Advances in Stormwater Monitoring

Wireless communications provide improved safety, savings, and reliability.

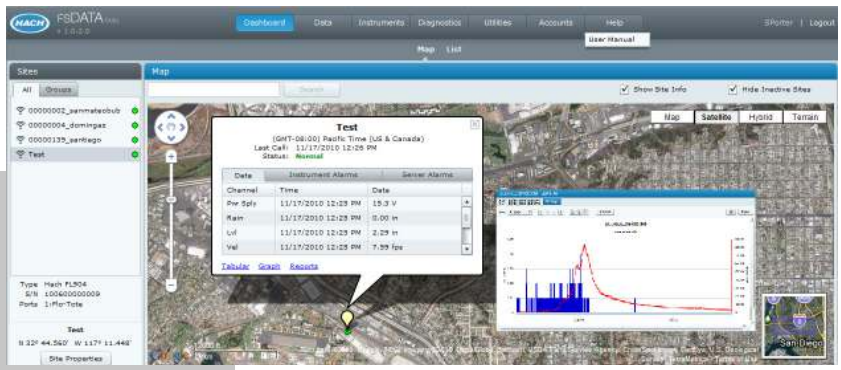
By Sean Porter

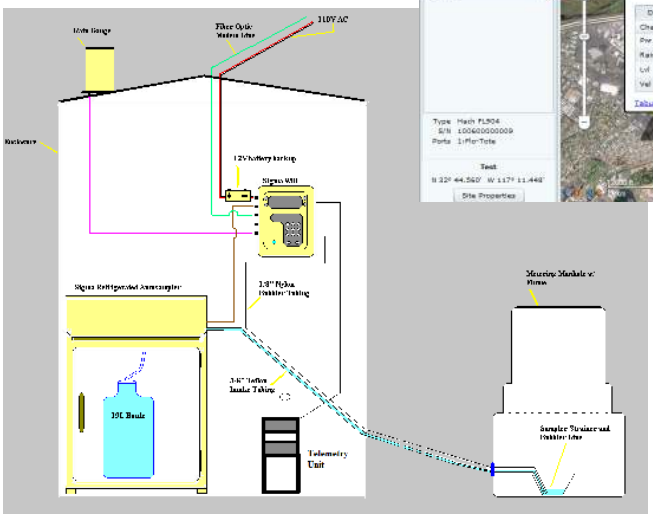
Many stormwater monitoring programs require the estimation of pollutant levels in discharges to receiving waters, especially in Total Maximum Daily Loads (TMDL) studies or in Daily Average (DA) calculations. Rainfall data, instantaneous flow data, and analytical samples are collected to assist in load calculations. Sampling usually occurs 24-7, with the exception of holidays. Numerous sampling approaches are selected to complement the study design, satisfy financial constraints, and ensure data quality requirements. In some cases, real-time water quality monitoring data is collected. These parameters often include pH, conductivity, temperature, etc. Stormwater sampling programs are often developed to comply with regulatory requirements such as TMDLs. Those loads are typically calculated by estimating a storm's Event Mean Concentration (EMC) and multiplying that by the total storm volume to obtain a load. The EMC for the runoff event is often used in reporting results for selected constituents.

Flow-weighted composite sampling is one sampling strategy utilized by many stormwater agencies which results in a storm EMC by compositing individual small volume samples into a large (multiple liters borosilicate) sample container. This flow-weighted or volume-paced method uses a flowmeter and automated sampler. When a specified volume has passed the monitoring point, the flowmeter triggers the automated sampler to draw a small volume (50ml-500ml) of sample. These are known as aliquots. The sampler will continue to draw aliquots at the specified intervals. Therefore, at higher flow rates, the aliquots are taken more frequently and the composite of all these aliquots is the flow-weighted composite sample, the sample is "weighted" towards the higher flow rates. The analytical result for this single sample is equivalent to an EMC for the storm.

In addition to the 24-7 schedule, one of the challenges with collecting a flow-weighted composite is estimating the volume-to-sampler pacing for each storm event. If the pacing is too low and more rainfall than expected occurs, the automated sampler will sample too frequently and bottles can overfill. If the pacing is too high and less than expected rainfall occurs, the automated sampler may not collect enough aliquots to represent the storm event, and the sample will not meet the analytical laboratory volume requirements. Sending field crews out to make last minute pacing changes can be costly and dangerous.

