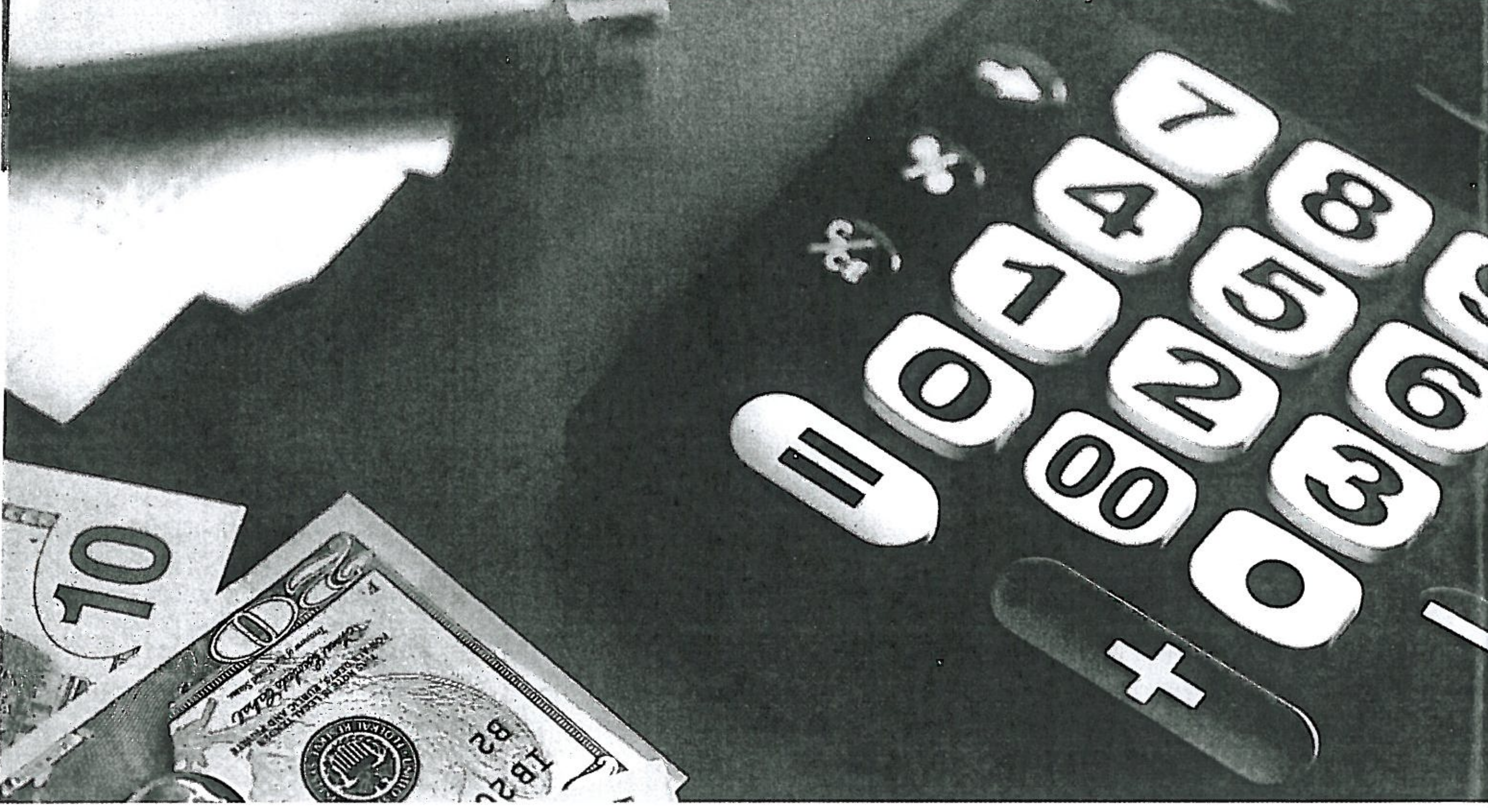

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Updating Your Landfill's Groundwater-Monitoring System

By James Lawrence

Small changes add up to big cost savings.

Groundwater monitoring at municipal solid waste landfills represents a significant and growing operating cost for owner/operators. Groundwater-monitoring systems should be periodically reviewed to look for opportunities for lowering costs of the monitoring program, without decreasing the effectiveness of the program or compromising environmental protection goals. Small improvements can add up to big cost savings over the required life of a landfill monitoring program.

