A DATA-DRIVEN APPROACH TO MANAGING SEWER BLOCKAGES AND PREVENTING OVERFLOWS

By **Kevin Enfinger**

Sewer blockages are a leading cause of sanitary sewer overflows (SSOs) and often result from grease, roots and debris. That means they are a major concern to wastewater collection system managers, supervisors and operators. Fortunately, there have been recent technological advances that transform the way we think about blockages, make them easier to manage, and ultimately help prevent SSOs in a more efficient manner.

Blockages are managed and mitigated in various stages of development along a blockage continuum, as illustrated in Figure 1. The preferred condition is the one shown on the left. This sewer has no blockage and operates as designed with the flow depth less than the sewer diameter. Now consider what happens as a blockage develops. A blockage in its earliest stage has minimal impact, but it nonetheless imparts a small increase in the flow depth upstream from the blockage. As the blockage get worse, surcharge conditions appear and, if left unabated, the flow depth continues to rise until an SSO occurs.

Where a blockage is on the blockage continuum determines how best to manage it.

Most sewer utilities use "preventive" approaches in the form of sewer cleaning to prevent blockages before they occur. This approach operates on the left side of the blockage continuum. It is to simply clean every gravity sewer over a pre-determined period, often once every three to ten years. While this approach is straightforward and makes a positive impact, some gravity sewers are often cleaned when it is not necessary and some that need to be cleaned more often are not.

As a result, some blockages continue to go undetected and result in SSOs. Therefore, sewer utilities will often implement higher frequency preventive cleaning for specific gravity sewers, where the probability or consequence of SSOs is greater. While incremental improvements are observed, the same uncertainty as to what really needs to be cleaned and when still remains.