Most modern stormwater monitoring stations are equipped with flowmeters,





(above) A FSDATA Web-based system was designed for lage-scale monitoring programs where flowmeters and automated stations are connected to and programmed from a Web-based server

(left) Most modern software monitoring stations are equipped with flowmeters, water quality probes, autosamplers, solar panels, and telemetry devices or Web-enabled flowmeters

water quality probes, autosamplers, solar panels, and telemetry devices or web-enabled flowmeters that can be queried to retrieve dry weather, antecedent rainfall data, and stormwater water quality and flow data. The equipment is housed in small locking weather proof enclosures. In addition, the volume to sample ratio can be set remotely. This means unexpected rainfall accumulation estimates can be accounted for with last-minute pacing changes.

Remote Data Systems

The solution to last minute pacing changes is to use modern technology such as remote stormwater data systems (RSDS). These days, with 4G smart phones, wireless communication has become more efficient. Several manufacturers of flow monitoring and sampling equipment offer phone or Internet line connection (or web-enabled) options. To access the flowmeter remotely with the phone option, "dial" the flowmeter modem with a PC fitted with an analog 56K baud modem and a telephone land-line. The ISCO 2105c/g Cellular Interface Module and the HACH Sigma 1000 offer these capabilities. In both cases, the PC can wirelessly connect to the flowmeter to download data or make programming changes. The ISCO system can be programmed to dial out and push data to a server. The server could host the data on a custom website, but programming or sampler pacing changes would need to occur through the dial-up process.

The other option is to use Internet-connected (or web-enabled) flowmeters such as the Telog RU33and the HACH FL900. The FL900 uses the Internet to connect to and program the flowmeter using packet-based information. The good news is, these monitoring systems offer a newer form of data transmittal and web control since all programming changes, data upload frequency, alarm conditions, and sampler controls are available from the website. There is no need to "dial" the flowmeters. The other good news is that these automated systems are plug-and-play with existing flowmeters, autosamplers, and water quality monitoring probes.

The new web-enabled HACH FL900 flowmeters are equipped with the FSDATA™ system out-of-the-box and can be cabled to the autosamplers, rain gauges, and solar panels. This web-based system was designed for large-scale monitoring programs where flowmeters and automated stations are connected to and programmed from a web-based server. The real-time data and programming capabilities are available to Internet-connected computers, 3G and 4G smart phones, and to cellular phones via text messaging. Using a system like this can reduce labor by 30-40 percent, significantly increase safety, allow field crews to respond quickly to equipment failures, and improve overall sample accuracy.

The web-enabled flowmeters automatically push data to the server as quick as every five minutes, display the real-time status of each monitoring station including flow hydrographs and sample history, and have alarm capabilities that allow field crews to quickly respond to failures of automated composite sample collection equipment. The result is a RSDS that allows integrated, remote access capabilities for every monitoring station from any Internet-ready location in the world. Therefore, regional monitoring programs would require fewer staff members to collect successful samples at multiple stations. This results in significant cost savings due to the minimized staff requirements.

To complete the package, the system allows for Short Message Service (SMS), also referred to as texts, which includes alarms and current status updates. For example, field crews can send SMS messages to the flowmeter, requesting current status. The flowmeter will then respond with battery voltage, current flow rate and rainfall totals sent to a single cell phone. This feature results in additional cost savings since cellular-enabled field crews will not require laptops or an Internet connection to respond quickly to weather changes or equipment failures. Fewer trips to the monitoring site means reduced risk.

Stormwater monitoring stations can be housed in small, locking weather-proof enclosures.

Collecting flow-weighted composite stormwater samples is challenging, due to the technical nature of the programs, the schedule, and estimating the volume-to-sampler pacing for each unpredictable storm event. By using modern stormwater monitoring equipment, web-enabled flowmeters and autosamplers, sending field crews out to make last-minute changes can be avoided. In addition, telemetry and web-equipped data systems logging antecedent rain and flow data can be quickly queried, reducing dry weather maintenance and download times. Overall, the quality of the monitoring programs is improved because the data is more reliable and there is little chance of data loss. As we move forward, expect stormwater monitoring equipment to become more compact, sophisticated and user friendly -- with access to even more data.

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