The required groundwater-monitoring period at a municipal solid waste landfill is generally quite long, because monitoring is required through the life of the site plus the 30-year post-closure period. This greatly magnifies the benefits of making cost-saving improvements today that bring financial benefits for perhaps 50 or 75 years into the future.

Many landfills have a monitoring system with some wells that have, over time, become less than optimally utilized due to changes in landfill design or sequence of development, wells that were poorly located in the first place or that have been rendered obsolete by newer well installations. In many cases, the "creeping obsolescence" occurs in such small increments that it does not occur to anyone to conduct a thorough review of the overall monitoring system to determine if improvements can bring cost savings. Over the life of a typical landfill, many unrelated, small monitoring system changes are made that ultimately can add up to a system that is not particularly efficient from a cost or monitoring point of view.

Sometimes opportunities arise that create a need for an overall review of a landfill groundwater-monitoring system, and indicate that changes can bring improved efficiency in monitoring while lowering cost. Three major opportunities for significant long-term cost savings include:

- Reducing the total number of monitoring wells through a combination of plugging and respacing wells;
- Reducing false positives by changing required laboratory reporting limits; and
- Analyzing leachate to determine if some test constituents can be removed from the required list.

These types of changes to the monitoring program generally require regulatory approval—you have to make the case with the regulators that these changes are reasonable. Many state regulatory programs are amenable to these improvements as long as sufficient documentation is provided to justify the change.

Reducing the Number of Monitoring Wells

Monitoring inefficiencies cost far more than many people realize, because small inefficiencies are multiplied over many years of required monitoring. Making good planning decisions for cost control starts with accurately determining the cost of one well over the life of a site. The cost estimate should take into account the fact that a well at any one location may not last the life of the site; a number of wells may require replacement one or more times due to normal aging or accidental damage.

Therefore, the cost of one well location becomes:

- the cost of the original installation;
- the cost of replacement at some interval (25 years is a reasonable planning number); and
- the cost of sampling, analysis, and reporting over the life of the site.

The actual cost for these items varies from landfill to landfill. Table 1 illustrates a landfill monitoring system with twelve 25-foot-deep wells and an 80-year monitoring requirement (50-year site life plus 30-year post-closure care). All costs are in 2008 dollars.

Well installation costs include all drilling, required reporting to regulatory agencies, and project management.

Monitoring costs include all sampling, laboratory analysis, and reporting costs.

It can be seen that monitoring is by far the largest cost component (90.6% of total cost), and yet there is an even larger but less tangible cost when considering the impact of unnecessary wells: potential assessment monitoring or corrective measures costs. The "site-wide false positive rate" always increases with increasing numbers of wells; in other words, every well represents an opportunity for monitoring to falsely indicate that a regulatory limit has been exceeded, causing additional regulatory costs at that well location that can greatly exceed the routine monitoring costs. The statistical chance of a false positive occurrence at a single monitoring event can be surprisingly high, and unnecessary assessment monitoring costs can be incurred when this happens. It is difficult to assign an absolute number to this potential cost, but assessment monitoring costs (not including the cost of corrective measures) can easily be $10,000 or more, and these significant potential costs must be carefully considered when critically reviewing the number of monitoring wells needed at a landfill.

Example 1

In this example, a review of a site's monitoring system was required by a new state solid waste regulation that mandated a

Table 1

	Cost (dollars)	Cost as a percent of overall lifetime costs
Cost of original well installation	$5,000	2.4
Cost of replacing well every 25 years (3 total replacements)	$15,000	7.0
Monitoring cost for 80 years	$192,000	90.6
Overall lifetime cost of one well	$212,000	

new, fixed, down-gradient well spacing of 600 feet. Most of the site's down-gradient wells were approximately 800–900 feet apart. One solution would be to install new wells in between the existing wells. This approach has the lowest cost up front, but results in wells spaced closer than required by regulation—and a total number of wells that may be excessive.

The long-term cost of wells that are spaced more closely than required by regulation far outweighs the savings of this nearsighted approach to saving money this quarter. This is because the wells must be monitored for the life of the site plus 30 years post-closure. The monitoring costs of any unnecessarily closely spaced wells are greatly magnified by this long-term monitoring requirement.

Let's do the math on the eye-opening life-of-site difference between two alternatives for complying with a regulatory requirement to tighten well spacing. In this real-life example, the lowest-cost alternative in terms of immediate cost is to install wells in between existing wells. For the example site, this increased the number of monitoring wells from the existing 12 to 20 wells. If you think of this eight-well addition only in terms of current-year costs, the landfill would incur $40,000 to install these wells.

