-time updates for temperature profiles.

Radio telemetry is recommended when all equipment is in close proximity. If equipped with a license-free spread-spectrum radio, a data logger can communicate with a shore-side or dam-mounted radio base station. This range may vary depending on the logger and base station used. Spread-spectrum radio technology may allow a range as far as five miles (line-of-sight) or a few hundred feet (non-line-of-sight). The radio base station serves as a central hub for any compatible data logger in range, with the ability to send the collected data to a project computer.

Cellular telemetry offers more geographic flexibility than radio, though it does require a cellular data plan. This small, additional cost permits data transmissions from anywhere that receives a cellular signal. With cellular telemetry, monitoring stations do not need to be in close proximity, nor is a

base station required. If multiple monitoring stations are required, each data logger can send information individually to a central database. All the data can then be accessed wirelessly from any computer via the Internet. Data loggers may be equipped with cellular modems from different providers, including AT&T, Verizon and Sprint.

For remote applications where radio and cellular telemetry are not feasible, satellite telemetry can be used. The Iridium communications network maintains a dynamic, cross-linked constellation of Low Earth Orbiting (LEO) satellites, providing coverage all over the world. This means that data loggers with an Iridium satellite modem can transmit data in real time from anywhere on Earth. As with cellular networks, the data are sent to a central gateway, which then transfers the data over the Internet to any project computer or cell phone.

Real-Time Online Datacenter

The easiest way to share and view river and stream monitoring data is through a web-based datacenter. An online datacenter offers 24/7 instant access to project data via any web browser. Water pressure and other data can be exported into the datacenter directly from the data logger, or through the project software.

This project management service can be password protected or public, and allows users access to the collected data in real time. In addition to any profile-specific information, the online interface can provide dynamic area maps, overlaid with weather information, recent and historical data, time series graphs and statistical summaries. Visitors can interact with the project maps and view real-time monitoring data or trends over time.

But these cloud-based datacenters are more than just a pretty face. Many can be programmed to send out automated alarm notifications when parameters exceed pre-defined limits. Once an allowable range has been set, the data are entered into the online database. If levels exceed or fall below these recommended ranges, the datacenter will immediately issue an alert (text and/or email) to the appropriate project manager or interested party.

With the availability of real-time data and the datacenter's auto-alert system, project managers can be notified immediately when interesting or action-oriented events may exist. This can be nutrient pollution, algal blooms, turbidity, eutrophication, etc. The online datacenter can also transmit this alert back to the data logger in order to respond to the exceeded temperature, conductivity, pH or any other range. Automated responses may include taking more frequent readings high or low temperature periods, then resuming regular log intervals when levels return to normal.

QUALITY ASSURANCE

To maintain accuracy and keep equipment functioning within specifications, best practice recommends cleaning and calibrating the instruments at regular intervals. It is also recommended to cross-check sensor accuracy against a separate instrument. Projects may even require the use of a Quality Assurance Plan (QAP) that provides a detailed outline of maintenance, calibration and QA/QC requirements.

System Maintenance

Regardless of the water quality instrument(s) deployed, periodic maintenance and calibration is essential. Instrument maintenance includes cleaning the instruments (especially if a sensor is not self-wiping), and replacing any deteriorating O-rings to prevent water ingress. Maintenance intervals are largely dependent on site conditions and other variables, such as the potential for biofouling. Common calibration and maintenance intervals are on a bi-weekly or monthly basis.

Prior to calibration, it is important to thoroughly rinse the calibration cup with water and then rinse with a small amount of the calibration standard for the sensor being calibrated. Two to three rinses are recommended. Discard the rinse standard, then refill the calibration cup with fresh calibration standard. Fill the cup with adequate calibration standard to fully submerge the sensor. Volumes will vary, just make certain that the sensor is submerged. Be careful to avoid cross-contamination with other standards. For greater details regarding sensor calibration, the manufacturer's user manual should be referenced.

In case of sensor failure or damage, it is useful to have spare sensors or sondes on hand. These can be field swapped during calibration or routine maintenance checks. Having spare equipment available will reduce downtime due to unforeseen sensor failure, which could cause critical and costly interruptions to long-term datasets.

Performance Verification

In addition to keeping equipment calibrated, it's important to periodically verify that the sensors are providing accurate data. The best way to achieve this is by checking water quality values in the same area using a separate, portable monitoring system. This is also known as spot sampling.