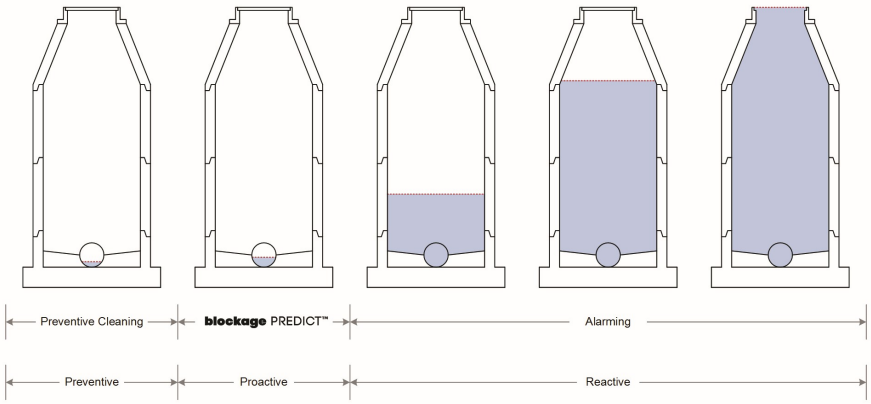

Figure 1. *Blockage continuum.*

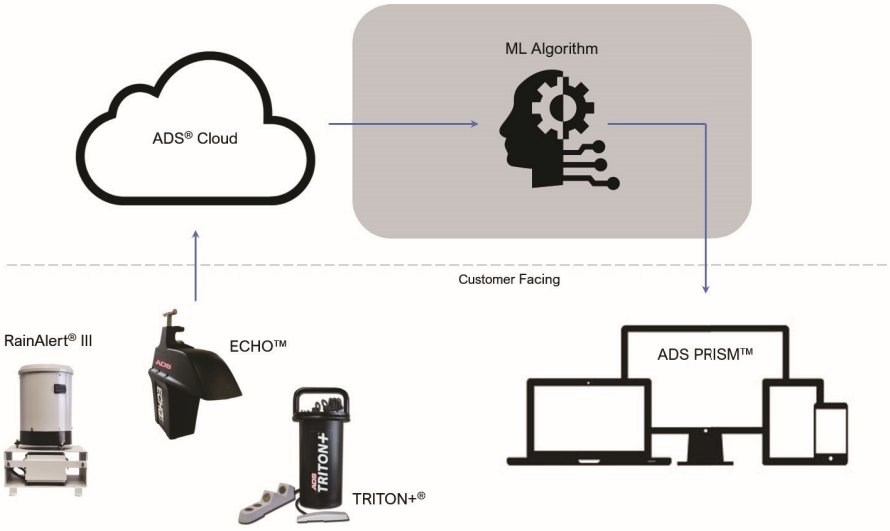

Figure 2. *Predicting blockages with data-driven technologies.*

Most sewer utilities also use "reactive" approaches, often in response to high depth alarms or problems reported by the public. In these situations, response time is critical. If identified early enough, the response operates in a "rescue" mode where the blockage is removed, flow conditions are restored to normal, and an SSO is averted. If identified too late, an SSO has already occurred, and the response operates in a "recovery" mode where the blockage is removed, flow conditions are restored to normal, and cleanup and reporting activities are performed. However, both "rescue" and "recovery" imply an emergency response that is disruptive to routine operations with little time to spare.

It is important to note that there is a portion of the blockage continuum not served by traditional "preventive" or "reactive" approaches. If a blockage can be detected in its earliest stage of development, sewer cleaning resources can be deployed at the

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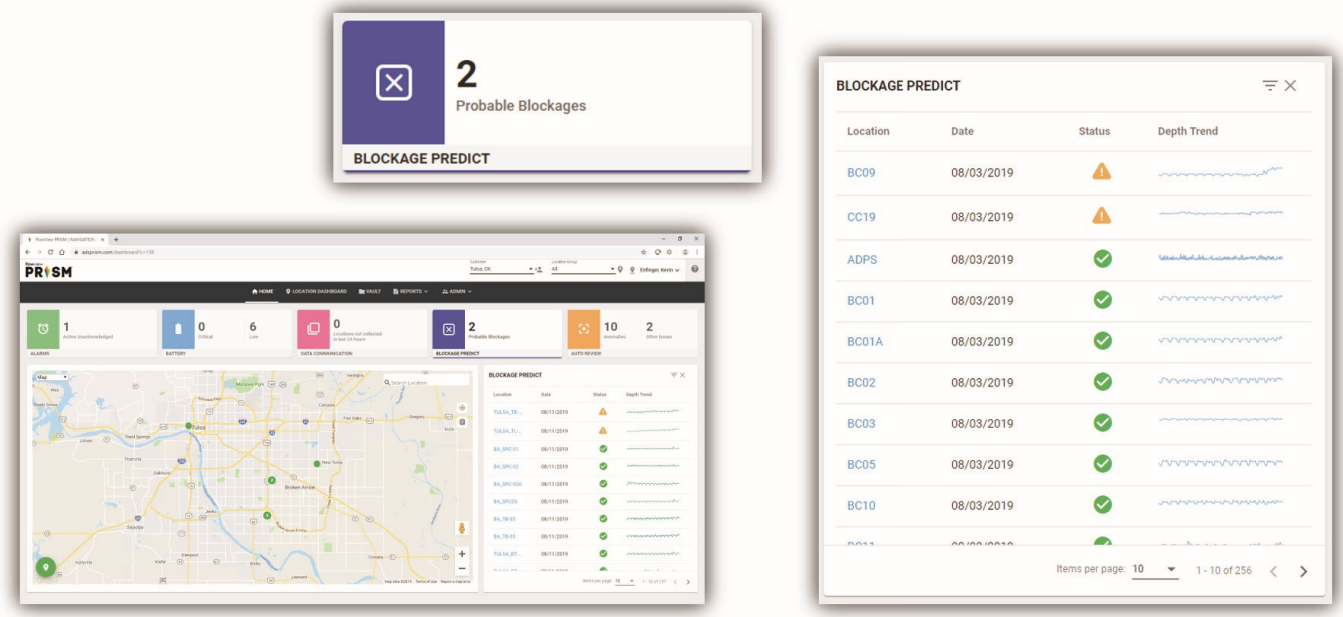

Figure 3. *ADS PRISM web app with blockage PREDICT.*

right place at the right time to prevent SSOs well before they occur.

