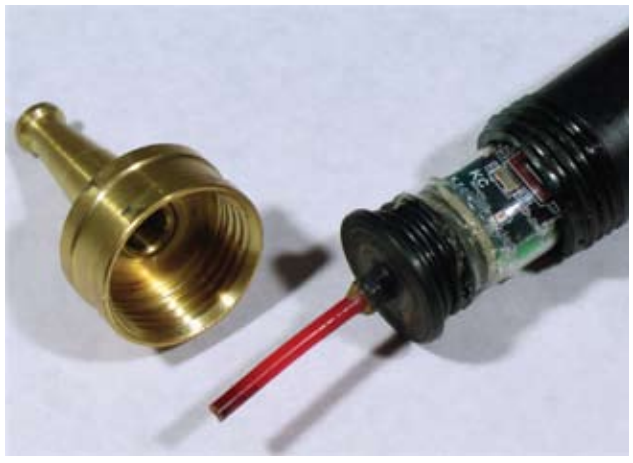
MASS metering

A new metering methodology for detecting groundwater infiltration and inflow (I&I), mass metering, is emerging for sanitary sewer collection systems. While the concept of using flowmeters for the detection of I&I during wet-weather events is not new, recently technology has been developed to lower the cost and increase the ease of installation, data collection and analytical tools. These advances have led to the possibility of more quickly and easily isolating smaller manhole-to-manhole changes in flow rates as a selection tool.

By Tom Butler

Effective metering methodology for infiltration and inflow detection



Scout flowmeter.

Installation in a manhole.

History of Mass Metering

The approach and technology was first developed by the owner of South Haven Sewer Works in Indiana, who first explored the traditional approach to flowmetering to attain compliance with a management plan in 2004. At the time, the quotation received for flowmetering was approximately $72 per manhole per day of flow testing. In addition, there was no assurance that such a flowmetering program (on only a small percentage of the total collection system) would be successful in identifying the sources of I&I that caused multiple sanitary sewer overflows during wet-weather periods.

In response to these challenges, a new flowmeter called the Scout and new data analysis software called FloVis were developed to make the process of metering for I&I more economical and effective.

Mundell Field Pilot

Recently, FloCis Applications Inc. started a mass metering deployment program in the Mundell Field area of Hobart, Ind. Hobart is a client community serving approximately 10,000 homes and 25,363 people, and it has a land area of approximately 27 sq miles. The Mundell Field regional division of the collection system serves 711 homes and nine businesses in an area of approximately 178 total acres.

While as many as 50 meters were deployed simultaneously in South Haven in 54 miles of sewer piping, the focus at the Mundell Filed project is on a much smaller area—with 20 meters deployed in 4.5 miles of piping.

Meter Deployment

Scout meters were deployed first in the most downstream locations and in other central interceptor points where lateral mains meet trunk lines. Other important locations to meter are before and after a point where a storm main crosses or runs parallel to the sewer main. Unlike traditional regional metering studies, however, Scout meters can be deployed in more locations at a reasonable cost.

The main point of the mass metering process is the ability to then deploy more meters and therefore capture more local data. Because Scout meters are inexpensive and easy to install, mass deployment helps with specific isolation of sources down to a sub-basin level.

Measurements

Scout meters measure temperature, depth of flow and have an accelerometer that measures the "wobble" or "tilt" of the flow. Measurements can be made as often as every second, but an interval of five minutes is recommended. Measurements of flow temperature at different times of year are strong indicators of intrusion from nearby sources: Warmer water indicates I&I arrival from sunny paved areas during a first flush, and cold water from localized snowmelt is an indicator of the presence of antecedent I&I.

The most important measurement is the change in flow depth over time. Rapid changes in flow depth relative to a location and flow changes in other locations within the collection system often comprise the most meaningful data.

