
Example Mobile RMC Screen.
*Courtesy: SCS Engineers.*

# Your Tomorrow's Waste Technology Today

by David Hostetter, Sam Rice, Joy Stephens, and Chris Woloszyn

A look at how innovative technology is being used to improve landfill operations.

**Solid waste landfills are complex, evolving facilities** that require ongoing operations and maintenance. As technology continues to progress, engineers, operators, and managers have opportunities to adopt these new technologies for use on landfills. This article, written by four young professionals, presents how the authors use this evolving technology to improve operations at landfills. The new technologies include remote monitoring and control (RMC) systems, supervisory control and data acquisition (SCADA) systems, geographic information systems (GIS), and aerial drones.

## RMC and SCADA

In many industries, companies realize the immense value of having timely and accurate equipment and operational data, and landfills are no exception. For example, at landfills, there are pieces of equipment such as gas wells and blowers used to extract landfill gas from beneath the landfill's surface and flares that control (combust) the collected gas. In addition, there are pressure sensors/gauges, flow meters, temperature sensors/gauges, and other devices used to monitor this equipment for proper operation. Across the landfill industry, most equipment data and system data are collected manually for regulatory compliance; this process is time-consuming, expensive, and can be dangerous.

As a result, most sites only collect a few data points per day, which may not give a complete picture of landfill operations. This, combined with an inability to monitor or control equipment remotely, can result in compliance issues and extended equipment downtime, especially on closed or distant landfill sites. Sites with equipment that is interrelated, but controlled separately, can also add to headaches for site operations. RMC and SCADA systems allow deeper insight into and control of landfill operations, even when the user is not on site. With an RMC system, operators can securely connect to the equipment from anywhere with internet access (see Figure 1).

These systems provide the operations and management teams with precise monitoring of and control over their landfill, no matter where the team is located relative to the landfill. For example, RMC and SCADA systems provide an operator the ability to check condensate and pump station levels, then restart a faulted flare, all from their couch using a laptop or mobile phone.

SCADA systems collect and store vast amounts of operational data for later review. With this data, a SCADA platform can automatically generate complex regulatory reports