Proactive sewer cleaning is data-driven and based on current conditions, while preventive sewer cleaning is schedule-driven and based on past conditions. Proactive cleaning is more effective and more efficient than preventive cleaning, especially at "hot spot" locations that have traditionally been cleaned on a more frequent basis. A "proactive" approach also reduces the need for "reactive" measures by detecting problems and resolving them earlier, before they become more serious problems.

ADS has recently released blockage PREDICT™ to provide actionable insight on when and where to clean. "Hot spots" where more frequent preventive cleaning is performed are natural integration points for this new approach.

HOW DOES BLOCKAGE PREDICT WORK?

An ADS ECHO™ level monitor is installed upstream from a location of interest, measuring flow depth at regular time intervals. This data is transmitted periodically to the Cloud, where a machine learning (ML) algorithm evaluates the data each day, looking for tell-tale signs of developing blockages. Figure 2 illustrates this process.

The results are available in the ADS PRISM™ web app in an intuitive, easy-to-use format as shown in Figure 3.

The blockage status of each location is conveyed by one of three simple icons:

✅ Green indicates that a blockage is not probable based on the ML algorithm. There is no urgency, and no action is needed.

⚠️ Yellow indicates that a blockage is probable based on the ML algorithm and

continued overleaf…

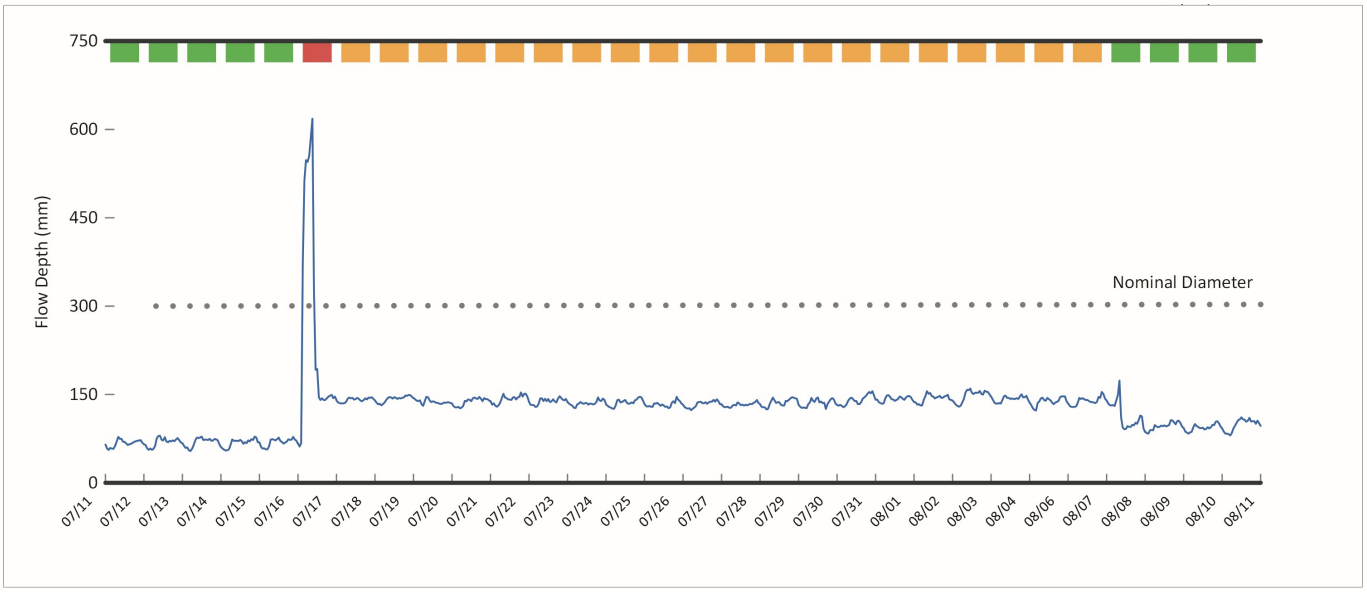

Figure 4. *Detecting a blockage caused by rocks and gravel.*

that it is in an early stage of development. The sewer is not surcharged. As a result, the urgency level is proactive, and there may be a few days to several weeks to respond to intervene and prevent an SSO.