The Scout's proprietary sensor tilt measurement is a function of the velocity and turbulence of the flow. Because the wobble of the sensor is measured, different types of surcharges (e.g., ones caused by obstructions or blockages) can be differentiated from high flows due to factors such as large amounts of storm water I&I.

Installation & Maintenance

Unlike with conventional meters, entry into a manhole is not required to deploy a Scout meter or to download data. The meters are installed at street level using a sturdy custom bracket and hang into the invert with a stem made of a ¾-in. PVC pipe. Because the meter is installed at an angle with a curved pipe design, it sloughs off rags in the flow effectively. Mounting requires no special tools or electricity and no confined space entry.

Desiccant used to preserve the electronics lasts about six weeks and is replaced at street level. This means that staff can visit metering locations infrequently. The Scout meter is lightweight, requires no electricity and can run on its battery for more than two years. The meter stores nearly twice the amount of data records in its memory than is typically downloaded in a traditional 90-day sampling period.

A standard handheld Windows-compliant computer or PDA collects data wirelessly in a matter of minutes using a common wireless protocol. The data collection process is quick and easy because the meter does not require a wired connection to the computer.

Data Analysis

The FloViz software program was developed to visualize potential groundwater infiltration and surface water inflow events, even when there are tens of thousands of data points from meters at multiple locations. The program helps utility owners isolate sites having groundwater intrusion as measured by Scout sensors placed at manholes in the collection system. This discovery process begins with a broad area of the collection system and correlates this data generated during wet-weather events with the fixed flow measurements (typically collected at the treatment plant or lift stations). As the data from these wet-weather events is correlated with specific readings from Scout sensors, water intrusion areas are identified.

The power and flexibility of FloViz allows users to easily see rapid changes in sensor readings in a 3-D cube. The analyst can see the start of a rain event, the rain rate, the changes in the collection system and how that flow change affects other areas of the collection system. Thus, with multiple data collection sources, the analyst can better grasp the specific location of groundwater intrusion.

Next Steps

The specific detection of infiltration points is typically slower and more difficult through the use of traditional metering. While traditional meters can have

Figure 1. This side chart view of FloViz shows data from about 50 meters (South Haven project), simultaneously displaying data from the same 30-minute time period. Some locations have experienced a very rapid rise in flow rate, while others have not.

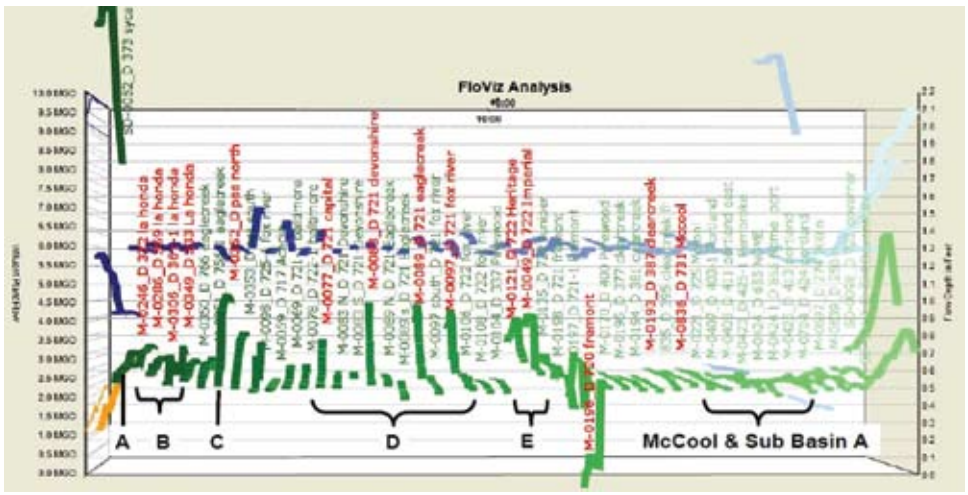


Figure 2. This side chart view of FloViz shows data from about 40 meters (South Haven project), simultaneously displaying data from the same 30-minute time period. The meter to the far right shows a strong partial obstruction.