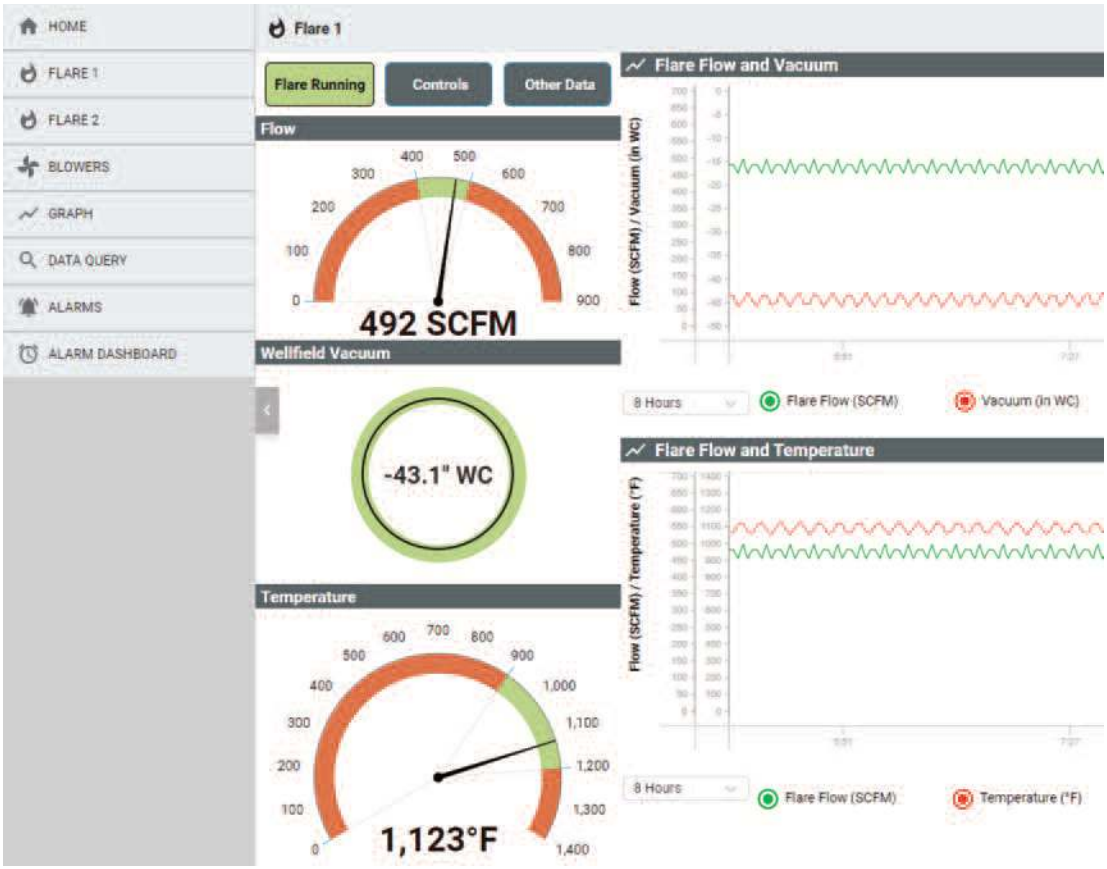


**Figure 1.** Example RMC Screen.
*Courtesy:* SCS Engineers.

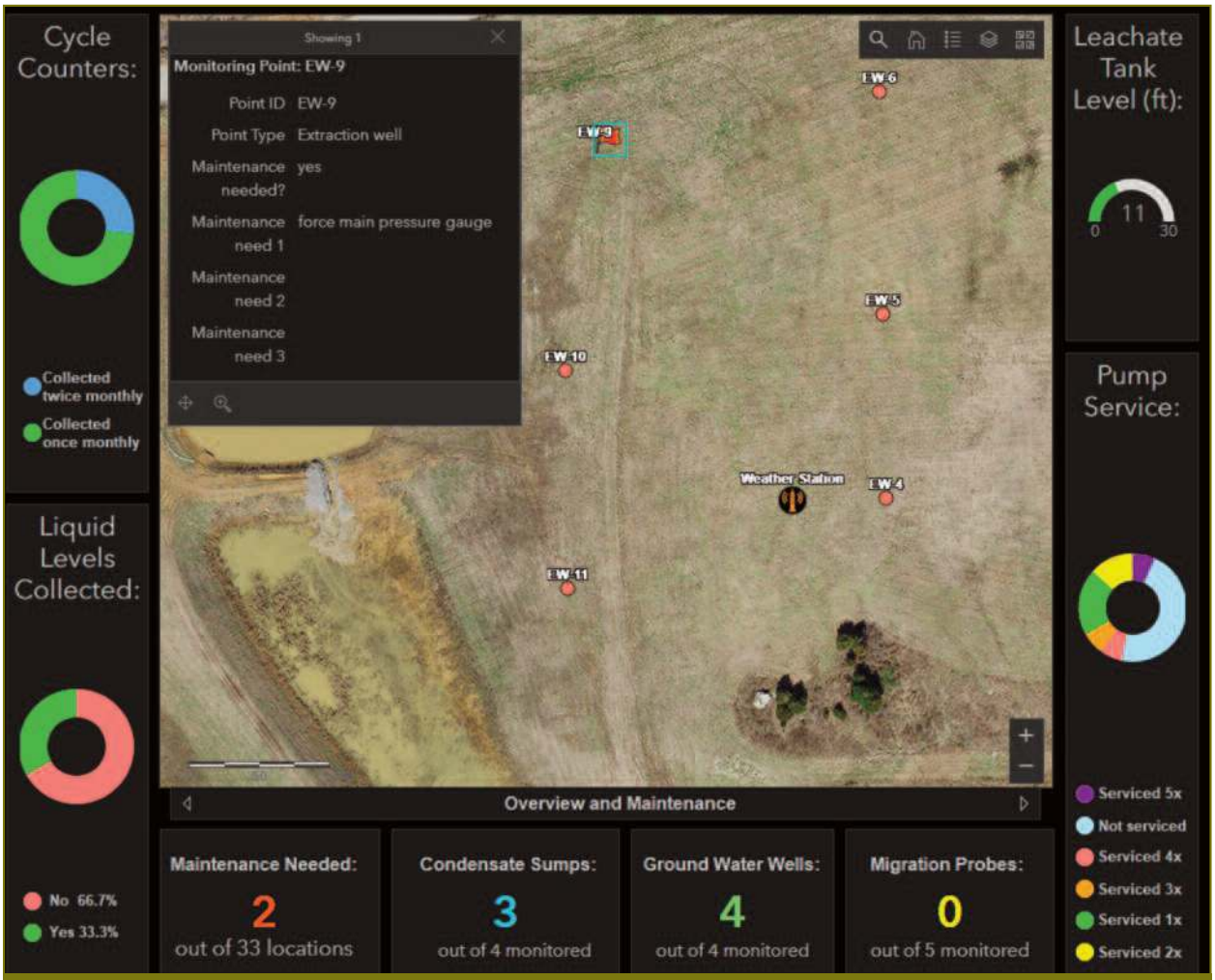


**Figure 2.** Example GIS Dashboard.
*Courtesy:* SCS Engineers.

without requiring a technician to take manual readings. With real-time monitoring and alarms, operators can quickly understand what is happening with the equipment and react quickly to correct problems using the remote-control features. SCADA systems often integrate more data than what could be gathered manually in the past, allowing operators now to predict and prevent problems, and to more quickly resolve problems that do develop. Additionally, SCADA systems include data analysis features, such as key performance indicators for equipment having malfunction alarms. This can help a landfill site identify the equipment that triggers alarms most frequently, and hence is malfunctioning most frequently. With this knowledge, landfill operators can focus maintenance efforts on the equipment causing the most downtime.

RMC and SCADA systems are now here and represent the future of landfill operations. They automate tedious and time-consuming processes, allow operators to understand their facilities' operating status quickly, and promptly act on issues remotely. They lower environmental risk by helping to prevent environmental problems like overflowing pump stations or tanks, odors, or free venting of landfill gas. Furthermore, sites can save energy and money by controlling interrelated systems together through the RMC or SCADA system.

