Stormwater Monitoring Guide

CONTENTS

INTRODUCTION

Stormwater runoff monitoring provides information on the quantity and quality of stormwater runoff. Data gathered helps identify pollutant sources, and guides development of pollution control and prevention plans.

The Clean Water Act

In 1972 Congress passed the Federal Water Pollution Control Act. This legislation is often referred to as the Clean Water Act (CWA). This set of laws was promulgated specifically to prohibit discharge of pollutants into the navigable waters of the United States. The major intent of this legislation was to prevent a discharge from a point source, unless the discharge was authorized by an NPDES (National Pollutant Discharge Elimination System) permit. The NPDES program is designed to track point sources and requires the implementation of the controls and monitoring needed to minimize the discharge of pollutants.

Initial efforts within the NPDES program primarily focused on reducing pollutants in discharges from easily identifiable sources such as industrial process wastewater and municipal sewage. Their polluted discharge of often led to serious degradation in the water bodies. As pollution control measures for industrial process wastewater and municipal sewage were implemented and refined, it became evident that many other sources were also causes of water quality impairment.

In particular, stormwater runoff from large surface areas, such as agricultural and urban land, was identified as a major problem.

The goal of stormwater runoff monitoring is to collect data on the duration and amount of rainfall, the duration and amount of the runoff, and the types and amounts of pollutants that may be present in the runoff. This goal is achieved by measuring the rainfall rate and the runoff flow rate, and by collecting representative samples of the runoff for laboratory analysis.

Isco offers municipalities and industries an integrated system that automatically gathers the data needed to comply with EPA regulations. Data provided by the Isco system can play an important role in the development and implementation of corrective measures.

Early Studies of Runoff Pollution

The *NURP* study[1] was the first of its kind to determine the affect of urban runoff on the nation's waters. The study was conducted from 1978 to 1983 and consisted of 22 urban/suburban areas nationwide. The EPA conducted the NURP study to document the nature of urban runoff from residential, commercial, and industrial areas. Its focus was mainly on flows from separate storm sewers. The majority of samples collected in the study were tested for eight conventional pollutants and the presence of three heavy metals. Data collected under the NURP study indicated that discharges from separate storm sewer systems, that drained runoff from residential, commercial, and light industrial areas, carried more than 10 times the annual loadings of total suspended solids (TSS) than did discharges from municipal sewage treatment plants. The NURP study also indicated that runoff from residential and commercial areas carried somewhat higher annual loadings of chemical oxygen demand (COD), total lead, and total copper than effluent from secondary treatment plants. Findings also showed a wide range of fecal coliform counts in urban runoff (typically from tens to hundreds of thousands per hundred milliliters of runoff) during warm weather conditions. The median for all sites was around 21,000 per 100 ml. of runoff.

"The (NURP) study concluded that the quality of urban runoff can be affected adversely by several sources of pollution that it had not directly evaluated, including illicit discharges, construction site runoff, and illegal dumping."

Monitoring data, summarized in the NURP study, provided important information about urban runoff from residential, commercial, and light industrial areas. The study concluded that the quality of urban runoff can be affected adversely by several sources of pollution that it had not directly evaluated, including illicit discharges, construction site runoff, and illegal dumping.

Data from the NURP study were analyzed further in the *U.S. Geological Survey (USGS) Urban Storm Water Data Base for 22 Metropolitan Areas Throughout the United States* study[2].

The USGS report summarized additional monitoring data compiled during the mid-1980s, covering 717 storm events at 99 sites in 22 metropolitan areas, and documented problems associated with metals and sediment concentrations in urban stormwater runoff.

Illicit Connections to Storm Drains

The NURP study also found that pollutant levels from illicit discharges were high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. The study noted particular problems with illicit discharges of sanitary wastes, which can be directly linked to high bacterial counts in receiving waters, and can be dangerous to public health.

Because illicit discharges to MS4s can create severe widespread contamination and water quality problems, several municipalities and urban counties have performed studies to identify and eliminate such discharges.

