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HOW-TO GUIDE FOR STORMWATER MONITORING

The Dos, Don'ts and Must Haves!

Stormwater monitoring doesn't have to be a headache for your organization. With proper site, sensor and equipment selection, you can be up and running within your compliance or organizational strategy in a relatively short time period. Here is some information to help you know what to look for, and some simple steps to get you started.

Organizations embark on Stormwater monitoring projects for a variety of reasons such as Municipal Separate Storm Water Sewer System (MS4) compliance, Total Maximum Daily Loads (TMDL), construction impact, and a variety of perimeter monitoring scenarios for contaminates such as heavy metals. One example of stormwater impact monitoring would be a proactive monitoring study for the possible effect of deicing media run-off from airport tarmacs into surrounding water bodies.

The criteria and scope of monitoring required varies depending on state, federal, and local government driven compliance initiatives, and the type of public and private organizations involved. Typically these monitoring practices will follow a tailored approach pending each organization's requirements and each monitoring site's application challenges. Stormwater sites encompass a broad range of parameters from simple rainfall and turbidity measurements, typically encountered during construction practices, to complex multi-parameter sites including open channel flow, level, rainfall, pH, temperature, conductivity, dissolved oxygen, turbidity, and even nutrients.

Additionally, programs may require discrete or composite water sampling routines once specific stormwater events have occurred. These samples must be collected within a limited time period and can require icing and/or refrigeration. Regardless of your organization's requirements, standardizing on a scalable real-time data collection and logic based control platform will provide you with the versatility and access needed for proper data quality assurance and vital event trigger execution when required.

The most important consideration when exploring any stormwater monitoring project is proper site and sensor selection. Most potential stormwater monitoring sites appear completely different during significant storm events than under normal conditions or during the initial field site selection and evaluation process.

YSI's field services crew finalizing the installation of complete stormwater site in North Carolina.

It is important to recognize the variable characteristics of each site, and the adjacent watershed, to insure that when a stormwater event of interest occurs that the proper sensors and equipment are ready and performing nominally throughout potential site conditions. Understanding each site's full range of water level variance, flow rates, rain events, and the significance of sediment or debris resulting in shifting channel geometry or obstruction will offer improved results.

Getting Started

To help avoid a costly learning curve resulting in the loss of valuable resource time, missed sampling opportunities, improper equipment selection, data discrepancies, and costly compliance violations; it is common practice to consider a manufacturer or consultant competent in understanding the specific challenges of stormwater monitoring. Avoiding the one size fits all approach as it pertains to monitoring methods and sensor types will significantly improve performance results.

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These application professionals can guide you through the process of choosing a versatile logic based data acquisition and control system capable of measuring all the required parameters. This would typically include the design of a solar powered system with an adequate power budget to maintain operation of each site's complete system through the duration of inclement weather. It is our job to provide customer assistance with proper sensor selection, event trigger logic configuration, sensor mounting hardware, proper equipment enclosures and real-time site access from your computer

Portable water quality stormwater site in Kansas equipped with WaterLog GOES satellite data delivery, EXO water quality instrument and solar power.

Step 1: Selecting a Precipitation and Level Sensor

The most common stormwater event triggers are rainfall and water level increases over a specified time duration. The trigger may require a combination of these conditions, or use just one of the parameters. The typical standard for rainfall measurement is a tipping bucket rain gauge with .01" resolution per tip and an 8" orifice. Proper mounting, maintenance, and site selection to avoid interference from its surroundings is critical for collecting accurate data with this sensor..

Water level/stage can be measured using a variety of sensor types with varying accuracy. Power, signal output, cost, and specific mounting requirements can vary widely among level sensors as well. Common sensor types include:

a. Pressure transducer (wetted and below low water level and can also be integral to water quality multi-probe or flow sensor)
b. Bubbler (uses a small in-situ bubble tube mounted below low water level)
c. Radar Sensor (mounted to a structure such as a bridge above high water level)
d. Ultrasonic Sensor (mounted to a structure above high water level)
e. Acoustic Sensor (mounted in-situ below low water level and typically integral to an acoustic Doppler flow sensor)
f. Shaft Encoder (wetted float and weight with the digital shaft encoder above high water level)

YSI field technicians installing protective casings for a EXO water quality sonde and discrete water sampler suction line.

Step 2: Event Criteria and Automation

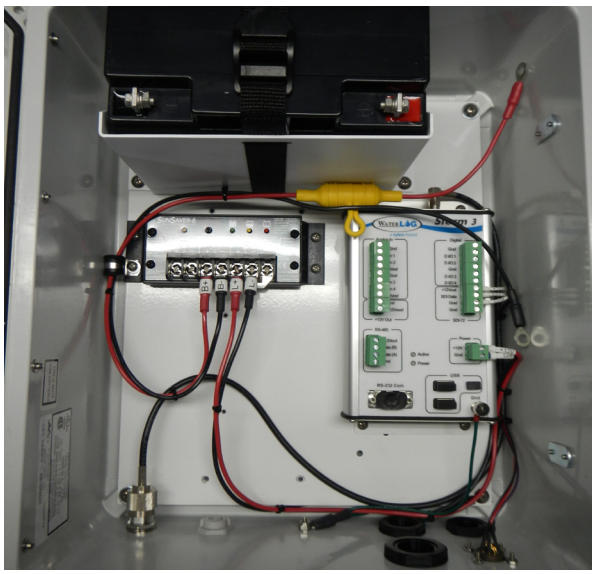
This is an important equipment choice to consider, as it determines the primary control of your system and your computer umbilical to your network of remote sites. The best approach is to standardize on the utilization of a DCP (data collection platform) where the same datalogger/controller is used through all sites within the network. This DCP should provide your field and supervisory personnel with the versatility to configure the logic criteria for event triggers, allow for routine data acquisition through cellular or other telemetry methods, and have either a software utility capable of running on your organizations PC/Server or have access to a professionally hosted website for data collection and provision (ideal for remote personnel and or multi-organizational access).