Red indicates that a blockage is probable based on the ML algorithm and that it is in an advanced stage of development. The sewer is surcharged. As a result, the urgency level is reactive, and there may be only a few days or less to respond to intervene and prevent an SSO.

CASE STUDIES

Figures 4 – 6 illustrate developing blockages identified using this approach. A hydrograph is shown for each example and displays flow depth conditions observed over a 30-day period before, during, and after a blockage, along with the corresponding blockage status determined by blockage PREDICT.

The first example shown in Figure 4 is from a sewer with a diameter of 300 mm. Sewer cleaning crews used a hydraulic jetter to clean several sewers upstream from this location on July 17.

However, rather than removing the debris, it was simply accumulated and "pushed" further downstream, inadvertently creating a blockage further downstream. Blockage PREDICT correctly identified the blockage and tracked it over a 21-day period, until a sewer cleaning crew returned and removed the accumulated rocks and gravel.

The second example shown in Figure 5 is from a sewer with a diameter of 200 mm. Grease accumulated in a manhole channel and resulted in a blockage. Blockage PREDICT correctly identified the blockage and tracked it over a 3-day period until the grease was removed.

The third example shown in Figure 6 is from a sewer with a diameter of 375 mm. A subtle increase in flow depth was observed by a level monitor and was identified by blockage PREDICT as a block-