In Michigan, Ann Arbor and Ypsilanti water quality projects inspected 660 businesses, homes, and other buildings and identified 14% as having improper storm sewer drain connections. The program assessment[3] revealed that, on average, 60% of automobile-related businesses including; service stations, automobile dealerships, car washes, body shops, and light industrial facilities, had illicit connections to storm sewer drains. The assessment also showed that a majority of the illicit discharges to the storm sewer system resulted from improper plumbing and connections which had been approved by the municipality when installed. In addition, an inspection of urban stormwater outfalls draining into Inner Grays, Washington, indicated that 32% of outfalls had dry weather flows. Of those flows, 21% were determined to have pollutant levels higher than would be expected in typical urban stormwater runoff, as characterized in the *NURP* study[4].

"First Flush" Runoff

Stormwater runoff from lands modified by human activities can harm surface water resources. In addition, such runoff can cause a water body to fall below state water quality standards. Stormwater runoff can cause a change in the natural hydrologic patterns, accelerating stream flows, destroying aquatic habitat, and elevating pollutant concentrations and loadings. This runoff can contain or carry high levels of contaminants, such as; sediment, suspended solids, nutrients (phosphorous and nitrogen), heavy metals and other toxic pollutants, pathogens, toxins, oxygen-demanding substances (organic material), and floatable materials[5].

> " *The highest concentrations of these contaminants often likely to be found in "first flush" discharges, which occur during the first major storm after an extended dry period. This is why, for industrial concerns, a separate first flush sample is required, along with a flow-weighted composite.* "

After a rain, stormwater runoff carries these pollutants into nearby streams, rivers, lakes, estuaries, wetlands, and oceans.

The highest concentrations of these contaminants is often likely to be found in *"first flush" discharges*[6], which occur during the first major storm after an extended dry period. This is why, for industrial concerns, a separate first flush sample is required, along with a flow-weighted composite. This allows data to be gathered specifically for the flow periods when pollutants are at their highest, while also showing the total effect the runoff has on receiving waters.

Individually and combined, such pollutants impair water quality, threatening designated beneficial uses and causing habitat alteration or destruction. Uncontrolled stormwater discharges from areas of urban development and construction activity negatively impact receiving waters by changing the physical, biological, and chemical composition of the water.

Effects of Urban Development

Urban development[7] increases the amount of impervious surface in a watershed as farmland, forests, and meadowlands with natural infiltration characteristics, are replaced by buildings with rooftops, driveways, sidewalks, roads, and parking lots, all having virtually no ability to absorb water. Stormwater and snow-melt runoff wash over these areas, picking up pollutants along the way, while gaining speed and volume because of their inability to naturally disperse into the ground[8]. Resulting flows are higher in volume, pollutant content, and temperature, than the flows from natural areas having vegetation and soil to slow and absorb the runoff. Studies reveal that the level of imperviousness in an area directly correlates with the quality of the nearby receiving waters.

When the Puget Sound lowland ecoregion was studied and documented[9], findings indicated that when the level of basin development exceeded 5% of the total impervious area, the biological integrity and physical habitat conditions necessary to support natural biological diversity showed a dramatic decline.

Research conducted in numerous geographical areas, concentrating on various aspects, and employing widely different methods, has led to a similar conclusion. Stream degradation occurs at relatively low levels of imperviousness, (10 to 20% of the total area). Furthermore, research has indicated that few, if any, urban streams can support diverse bioenthic communities at imperviousness levels of 25% or more. An area with a medium density of single-family homes can be anywhere from 25% to nearly 60% impervious, depending on the design of the streets and parking[10].

Of course, urban development leads to a population density increase. This in turn brings proportionately higher levels of auto emissions, auto maintenance wastes, pet waste, litter, pesticides, and household hazardous wastes, all of which may be washed into receiving waters by stormwater runoff, or dumped directly into storm drains that discharge into receiving waters.

A modeling system developed for the Chesapeake Bay indicated that contamination of the Bay and its tributaries from runoff is comparable to, if not greater than, contamination from industrial and sewage sources.

The *1996 305 (b) Report*[11] Inventory, based on a compilation of 60 individual 305(b) reports that had been submitted by States, Tribes, and Territories, showed that stormwater runoff was the major factor in non-attainment of state water quality standards in; 19% of river and stream miles, 40% of lake, pond, and reservoir acres, 72% of estuary square miles, and 6% of ocean shoreline waters.