In many cases, the same water quality instruments deployed in the stream or river can be outfitted with a cable and handheld display for spot sampling. For example, if a YSI EXO2 water quality sonde is deployed, then a separate EXO2 sonde with cable and handheld display can be used for performance verification. It is important to use the similar and consistent sensors when verifying data, as values tend to have variability across different sensing instruments. The sonde or sensor can be lowered into the water to a depth that matches the in-place sensors. While it is at that depth, a water quality measurement can be taken. The data from this portable system can then be compared to the in-place monitoring system and checked for discrepancies.

Another way to verify sensor performance is to pull the water quality instrument and check the sensor values in known standards prior to recalibration. This is sometimes referred to as a post calibration check. By checking the measured values against a known standard, it is possible to observe and document the amount of sensor drift that occurred since the last calibration. The difference in value can be compared to predetermined criteria. if the difference is outside the criteria, then the measurement data may need to be qualified.

RECOMMENDED EQUIPMENT

While there are plenty of hydrological monitoring instruments on the market, some stand out about the rest. Fondriest Environmental has selected these products as the best in their field for their quality, reliability and value. Together, they provide an advanced and powerful real-time monitoring system for any stream or river. The PT-500 Submersible Pressure Transducer from APG is durable enough to measure depth in the dirtiest, most turbulent waters. YSI's EXO2 Multi-Parameter Water Quality Sonde provides six sensor ports, making it the perfect foundation for water quality monitoring in any setting. The NexSens 3100-MAST Wireless Telemetry System features a mast-mounted data logging system with cellular modem telemetry and solar charging to keep your data up to date while you're away from the field. Additionally, the WQData LIVE web datacenter allows 24/7 remote access to collected data from any computer or mobile device, while incorporating instant alarm notifications and trend tracking.

YSI EXO2 Multi-Parameter Sonde

The YSI EXO represents the next generation of water quality instruments from YSI. The advanced sonde platform offers a wide range of capabilities to those dedicated to monitoring natural aquatic environments such as oceans, estuaries, rivers, lakes, and groundwater. With a highly efficient power management platform, robust construction, and chemistry-free anti-fouling system, EXO allows accurate data collection for up to 90 days between service intervals.

The EXO2 sonde includes six sensor ports and a central anti-fouling wiper option. Sensor parameters include temperature, conductivity, depth, dissolved oxygen, pH, ORP, total algae (phycocyanin and chlorophyll), turbidity, and fluorescent dissolved organic matter (fDOM). The sonde can also output 4 calculated parameters including salinity, specific conductance, total dissolved solids (TDS) and total suspended solids (TSS).

All EXO sensors are digital sensors with on-board signal processing and memory. Built-in sensor diagnostic and calibration data allows users to calibrate multiple sensors in one sonde and distribute to various other sondes in the field. Wet-mateable connectors allow for swaps in wet conditions, while active port monitoring automatically detects each sensor and verifies operation.

APG PT-500 Pressure Transducer

The APG PT-500 submersible pressure transducer is ideally suited for measuring water level in weirs, flumes, small to large streams, ponds, lakes, irrigation channels, and groundwater wells. The sensor is installed in a fixed location below the minimum expected water level, and a cable containing the sensor signals and vent tube is connected to a data logger mounted above flood stage.

The PT-500 measures the combined pressure exerted on it by the atmosphere and the head of water above it. A vent tube in the cable automatically corrects for changes in barometric pressure, and measured values are mathematically compensated for all linearity and temperature errors. With +/-0.1% Full Scale accuracy, the PT-500 provides high performance and accuracy over a wide range of operating conditions. The housing is constructed with laser welded 316L stainless steel.

