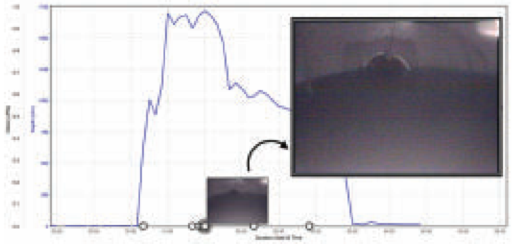
MONITOR WITH VISION®

A Picture is Worth a Thousand Data Points! A new take on an old saying as our world becomes increasingly filled with the amassed amount of information we collect and send wirelessly to cloud servers. All of the data still has to be analyzed and interpreted. Not only do we expect people to look at lines on a computer screen, we expect them to accurately interpret and draw conclusions that may cause critical pollution events, generate EPA fines, and impact the general health of a community. These problems can be eliminated and interpretation of data greatly assisted simply by monitoring with vision.

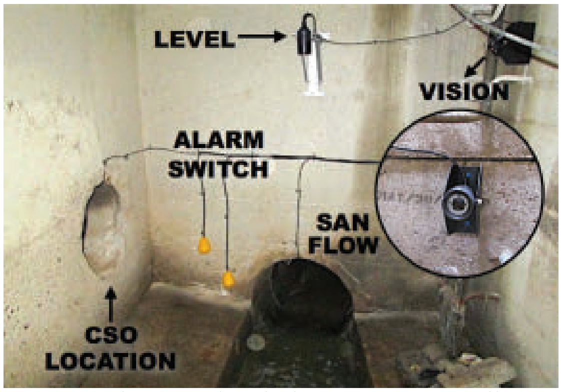
The Vision® Sensor is the addition to flow monitors that takes them from being data collectors to data verifiers. It should become an industry standard to automatically get a picture of the actual event and then use the sensor data for quantitive reporting. This way, events can be verified by visually seeing what has occurred. It's simple and the addition of a Vision Sensor can be economical and consume small amounts of power depending on the monitoring system you choose.



A Line Graph with a Vision Sensor confirms that an overflow is in progress.

The Vision Sensor can be configured to take pictures on a time schedule, and also on any sensor alarm condition, capturing the event in progress.

Monitors can be configured to send data and images to a cloud server on a schedule basis, and also real-time when alarms are triggered so that notification of an event is immediate. Text messages and/or emails are sent with a picture so that receivers can see what is happening in the sewer.

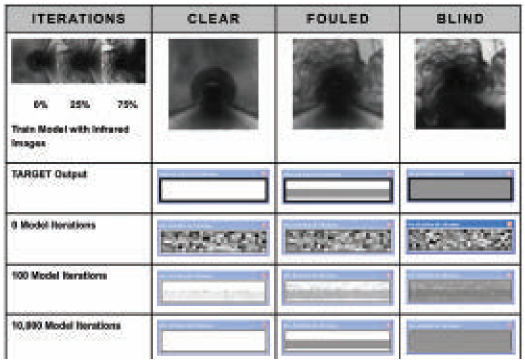


Camera, Flow, Level and Alarm Sensors are all connected to one wireless monitor running off the same battery and wireless data logger.

Cameras can be installed simply by hanging in a sewer or mounted to a wall. Power is supplied from the flow monitor and the camera is controlled by the core flow microprocessor and not a separate trigger output. Images are stored in the monitor and sent to the cloud server along with all sensor data. The Vision system is completely integrated rather than having separate modules that require additional power or wireless systems to operate.

Sewer Health Detection: Not only can images be used for detection and reporting of sewer overflows, they can also be used for detecting the health of a sewer. By installing an infrared camera into a pipe and taking pictures every hour, an image recognition model can determine if the pipe wall has changed and the rate at which this change is occurring. Knowing this, a proactive maintenance schedule can be established to avoid CSO and SSO overflows. Blockage and debris can be detected and removed before they become critical.

A neural network model that detects changes in pixel distribution and grayscale was developed to prove this monitoring approach. Neural network "linear matrix multiplication" models were developed to compare input vs. output. The model inputs are images of the pipe condition and the outputs are the percentage of degradation of the sewer health such as build up of siltation and grease.



Each image is associated with another image that represents the health condition. In this case, a model was developed using a grayscale percentage - the greater the degradation, the higher the percentage of grayscale pixels. The first step when building an image recognition algorithm is training the model. Model training is the process of associating input images with output images. After the model is trained, it can then be tested by feeding input images into the model and interpreting the output results. In this case, the output images represent three layers or shades. Each of the outputs can be further processed to represent a value which directly relates back to the percentage of sewer health. The following table shows the output model results. Each training iteration (Epoch) consists of three conditions and as the iterations increase, the output starts to match the input conditions.

Results show that using image recognition to detect sewer health is mathematically possible using neural network models. This method allows operators to understand the level of sewer health and make educated decisions regarding the resources required to carry out a proactive maintenance program. For more information visit www.blue-siren.com or

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