The 1996 Inventory indicated that approximately 40% of the Nation's assessed rivers, lakes, and estuaries are impaired (either partially or not at all supporting designated uses). The Inventory also found urban runoff/ discharges from storm sewers to be a major source of water quality impairment nationwide. They were found to be a source of pollution in 13% of impaired rivers, 21% of impaired lakes, ponds, and reservoirs, and 45% of impaired estuaries – ranking second, only to industrial discharges.

Obviously, pollutants in stormwater runoff are a prime concern for overall attainment of state water quality standards.

The new TMDL requirements are also an issue that must be addressed in order to meet EPA standards.

EPA Stormwater Regulations

In 1987, Congress amended the CWA to require implementation, in two phases, of a comprehensive national program for addressing stormwater discharges. Phase I was promulgated on November 16, 1990 (55 FR 47990).

It requires NPDES permits for stormwater discharge from a large number of priority sources, including municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or more, and several categories of industrial activity, including construction sites that disturb five or more acres.

> "*Phase II of the program is now in place, affecting municipalities that of less than 100,000. In addition, construction sites that impact less than five acres are now required to institute a set of controls for their storm water runoff.*"

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The initial deadline for the affected groups has been extended to March 10, 2003. In addition, certain industries can apply for a "no exposure" permit that would eliminate the need for other stormwater related requirements. (i.e. BMPs).

NOTE:

The EPA maintains a stormwater runoff website that is an excellent source for additional information and updates.

The address is:

www.epa.gov/owm/sw/

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Rainfall Measurement

A rain gauge is a key element in a stormwater runoff monitoring system. The instrument measures on-site rainfall (typically in increments of 0.01 inch or 0.1 millimeter).

The rain gauge allows system components to remain idle (conserving power) until there has been a sufficient amount of rainfall to warrant monitoring activity.

Each time the gauge's rain collecting mechanism is triggered, a signal is sent to another instrument – usually the sampler or flow meter. The monitoring system is activated once a pre-set rainfall amount has been reached.

If desired, the system can be configured to require additional rainfall parameters for activation.

Isco Rain Gauges feature a tipping-bucket mechanism to assure accurate rainfall measurement.

Runoff Flow Measurement

Most stormwater monitoring installations include an open-channel flow meter, used to measure the rate and volume of runoff.

The flow meter may also be set to activate an automatic sampler each time a certain (programmable) volume of runoff has been measured. This is known as *flow-weighted* sampling.

Isco Flow Meters record flow, rainfall amount, and sample data on a built-in printer. They can also store the data for downloading to a PC.

Level-to-Flow Conversion

Many open-channel flow meters determine flow rate by measuring the depth of runoff in a channel, and then computing the flow rate using the *Manning Formula* – an equation that estimates flow rate based on runoff depth and the size, shape, slope and roughness of the channel being monitored.

The Isco 4230 Flow Meter uses bubbler technology to accurately measure stormwater runoff. It can also activate and flow-pace a sampler.

Level-to-flow rate conversions for weirs, flumes, and the Manning Formula, are built in.

A keypad and backlit LCD makes programming fast and easy, and a dot matrix printer provides an on-site record of flow, rainfall, and sample data.

Since the Manning Formula only provides estimated figures, installation of a *weir* or *flume* in the channel is preferred. They generally provide more accurate flow rate measurement, but are sometimes impractical for stormwater monitoring installations.

While Isco does offer ultrasonic and submerged probe equipment for runoff level measurement, *bubbler* type measurement is usually best suited for stormwater monitoring.

Automatic drift compensation allows a bubbler to maintain its calibration indefinitely, making it ideal for standby applications like stormwater monitoring. In addition, a bubbler is not affected by wind and flow stream turbulence, nor can it be damaged by lightning or flowing debris, all of which may be present during a storm event.

Our 700 Series Flow Modules plug directly into Isco 6700 Series Samplers. They're interchangeable to allow a variety of capabilities.

Area Velocity Flow Measurement

Submerged, surcharged and/or reverse flow conditions may occur in some stormwater runoff channels. In these situations, the Manning Formula and weirs or flumes don't provide accurate measurement, as they are based on a measurement of level only.