The sensor features a plug-and-play interface to NexSens iSIC data loggers via RS-485 Modbus digital output. Data collection options include direct-connect, landline phone, cellular, radio, Ethernet, WI-FI, and satellite telemetry.
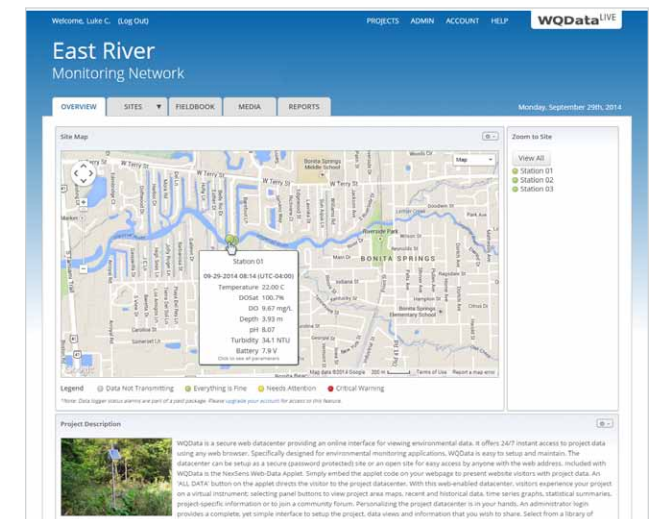
NexSens MAST Data Logging System

The iSIC-MAST system includes the data logger and solar panel pre-mounted to a 2" diameter pole to create a truly plug-and-play data collection and sensor interface platform. The system integrates a NexSens iSIC data logger and 20-watt solar power kit - all in a compact, pre-configured package. Simply thread the system to any 2" NPT male pipe thread, connect the solar panel & battery, wire the sensors, and setup a project using iChart software - it's that simple!

The iSIC data logger arrives ready for long-term deployment. All electronics are housed in a rugged, NEMA 4X enclosure constructed of heavy-duty fiberglass. The built-in 8.5 amp-hour sealed lead acid battery provides 12 volt power to the system, and the battery is continuously charged using solar power. Polymer-coated circuit boards, sealed connectors, corrosion-resistant stainless steel hardware and built-in lightning protection ensure reliable performance in the harshest conditions. All sensors are cabled through Sealcon gland fittings to ensure protection from the elements.

NexSens iChart Software is a Windows-based program for interfacing to an iSIC data logger or network of data loggers. The iChart Setup Device Wizard includes built-in drivers and a step-by-step interface for setting up and configuring remote monitoring sensors and systems. When connected, the user can quickly configure sample & log intervals, upload data, or troubleshoot communications.

NexSens WQData LIVE Web Datacenter

WQData LIVE is a web-based project management service that allows users 24/7 instant access to data collected from NexSens remote environmental data logging & telemetry systems. More than just an online database, WQData LIVE offers the ability to generate automated reports, configure alarms to notify project personnel when data values exceed threshold limits, create FieldBooks to store calibration forms, notes and media and much more. Projects are password protected with the ability to configure a public portal or presentation view to share data with the general public. Project Administrators have the ability to edit project descriptions and information, while users given Collaborator access are limited to data viewing and form entry.

The Google Maps view shows all project sites on a map with zoom, scroll and drag capability. Mousing over a site on the map displays the most recent data values, and clicking on the site navigates to a display showing the last reading or tabular data that can be downloaded to Excel and sent via email or FTP. FieldBooks can be created to store notes recorded during field visits, including forms to store calibration data, which can be submitted from the WQData LIVE mobile app. This eliminates the need for conventional fieldbooks while keeping critical project information in a single, easy-to-access location. Site photos can even be placed onto FieldBook pages or uploaded into the project's Media page.

The WQData LIVE report feature allows data to be shown both graphically and in a tabular format. Report templates can be saved so that specific information can quickly be referenced. Project alarms send email or text messages to project staff for immediate notification of critical conditions. With this unique set of features, WQData LIVE provides everything needed to effectively manage an environmental monitoring application.

PURCHASE
OR RENT?

When managing a large or long-term river or stream monitoring project, purchasing several profiling systems is often the most economical option. However, for short-term monitoring projects on a tight budget, it may not be practical to purchase the necessary monitoring equipment. In these situations, it is much more prudent to rent real-time monitoring systems. With several lease duration and extension options available, the flexibility of renting monitoring systems may still be cost-effective for the larger countermeasure applications as well.

River and stream monitoring equipment can be rented instrument by instrument, or as an entire system, calibrated and ready to deploy on arrival. Rental equipment can include multi-parameter sondes, integrated data logging systems, and web-based datacenter access. Real-time telemetry via radio-to-shore, cellular, and satellite can also be incorporated. A large rental pool also means that most monitoring equipment can be shipped same-day for quick deployment and emergency situations.