However, as can be seen in Table 1, the actual cost of these eight wells isn't $40,000—it's eight wells multiplied by $212,000 per well location, or $1,696,00. Clearly, it would be very beneficial to critically examine the proposed system to look for opportunities to reduce the number of wells.

By simply plugging some wells and respacing the system to achieve the required 600-foot well spacing, the total number of wells is reduced by four wells—a life-of-site savings of nearly a million dollars as measured in direct costs only—not counting the potential large savings of avoided assessment monitoring or corrective measures.

This second alternative does cost somewhat more in the first year, when plugging and respaced well installation costs are incurred. However, the long-term payback is huge.

Example 2

In example 2, a review of a site's monitoring system was conducted as a part of an overall permit update. The monitoring system line of compliance was convoluted and did not reflect the waste footprint outline. Some wells were close together and in line with groundwater flow (causing redundant monitoring) and some wells were located very far from waste. The reasons for this chaotic-looking monitoring system layout were lost to history, but the site would obviously benefit from a cleanup that included plugging the redundant wells and lowering the total number of wells. The immediate, least-cost solution was no changes to the system—in other words, the status quo. But the site took the opportunity of re-permitting and additional site characterization to determine that two of the monitoring wells were in redundant locations that "monitored groundwater twice," as indicated by flow path maps that showed groundwater in two areas passing pairs of monitoring wells that were in a line that exactly paralleled flow lines. In this case, after obtaining regulatory approval the landfill made a minimal investment required to plug the redundant wells, substantially reducing the site-wide false positive rate and lowering potential costs related to possible assessment monitoring or corrective measures.

Reducing False Positives

Laboratory-caused false positives are a frequent problem that leads to avoidable added costs for a landfill groundwater-monitoring program. These false positives can lead to the need for additional laboratory testing, additional field resampling, and/or unwanted regulatory scrutiny and associated added paperwork. These problems can be greatly reduced with improved reporting limits that avoid analyzing for the excessively low concentrations that easily trigger laboratory-caused false positives. Some regulatory agencies promote reporting limits that laboratories cannot consistently achieve, leading to a high false positive rate. As such, it is recommended that reporting limits be reviewed with laboratories to make sure they are appropriate—the laboratory will help landfill owners and their consultants set reporting limits that will reduce false positives.

Laboratory results should be reviewed for potential false positives immediately upon delivery from the laboratory, because if problems are noticed soon enough, they can often be resolved at the laboratory level—this is the least expensive way to resolve false positives and prevents the need to report such erroneous findings to the regulatory agency. If results are not reviewed until weeks after analysis, problems may be noticed too late to prevent the need for expensive well resampling.

Reducing Test Constituents With Leachate Analysis

Every landfill should be periodically analyzing leachate for groundwater monitoring parameters, for two reasons:

(1) Leachate analysis often consistently shows the absence of certain constituents; this is a demonstration that testing for these constituents is unnecessary.

(2) If a monitoring well indicates a detection that is a potential regulatory concern, the consistent absence of such constituent(s) in leachate analyses is a demonstration that the detections are not due to a leachate release.

Reducing the total number of constituents monitored is an important practice that can allow substantial savings by reducing the site-wide false positive rate. A landfill should establish and maintain a database that includes the results of leachate analysis. This database can often be used to show that certain constituents on the monitoring list do not occur in leachate. With these results in hand, your regulatory agency should be contacted to determine the approach to use the leachate information to reduce the total number of constituents monitored.

Leachate results can also be very useful if a well has a detection of concern for a constituent that is not detected in leachate. Providing the leachate data to the regulatory agency should make a clear and cost-effective demonstration that leachate could not be the source of the detection.

One note of caution regarding leachate analysis: Leachate generally has a high dissolved solids content; this can elevate reporting limits enough to make the results useless. The laboratory may have to dilute the sample to allow testing, causing elevated reporting limits that you may not learn about until you review the results. Work carefully with your laboratory prior to leachate sample submittal to make sure the analysts understand the importance of doing everything possible to avoid raising reporting limits to useless levels.

Conclusion

Groundwater-monitoring requirements for a municipal solid waste landfill are a substantial cost of doing business. Investing time in improving efficiency of the monitoring system can have very beneficial long-term impacts, including the lowering of actual direct costs and reduction of the liability of incurring non-routine assessment monitoring and corrective measures costs. **MSW**

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