At these sites, the *area velocity* method (that calculates flow rate by multiplying the area of the flow by its average velocity) should be used.

The 4150 Flow Logger is a rugged, submersible enclosure designed for AV flow logging under the most severe conditions.

Isco's 4250 Area Velocity Flow Meter delivers maximum accuracy and versatility in an easy-to-operate package with field-proven performance.

Samplers

An automatic sampler periodically collects samples from the flow stream. Its controller is programmed to initiate each collection sequence and to regulate the amount collected, as well as where it is deposited.

Samples may be collected at fixed intervals or after a set volume of stormwater has passed the monitoring point. To do the latter, the sampler must receive signals from a flow meter. Such samples are said to be *flow-weighted*.

Regulations require some industries to collect a "*first flush*" sample, typically during the first 30 minutes of a storm event, as well as a flow-weighted composite sample for the entire storm event. Isco offers samplers that collect first flush and flow-weighted composite samples into different bottles.

Depending on the pollutants to be monitored, and the specific analyses to be performed, glass or plastic bottles may be desired. The EPA recommends glass when sampling for oil and grease or metals and toxic pollutants.

The samples must be analyzed before chemical or biological changes occur. In order to delay those changes, portable samplers are designed to hold crushed ice. Refrigerated samplers are also available and may be preferred where conditions allow stationary units that have access to an AC power source.

In some cases, chemical preservatives can also be added to bottles before sampling to delay sample degradation.

Stormwater monitoring regulations require that samples be analyzed for a variety of properties, including pH. Since pH begins to change the moment a sample is collected (due to temperature variations and degassing of the sample), stormwater monitoring systems often include a pH meter.

Isco's 6700 Series Samplers feature a patented liquid detector and pump revolution counter to ensure accurate, repeatable, sample volumes.
Our unique 2-part programming allows separate collection of "first flush" and flow-weighted samples – in accordance with EPA stormwater regulations.
The rugged, submersible controller provides dependable performance over the long term.

Power Sources

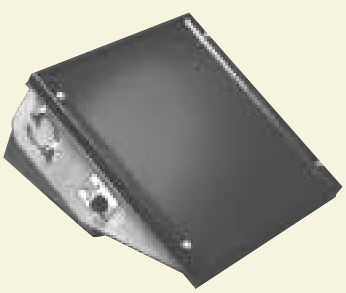
Lead-acid batteries are typically chosen for portable stormwater monitoring systems because they have a high capacity, are inexpensive, and retain maximum charge while idle. Automotive or deep-discharge marine batteries are also favored because of their high capacity.

For applications where line power is available, AC power packs can be used to convert AC power to the 12 volt DC current required by portable systems.

Solar-powered chargers may be preferred for long-term applications, especially for sites that are difficult to access, or for those in very remote locations.

The Isco 946 Lead-Acid Battery fits inside the sampler's cover it is most often used for stormwater monitoring.

The Isco 948 Lead-Acid Battery is a 45 amp/hour gelled-electrolyte type housed in a convenient, weather-resistant carrying case.



Isco's 954 Solar Charger is ideal for long-term battery-powered applications, and is especially popular for remote sites.

Data Collection

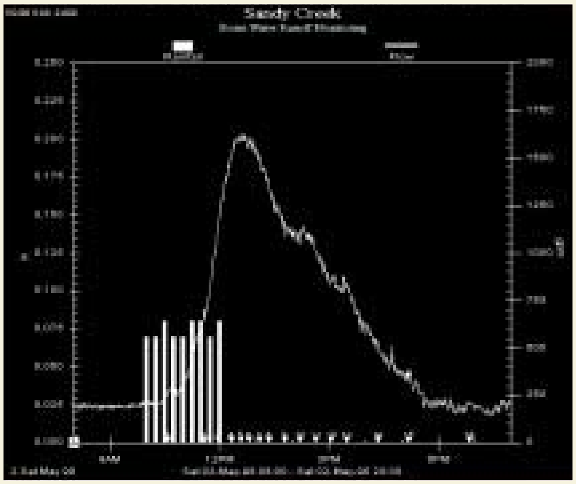
When the storm event is over, the sample bottles are taken to a laboratory to determine the types and amounts of pollutants in the runoff.