Just as with Fondriest purchases, rental projects have access to a knowledgeable support staff who will provide personalized service before, during and after the project.

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ABOUT
FONDRIEST

Company

Located in the Lower Great Lakes and Ohio River Valley region, Fondriest Environmental is a leading distributor and integrator of equipment for natural resource professionals and outdoor enthusiasts. Our team of specialists can help customers understand the products they are buying and make the correct decisions out in the field. We seek to understand project needs, devise a comprehensive solution, provide the equipment and know-how to implement it and then offer long-term project support for whatever needs arise.

Capabilities

We work closely with NexSens Technology, a company that specializes in the design and manufacture of real-time environmental measurement systems. A variety of sensor, platform and telemetry options are available to fit the unique needs of each project. We can provide complete integrated solutions and support projects from conception to completion. An extensive fleet of rental equipment is also available for short-term project needs.

Certifications

Fondriest Environmental is a Certified Repair Center for YSI, NexSens & Fish-Sens, offering quick turnaround, affordable labor rates and personalized service. Our knowledgeable technicians are available for phone, email and onsite support when the need arises.

Publications

We cover many customer projects in our Environmental Monitor magazine, which is updated daily online and printed quarterly. We also produce Lake Scientist, an interactive online resource providing research articles and news on lake ecology. Informational pages on environmental parameters and applications are available in the Measurement Sciences section of our website. And FishSens Magazine, available online, provides anglers, boaters and fisheries professionals with the latest fish science news.

Commitment

A commitment to integrity and longstanding customer relations are the standard, rather than the exception, at Fondriest Environmental. We support professionals, educators and researchers who continuously work to monitor and protect our global resources by providing them with the products and services needed to face today's environmental challenges. Our team of solution-driven experts has years of field experience and a keen eye for finding the best equipment for each application.

Contact Information

To reach an application specialist, please call (888) 426.2151 or email customercare@fondriest.com

FONDRIEST
ENVIRONMENTAL

SYSTEM CONFIGURATION TOOL

Fondriest application specialists will assist with tailoring system configuration and equipment choices on a site-by-site basis to ensure reliability and proper data management. The questionnaire below can help you get started. Once completed, this form can be faxed to (937) 426.1125 or, if completed digitally, emailed to customercare@fondriest.com.

Contact Information

Name: _____

Organization: _____

Telephone: _____

Email: _____

Site Conditions

Describe the site conditions in a paragraph or two. Please include details regarding levels of wind, waves and boat traffic experienced in the area.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Site Location

The location of a monitoring system can affect what equipment platform best suits the conditions. Please select in what type of water body the system will reside.

☐ Stream   ☐ River   ☐ Other   Please Specify _____

Measurement Parameters

☐ Water Level   ☐ Water Velocity   ☐ Temperature   ☐ Conductivity   ☐ Dissolved Oxygen

☐ pH   ☐ ORP   ☐ Turbidity   ☐ Nitrate   ☐ Phosphate

☐ Other   Please Specify _____

Cable Length

With stream or river systems, the cable lengths used for a deployment depends on the distance from the monitoring instrument(s) to the shore-mounted data logger.

☐ Between 5 and 25 ft.   ☐ Between 25 and 50 ft.   ☐ Between 50 and 100 ft.   ☐ > 100 ft. Please Specify _____

Telemetry

License-free spread-spectrum radio telemetry allows communication with a shore-side NexSens radio base station as far as five miles line-of-sight from the monitoring site. Cellular telemetry allows greater geographic flexibility and is able to transmit from almost anywhere in the U.S., but it includes the cost of a cellular data plan. Satellite telemetry can be used nearly anywhere in the world, but it tends to have the highest data cost compared with cellular telemetry.

☐ Cellular   ☐ Radio   ☐ Satellite   ☐ None

Project Length (Rental vs. Purchase)

Although it often makes sense to purchase systems outright, many short-term projects make it cost-prohibitive. Fondriest Environmental offers real-time monitoring systems with weekly and monthly rental rates to accommodate these operations. An application specialist can make recommendations on what choice is most cost-effective.

☐ 1-3 Months   ☐ 3-6 Months   ☐ 6-12 Months   ☐ >1 Year   Please Specify _____

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ENVIRONMENTAL

when your
research
demands
quality data

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