These DCPs should be designed to consume minimal power and have the ability to expand with your monitoring needs and evolving

event criteria. This type system design allows for a broader range of non-proprietary sensor and sampler interface options. Having a professional data acquisition system also provides a full range of options for telemetry peripherals, algorithmic functionality, automation, data delivery interface, and data visualization.

Step 3: Discrete and Composite Event Based Water Sampling

Once you have selected your data collection and control module, the next step is to select a water sampler with a bottle configuration for either discrete or composite sampling depending upon your requirements. Select a reputable manufacturer and an easy to use, robust sampler capable of receiving an external trigger signal from your universal datalogger/control module. This trigger signal is used to initiate a user configured sampling routine once the event criteria have been achieved. There are a variety of portable samplers on the market including an option for portable refrigerated samplers.



WaterLog Storm 3 Datalogger and control module enabled with water sampler trigger excitation and cellular IP addressable data access for event notification.

Step 4: Notification

As previously mentioned, there are several reasons to consider a data collection system enabled with real-time communication access to your sites via the Internet. The first and probably most important reason is for automated notification when event criteria at a specific site have been met. Typically this can be delivered through an email or text message to a specified subscriber group. Another key reason for having real-time access and automated data delivery from your network of sites is the assurance that your sites are functioning nominally and collecting quality data. This functionality will serve to minimize field service resources and costs while allowing continuous access to site data for baseline and trend analysis.

Step 5: Water Quality

Organizations required to monitor water quality parameters as an event trigger, or for other continuous monitoring needs, will want to consider a water quality multi-parameter instrument. These instruments are capable of being configured with common sensors providing data output to your datalogger/controller for temperature, pH, conductivity, dissolved oxygen, turbidity, depth, Chlorophyll, as well as, several other sensors and calculated parameters.

Proceed with selecting a multi-parameter instrument that can meet your current measurement needs, as well as, have the capacity to be expanded and or reconfigured with other sensors in the future. An important consideration is selecting a water quality instrument designed for continuous, in-situ field use and that offers proven anti-fouling methods, such as optical sensors, mechanical wipers, and copper -based materials, to deter sensor elements and surfaces from rapid biological growth during deployment. Premature bio-fouling can result in data deterioration and more frequent maintenance and calibration exercises requiring additional field service visits.

YSI Systems Stormwater monitoring enclosure with solar power, automated water sampler, cellular based real-time data/event notification, Waterlog rain gauge, EXO water quality instrument and a SonTek IQ flow sensor.

Step 6: Open Channel and Non-Full Pipe Flow Measurements

Flow proportional sampling is another common event trigger for discrete and composite water sampling routines. Stormwater channels and pipes range greatly to include concrete channels, corrugated pipes, natural streams, excavated ditches, concrete pipes and other conduits.

The best technology offered for these applications is an acoustic Doppler profiler that is capable of accurately measuring velocity even in stormwater with low amounts of suspended solids. The sensor should be capable of measuring the majority of the flow profile cross section and be able to adjust with water level fluctuations. There are several sensor technologies on the market that don't recognize the entire cross-sectional flow profile during velocity measurements. These methodologies rely primarily on algorithmic velocity estimation of the majority of the cross section. These sensors can include radar, laser and area velocity type meters providing variable performance. There are also other traditional methods requiring a primary device such as a weir or flume and a secondary device such as a level sensor for flow calculation. These methods offer less portability, are more intrusive to the discharge conduit, are unable to measure bi-directional or surcharged conditions, and are typically more expensive to engineer and install.

SonTek IQ acoustic Doppler profiler based open channel/ non-full pipe flowmeter being installed in a typical stormwater culvert.

There are several important steps to insure reliable and accurate open channel flow data. These include proper channel surveying, location of sensor in non-full pipe, and sensor mounting in natural streams with shifting sediment beds. Consultation with an experienced product application specialist or professional consulting/engineering firm experienced with these instruments is recommended.

Start Monitoring Today!

Again, stormwater monitoring doesn't have to be an insurmountable challenge for your organization. With proper site, sensor, and equipment selection you can be up and running within your compliance or organizational strategy requirements in a relatively short time period. Organizations often opt to have their sites professionally installed, configured, and routinely maintained by a qualified equipment manufacturer and/or consultants experienced in stormwater monitoring and with experienced field service technicians.

Of course, our water monitoring experts are always available to help get you started! You are always welcome to send general application questions to environmental@ysi.com. Questions about loggers? Contact sales@waterlog.com. Or, if you're looking for flow data, send your questions to SonTek at inquiry@sontek.com.

YSI EXO2 multi-parameter water quality instrument being installed by a YSI field technician at a monitoring site in New York.

About the author

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Kevin has over 18 years of experience in designing and installing stormwater monitoring systems . He has worked with all the Xylem Analytics brands and key water sampler manufactures to enhance the integrated stormwater monitoring solutions offered to our customers globally. Kevin and YSI's Integrated Systems and Services team of application engineers, systems engineers and field service technicians have extensive experience integrating hundreds of monitoring networks for municipal, government, research, construction, industrial and environmental consulting organizations. His key emphasis is on a tailored approach to each customer's unique application and monitoring challenges. Xylem Analytics has integration centers and application specialist located throughout the world ready to assist you with your next stormwater monitoring endeavor. See Xylem's complete Stormwater monitoring solutions at www. ysisystems.com

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