Isco offers flow meters with built-in printers that provide a hard-copy record of the flow, rainfall, and sample data collected by the system.

Data from current Isco products can be downloaded directly into a laptop PC, equipped with Isco Flowlink® 4 Software.

In addition, Isco offers the 581 RTD (Rapid Transfer Device), a small, hand-held module that retrieves and stores data for later downloading to a PC.

A number of remote data retrieval devices and methods are also available. They are described in the following section (Communication).



A laptop computer with Isco Flowlink® 4 Software installed, can be used to retrieve flow, rainfall, parameter and sample data from our instruments.

Whatever the collection method, Flowlink 4 allows you to review and analyze data, then quickly generate a variety of informative graphs and reports.

Communication

Wireless Module

Isco’s 2102 Wireless Module allows drive-up data retrieval from several Isco instruments.

The 2102 uses exclusive spread spectrum digital radio for direct, reliable, two-way communication to a laptop computer in your vehicle.

A 2102 base unit, located in a service vehicle, retrieves stored data from another 2102 module (connected to a 6700 Series Sampler). The base unit then feeds collected data into a laptop computer equipped with Isco’s Flowlink® 4 Flow Data Software.

Internal/External Modems

An internal or external modem can be used with 6700 Series Samplers and 4200 Series Flow Meters to collect data or check status.

The internal modem can be used to have the sampler run a specific program, as directed by the user’s call.

Alarm Dial-outs

Isco internal modems can also initiate an alert call to the equipment user when an event is taking place.

The alert can be sent to a telephone or pager, to notify crews that the system is collecting information and samples of a storm event.

Phone Lines

Isco 6700 Series Samplers and Isco Flow Meters can be used with either standard phone connections or cell phone service. When using cell phones to communicate with the equipment, care must be taken to assure that adequate signal strength is available.

Another factor to consider is power consumption. A continually active cell phone requires large amounts of power. To conserve batteries, Isco’s 6712 Sampler can be programmed to modulate periodically between “on” and “off” periods throughout the day.

If an event occurs during an “off” time, the cell phone is automatically powered up to send out the alarm signal.

Additional equipment (such as antennas) may be required to insure that proper signal is available to the cell phone.

Rainfall Measurement

Where should a rain gauge be located?

The rain gauge should be installed where its collector (top) has unobstructed access to rainfall. Its location should be away from trees, buildings or other objects.

The photo at right shows a rain gauge mounted on a telephone pole. The center photo shows a rain gauge placed in a common location – on top of a protective shelter.

Our sampler and flow meter are inside a manhole, making it impractical to connect the rain gauge to the flow meter. Is there an alternate way to store rainfall data?

Isco's 675 Logging Rain Gauge is perfect for such situations. It has an internal logger that records rainfall data. The stored data is retrieved using a PC.

The 675 is also useful in applications where the outfall is in a covered location (forested area, etc.) that requires the rain gauge to be installed at a separate location.

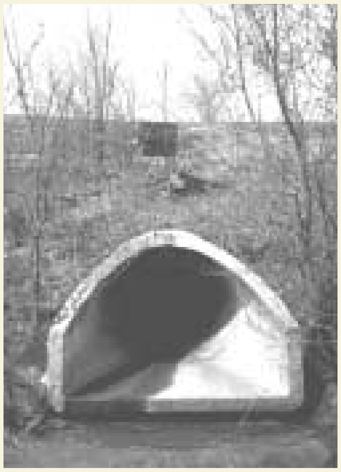
The fire stations in our city already have rain gauges. Will we be able to combine their data with the data from our sampler and flow meter?

Yes. Flowlink® 4 Software can import rainfall data (stored in ASCII format) from a spreadsheet file. Once imported, Flowlink allows you to analyze this data along with the flow and sample data collected by your stormwater monitoring system.

This advanced flow data program can also import and analyze data from several other sources.

Flow Measurement

Note: In-depth flow measurement information is contained in Isco's Open Channel Flow Measurement Handbook.



Can the Manning Formula be used to determine flow rate for stormwater monitoring?

Yes. The Manning Formula provides sufficient accuracy for many stormwater applications. It's often the most practical, since all it requires is a depth-of-flow measurement.