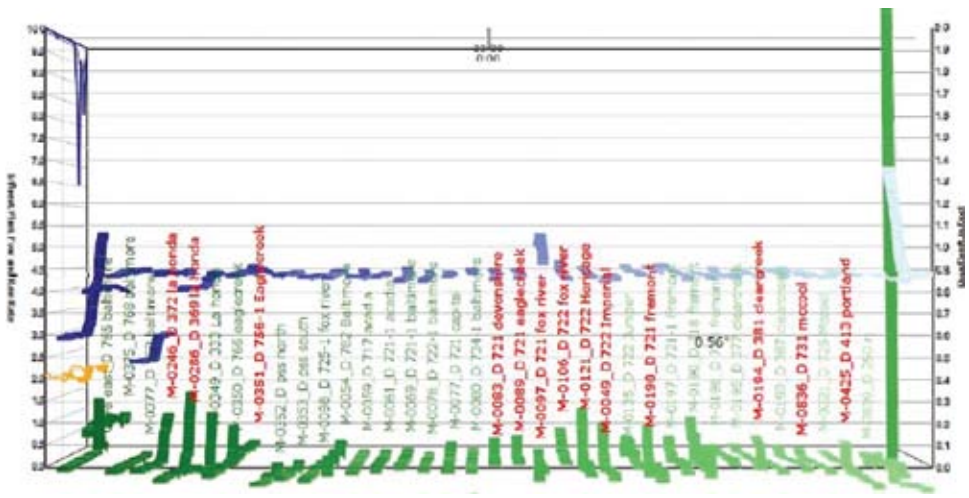
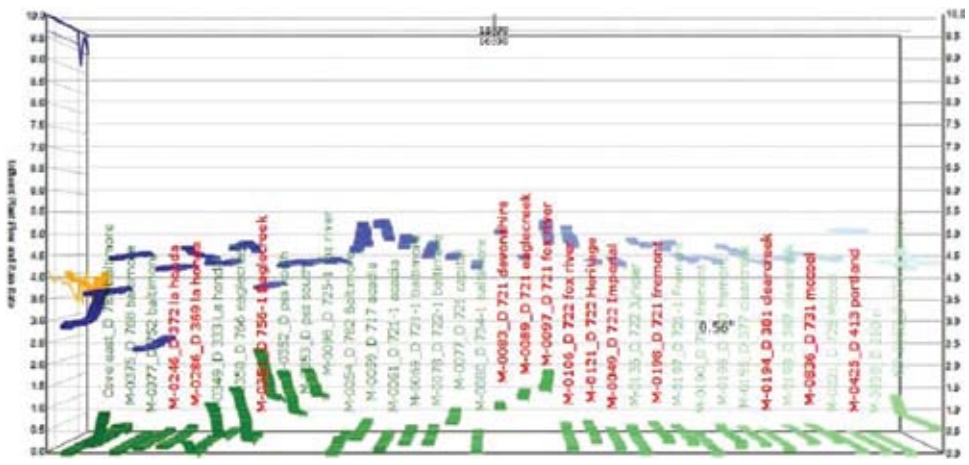


Figure 3. This side chart view of FloViz shows data from about 40 meters (South Haven project), simultaneously displaying data from the same 30-minute time period. "Late stayers" near the end of a rain event show where sources of water from storm sewer system intersections later were found to exist.



greater precision, sparsely placed meters make it difficult to visualize significant differences that may exist between flows at different times and points in the collection system. Having sensors that are easy to install at many locations simultaneously is key to efficiently moving through the system to locate specific problem areas.

Follow-up work such as video camera inspections and physical inspections of the local watershed is recommended in areas where high flows are found during wet weather. Because private properties can contribute 50% or more of I&I to community collection systems, in sections of main where meters have detected high flows, inspections of private laterals, building foundation drains and gutters should be done, given the political will exists and the statutory authority permits. WWD

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