## GIS

Operating and maintaining a landfill requires collecting immense amounts of data: liquid extraction, pump exchange and performance, condensate sump monitoring, landfill gas extraction and quality, site-specific sampling (e.g., carbon monoxide and hydrogen sulfide), surface emissions monitoring (SEM) for methane, pinched or compromised wells, and general maintenance needs. Field technicians—often heavily laden with instruments, printed data collection sheets, logbooks, clipboards, maps, and other gear—spend most of their days working to complete the aforementioned tasks. Hours of additional labor await supervisors and managers as they work to transcribe, digitize, or otherwise prepare these data for analysis. Their already tedious task is complicated by needing to decipher information recorded on sheets and logbooks decorated with leachate stains, mud spatters, and water damage. GIS tools not only provide a low-cost solution to

**Figure 3.** Drone Inspection of a Flare Stack.
*Courtesy:* SCS Engineers.

**Figure 4.** Drone Used in Construction Quality Assurance (CQA) Services.
*Courtesy:* SCS Engineers.

streamline, track, visualize, and analyze collected data, but they also foster real-time data sharing between field and office staff. An example of a GIS data summary as a "dashboard" is provided in Figure 2.

Using GIS to streamline data collection begins with field technicians. GIS applications for mobile devices, such as the Environmental Systems Research Institute's (Esri) Survey123 and Collector for ArcGIS, support reliable data collection online or offline, enabling technicians working on site at a landfill to view their location on a site map, submit data, and visualize their progress all from a phone or tablet. Compiling field technicians' data to provide a holistic view of wellfield status and task completion is an equally simple task using GIS.