For best results, the channel must be straight– as well as uniform in shape and wall texture – for several hundred feet upstream of the measurement point.

In the example at right, the flow meter is measuring the level in the pipe at a point well upstream of the outfall.

Our stormwater does not flow through a round pipe. Can we still use the Manning Formula?

Probably so. The Manning Formula is most often associated with flow in round pipes. However, it can work to estimate flow rate in channels of any shape.

An example is the trapezoidal channel shown in the center photo. The straightness and uniformity of this channel make it ideal for the Manning Formula.

Can we use the Manning Formula to measure flow rate in a natural ditch?

You can, but accuracy will suffer. The Manning Formula will work to estimate the flow rate in a ditch (such as the one pictured at right), but it can be considerably less accurate under these conditions.

Natural channels are seldom straight and uniform, and it can be difficult to determine slope and roughness. In addition, flow resistance in the channel will increase as vegetation grows.

However, the Manning Formula may well be the only practical method to estimate flow rate in a large ditch.

Are there more accurate methods than the Manning Formula?

Absolutely. For maximum accuracy, consider installing a *weir* in your runoff channel. A weir is a type of dam, built across an open channel, that lets water pass through an opening (or notch), having a known area. Weirs are simple and relatively inexpensive to build and install.

A flow meter measures the level upstream from the weir and converts it to flow rate – based on the known relationship between the area of the opening in the weir, the water level, and the flow rate.

The photo at right shows a V-notch style weir in place.

Our runoff sometimes contains heavy debris that could block a weir. Is there a better method for accurately measuring such flows – especially one that wouldn't require constant attention?

Because they tend to be self-cleaning, *flumes* are often used to measure flows containing sediment or solids. A flume is a specially shaped channel that is inserted into the flow stream. A flow meter measures the level at a certain point in the flume and converts it to flow rate, based on known dimensions.

Flumes are more complex than weirs, but are available ready-made from several sources.

The center photo shows an H-flume.

Submerged, surcharged or reverse flows occur in our runoff channel. How can we accurately measure flow there?

Weirs, flumes and the Manning Formula are based on a measurement of level only, so they can't provide accurate measurement in these instances.

The *area velocity method* should be used at sites where these conditions can occur. By multiplying the area of the flow by its average velocity, the AV method accurately measures flow at sites under virtually all conditions.

The Isco 4150 Area Velocity Flow Logger uses patented Doppler technology to directly measure average velocity in the flow stream. An integral pressure transducer measures liquid depth to determine flow area.

Sampling

Some industrial facilities must collect a "first flush" sample during the first 30 minutes of the runoff, as well as a flow-weighted composite sample for the entire storm event (or the first three hours of the runoff, whichever occurs first). Can a single sampler collect both of these samples?

Our exclusive software program allows an Isco Model 6700 Sampler accomplish that task.

First flush samples are collected following system initiation by measured parameters. The flow-weighted sample is then collected according to the pre-set program.

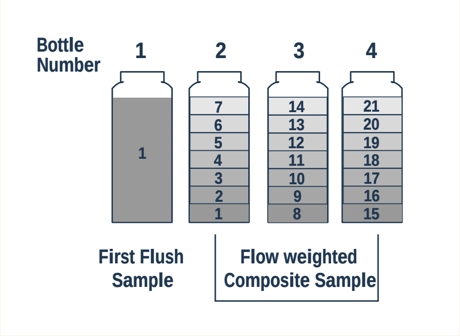
Specific bottle sets can be reserved for various storm events.

What's the best bottle configuration for stormwater sampling?

Most prefer using four 1-gallon glass bottles.

The first flush sample is stored in bottle 1. The sampler is programmed to fill bottles 2 and 3 with flow-weighted samples – when the stormwater flow is average. If the flow is 50% or more below average, only bottle 2 will be used for composite sampling. Bottles 2, 3 and 4 will all be used if the flow is 50% or more than average.

In this way, a 4-bottle sampler can collect a representative sample from a storm event that is ½ to 1½ times the average.