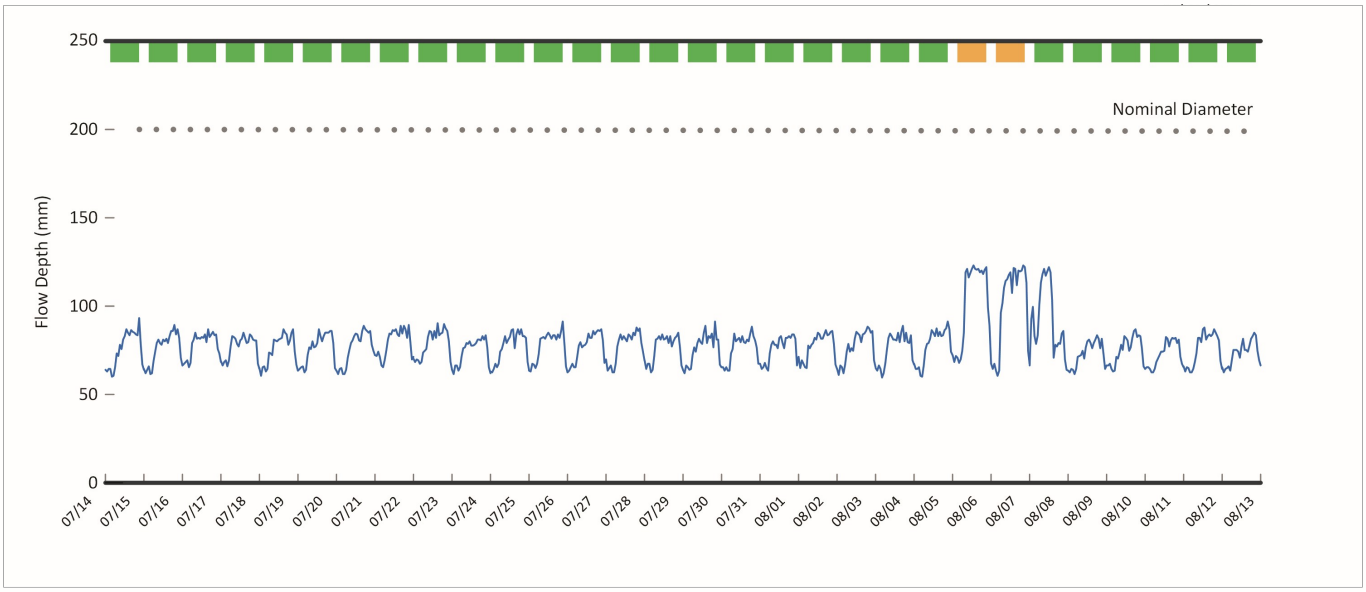

Figure 5. *Detecting a blockage caused by grease.*

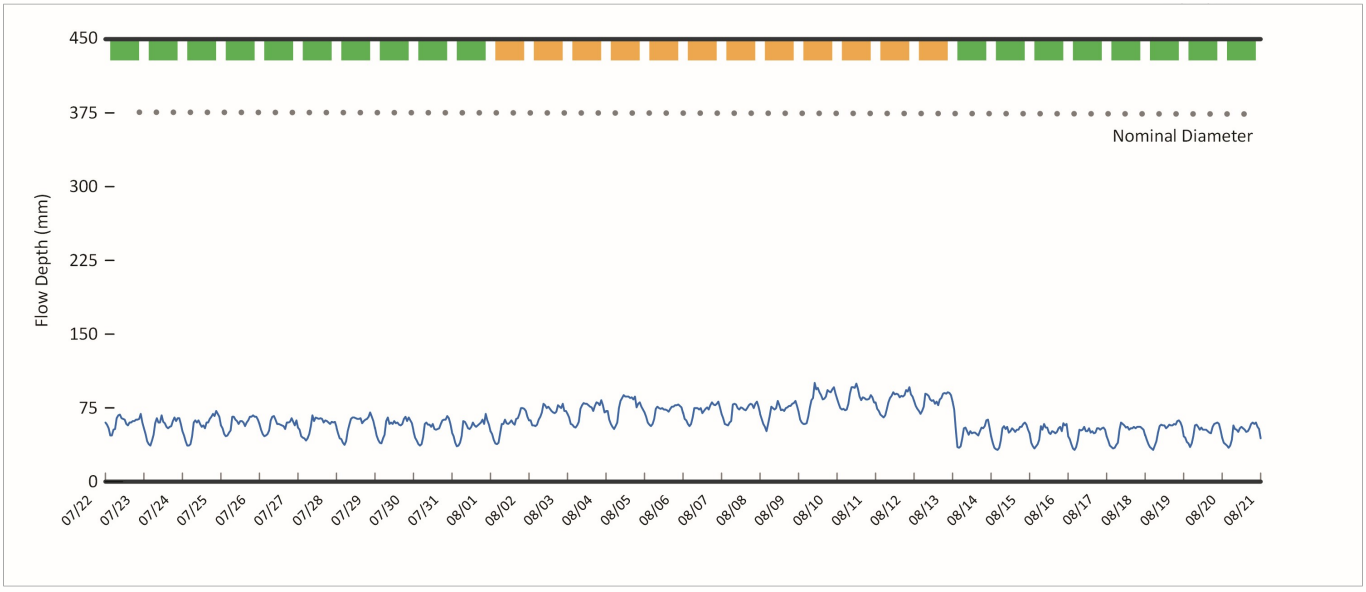

Figure 6. *Detecting a blockage caused by debris.*

Grease blockage observed in manhole channel.

Stick blocking outlet pipe resulting in ragging.

age. It was tracked over a 12-day period, at which time a crew was dispatched to investigate. The culprit was soon located and identified as a small stick that was lodged in a manhole channel across the outgoing sewer. Once lodged, floating tissue and other debris began accumulating on the stick.

Blockage PREDICT enables collection system managers, supervisors, and operators to take a data-driven approach to detecting blockages early and deploy cleaning resources at the right place at the right time to prevent SSOs. ■

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