Platforms such as ArcGIS Online allow for creating dashboards that feature interactive web maps and infographics designed to do just that. In one glance, project managers, superintendents, and environmental managers can see areas requiring more frequent pump exchanges, landfill sections with higher force main pressures, how many liquid levels remain to be collected for the given time period, leachate tank levels, and so on. Finally, users may easily export collected data in various formats, whether in tabular data or as static maps for reporting.

GIS provides a low-cost way to streamline data collection, track progress, visualize task completion, and analyze collected data to deliver an overview of the landfill's status. Integration of additional automatic and manual data collection methods, such as quarterly or annual drone flights (more on this below), RMC systems, and remotely monitored and controlled wellheads, will further facilitate a deep understanding of landfill performance and overall condition.

## Drones

Quick, effective data collection and analysis is the goal of every environmental management team. Owners, managers, and consultants alike seek out the next generation of comprehensive data analysis. Typical environmental data collection methods at landfills, including surveying, field measurements, 3D modeling, methane mapping, and inspections, are completed by a handful of separate companies and personnel. Separating these tasks increases operating expenses and impedes a project's progress. Introducing unpersonned aerial vehicles (UAVs) allows one small team of people to complete all these processes with a lower overall cost and time requirement with outstanding deliverables.

UAVs, also known as drones, allow for safe inspections, quick data gathering, and lower operating costs. Using UAVs allows all this to happen remotely, while keeping the pilot away from dangerous locations and situations on the landfill site (see Figures 3 and 4).

Using UAVs, vast quantities of data can be collected quickly at a landfill, often combining the tasks of many contractors into a single visit. For instance, flying a UAV above a landfill to build a 3D scan of a particular structure on the site, or of the landfill site itself, provides a preliminary visual inspection, a 3D model for discussion, measurements in the x-y-z axes,

RMC and SCADA systems represent the future of landfill operations.acres to view.

area topography, and photo references for review and marketing material. With half an hour of flight time at the site and a few hours of data post-processing, the drone has replaced a surveyor, multiple technicians, a lift rental, and hours of field measurements. This significantly boosts project productivity for owners, managers, engineers, and contractors combined.

Beyond cameras, various sensors can be attached to a drone. These sensors range from infrared cameras to LiDAR sensors to gas identification tools. One such tool helps identify the presence of methane leaking out of a landfill. A drone pilot can maneuver over the entire landfill, sniffing out methane leaks and seeking out poor landfill-cover integrity, all in a matter of hours. Drones collect methane data quickly and accurately without the need for traversing the ground by foot or risk of weather interrupting a multi-day ground-based inspection.

Above all else, UAV work is performed remotely. A remote pilot does not have to traverse over frozen ground, through the brush, around equipment, or on a rooftop. UAVs can provide inspections without impeding the work of others or endangering the pilot's safety. The greatest assets to any company are the great personnel they employ; UAVs help keep those assets safe and secure. Learn more about using UAVs on landfills from the following resources: Landfill Methane Monitoring (https://youtu.be/_pZIhDu_RCA) and Using Drones for Landfill Monitoring (https://www.wastetodaymagazine.com/article/landfill-monitoring-drones/).

## Closing

Technology advances are continuously improving the world around us, including at landfills. As shown above, RMC/SCADA systems, GIS, and UAVs can improve landfill operations by increasing the efficiency of landfill inspection, monitoring, and operation; reducing operating costs; providing actionable intelligence; increasing productivity; and reducing environmental risks. As you read this, we challenge you to think, "How could I use technology to make this job or task better or easier?" If you have thoughts or questions, please reach out to co-author, Dave Hostetter (mailto:dhostetter@scsengineers.com). We would love to discuss technological advances in the solid waste field and their benefits with other *EM* readers. **em**

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