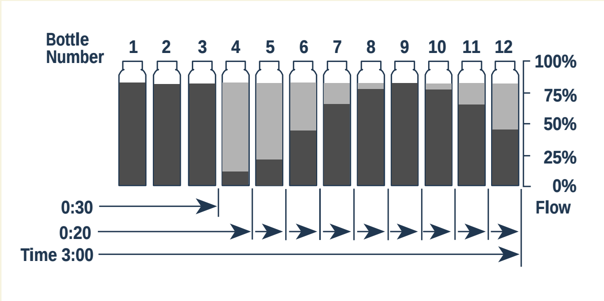
It's difficult to estimate the amount of runoff prior to a storm event. If we underestimate, all the bottles fill too soon. If we overestimate, we don't collect enough sample for complete analysis. Is there a way to solve this problem?

An Isco sampler with twelve 1-quart glass bottles is the answer. The first flush sample is stored in the first three bottles. Individual samples are collected into the nine remaining bottles at 20-minute intervals. After the storm, sub-samples from each of these nine bottles can be poured into one container, resulting in a flow-weighted composite sample.

The volume of each sub-sample is proportional to the flow at the time of sampling, as measured by the flow meter – eliminating the need to predict runoff volume before the storm event.

In addition, the 6700 Series Samplers can collect volumes of sample paced by the flow volume. You select the amount of sample to collect, per amount of measured flow. This time-paced, flow-weighted sample volume is then deposited in the bottles.

For example, assume you want to collect 25 ml of sample for every 1,000 gallons of measured flow. If the measured flow in a 150-minute span is 6,000 gallons, the volume of sample collected would be 150 ml (25 ml for every 1,000 gallons. 25 ml x 6 = 150 ml).



We are required to collect samples, but don’t need to measure flow and rainfall. Is there a way to activate the sampler when runoff occurs – without a using a rain gauge?

You bet. Use Isco’s 1640 Liquid Level Actuator. It has a probe located in the flow stream area. When the runoff level rises and touches the probe, the Liquid Level Actuator signals the sampler to begin collecting.

Where should the sampler pick-up (strainer) be placed?

In order to collect a sample that is representative of the entire flow stream, the pick-up should be located where the flow is turbulent and well-mixed (generally, at about 60% of flow depth).

For example, if you are collecting samples from an open channel, the strainer should be located downstream from the flow meter’s sensor.

Likewise, if you are using a weir or flume, the strainer should be placed downstream from it.

What about collecting samples of volatile organic compounds (VOCs)?

Standard samplers won’t work for VOC sampling because peristaltic pumps strip VOCs from the liquid. In addition, their bottles aren’t sealed after sample collection.

Our 6100 VOC Sampler (bottom right) automatically collects and seals representative samples according to EPA protocols. Our flow meters can activate both the 6100 and a standard sampler at the same time.

Keep in mind though; unlike standard samples, VOC samples must be collected from a tranquil section of the flow stream.

Power Sources

What's the best way to power a storm water monitoring system?

For stormwater applications where portable equipment is used, Isco recommends lead-acid batteries. They hold a charge longer than other types – an obvious advantage where long periods of time are likely to occur between activity.

Some prefer to use automotive or deep-cycle marine batteries to power their systems as they offer a very high capacity at a relatively low cost. Isco offers a 45 amp/hour gelled-electrolyte battery in a convenient carrying case along with an integral cable for connection to an Isco sampler or flow meter.

Where line power is available, an AC power pack can be used to convert 120 or 240 volts AC to the required 12 volts DC.

Of course, where conditions permit, and line power is available, stationary refrigerated samplers are ideal.

For long-term applications, or where access is difficult, solar panels may be most suitable. A solar charger maintains a lead-acid battery in a fully charged condition, virtually eliminating the need to visit the site for periodic battery replacement.

Data Handling and Communication

Can we get an on-site printout of the data from our storm water system?

Sure. Isco 4200 Series Flow Meters have a built-in printer that plots flow, rainfall and sample data, and also provides summary reports at selected time intervals. This makes it easy to analyze your results in the field and make programming changes before leaving the site.

Can we monitor the status of our storm water systems without visiting the site?

Yes you can – by adding a modem to your system. You can be notified if a storm event has begun and if the flow meter has activated the sampler. After the storm, you can retrieve flow, rainfall and sample data over the phone.

Use of a modem also allows you to change program parameters without visiting a site. For example, you can change the conditions for activating the sampler, or the volume of runoff for collecting flow-weighted samples, simply by dialing up the system modem.

Our storm water sites are located in remote areas, and we don't always know when it is raining at these sites. Can the storm water system notify us when a storm event occurs?

Yes. Isco's 6700 Samplers and 4200 Flow Meters are both able to make outbound calls. When the system is activated, you can be notified by phone, beeper, etc., that data and samples are ready for collection.

Parameter Measurements

What about measuring water quality parameters at the runoff site?

Depending on your specific application, this can be accomplished using various Isco equipment.

A. Isco provides modules to measure pH and DO (DO with the 4200 Flow Meter only).

B. The 600R Sonde from YSI, when connected to an Isco 4200 Flow Meter or 6700 Series Sampler, allows measurement of up to four parameters (pH, DO, conductivity, and temperature). The information collected can be stored in the Isco unit and be used for system initiation, alarm notification, or sample collection.

C. Isco 6712 Samplers utilize an SDI-12 interface, for communication with external devices. This allows you to use any SDI-12 compatible device, and to store up to eight different external parameters.
An additional eight channels are available for triggering sample collection or system initiation. However, those parameters will not be stored in the sampler's memory.

NOTE: Care must be taken to properly utilize various parameter measuring equipment. Please refer to information provided by the water quality instrument's manufacturer regarding application data, calibration, and proper installation.

System Security

How should I protect my storm water monitoring system from exposure, theft and vandalism?

All Isco water monitoring products are watertight and suited for outdoor use without additional protection. They are also corrosion resistant and engineered for manhole environments. However, where theft, tampering, or vandalism is of concern, some type of lockable enclosure is recommended.

A box-type enclosure (as below) that can contain the entire system allows for portability. Walk-in enclosures are also available from a number of manufacturers.

For permanent sites, it may be most economical to build your own enclosure. The custom-built example shown (top right) is set on stilts to keep the system above the water line should a major storm occur.

Many municipalities suspend their samplers and flow meters inside storm sewer manholes. The photo at right shows a metal enclosure (painted to look like the other utility boxes in the town). The bubble line from the flow meter, and the suction line from the sampler, were routed through a conduit from the enclosure into the adjacent manhole.

The photo in the lower right shows an installation that monitors runoff near a busy city street. In this case, the sampler and flow meter were located in lockable garbage cans. Heavy vegetation at the site provided ideal camouflage.

Stormwater Monitoring Strategy Checklist

A well-thought plan that incorporates the right equipment and software is the key to successful stormwater monitoring - and therefore to compliance with NPDES requirements. Use the following checklist as a guide to help plan the overall strategy for the site or sites you will be monitoring.

Aspects Monitored

__ **Rainfall Amount**
__ **Flow Rate**
__ **Flow Depth**
__ **pH**

Sampling Method

__ **Time-paced**
__ **Flow-paced**

Samples Required

__ **Periodic**
__ **First-flush**
__ **Flow-weighted Composite**

Site Conditions

__ **Easily Accessible**
__ **Remote**
__ **AC Power Available**
__ **Secure** __ **Vulnerable**

Channel Type and Condition

__ **Round Pipe**
__ **Lined** *(concrete, etc.)*
__ **Natural** *(earthen ditch)*
__ **Smooth** __ **Rough** __ **Irregular**
__ **Surcharge Possible**
__ **Reverse Flow Possible**
__ **Submerged Flow Possible**
__ **Debris Likely**
Channel Length __________ *ft.*

Equipment Needed

__ **Rain Gauge**
__ *Standard* __ *Logging*
__ **Flow Meter**
__ *w/Printout* __ *Modular*
__ *Bubbler* __ *A.V.* __ *Other*
__ **Sampler**
__ *Portable* __ *Stationary*
__ *4 Bottles* __ *12 Bottles* __ *Other*
__ **Weir** __ **Flume**
__ **System Enclosure**

Data Retrieval/Communications

__ **Laptop PC**
__ **Field Transfer** *(RTD)*
__ **Telephone Modem**
__ **Alarm Dial-out**
__ **Cellular Phone**
__ **Land Line**
__ **Wireless** *(2102 Module)*

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