A.1 SNAP SAMPLER

A.1.1 Peer-reviewed paper in *Ground Water Monitoring and Remediation*

Negative Bias and Increased Variability in VOC Concentrations Using the HydraSleeve in Monitoring Wells

The Snap Sampler was used as a no-purge "control" in the comparisons discussed in this paper

A.1.2 Summary

Media:	Groundwater
Study Type:	Side-by-side comparison study
Technology:	Passive Grab Sampler/Snap Sampler
Peer Reviewed:	Yes
Publication Date:	2016

A.1.3 Site Description

Three field sites with comparatively large comparison databases were evaluated to assess differences among passive/no-purge sampling and low flow/purge sampling approaches. The primary goal was to identify differences in VOC recovery and event-to-event data variability for the HydraSleeve compared to purging. The Snap Sampler was also compared as a control to see if the differences identified were a result of purging vs. not purging or the no-purge device itself.

- **Texas Site.** A Department of Defense site in northeast Texas with low permeability soils was evaluated comparing 47 wells using low flow, Snap Samplers and HydraSleeve. Repeat sampling among devices yielded 55 comparison pairs for the HydraSleeve and 47 comparison pairs for the Snap Sampler.
- **California Site**. A private site in southern California with variable permeability soils was evaluated comparing six repeated sampling events at eight monitoring wells. Snap Samplers, HydraSleeve, low flow, and volume-based purging were compared. Ten different VOCs were evaluable yielding a matrix of 480 comparative data points.
- **Utah Site.** A department of Defense site in northern Utah with variable permeability soils was evaluated with a total of 194 monitoring wells comparing the HydraSleeve and volume-based purging. A total of 410 comparison pairs were available.

A.1.4 Remedial Phase

Long Term Monitoring

A.1.5 Outcome

Several informative quotes are relevant for the Snap Sampler technology, especially for comparison to the HydraSleeve alternative.

Texas Site:

- "The TCE concentration measured using the HydraSleeve was lower than the concentration measured using the low-flow purge sampling method for 43 of the 55 paired measurements (80%), indicating an overall negative bias for the HydraSleeve results. The median bias in TCE concentration measured using HydraSleeve compared to purge sampling was −71%. This negative bias was statistically significant ($p < 0.001$) by the Wilcoxon Signed-Rank test."
- "The TCE concentration measured using the Snap Sampler was lower than the concentration measured using purge sampling methods for 24 of the 47 paired measurements (51%) and higher in the other 23 paired measurements, indicating no meaningful overall bias for the Snap Sampler results. The median bias in TCE concentration measured using Snap Sampler compared to low-flow purge sampling was −3%. This negative bias was not statistically significant ($p = 0.5$) by the Wilcoxon Signed-Rank test."

California Site:

- "VOC concentrations measured using the HydraSleeve were lower than the concentrations measured using the low-flow purge sampling method for 258 of the 480 paired measurements (54%) and the median bias was −5%, indicating only a small overall negative bias for the HydraSleeve results. This bias was not statistically significant ($p = 0.08$) by the Wilcoxon Signed- Rank test."
- "VOC concentration measured using the Snap Sampler was lower than the concentration measured using the low-flow purge sampling method for 210 of the 480 paired measurements (44%) and the median bias was +7%, indicating a small overall positive bias for the Snap Sampler results. This bias was statistically significant ($p = 0.002$) by the Wilcoxon Signed-Rank test."
- "[T]he HydraSleeve showed a large difference in performance between the shallow wells (median bias = +4%) and the deep wells (median bias = −26%). For the deep wells, the VOC concentration measured using the HydraSleeve was lower than the concentration measured using the low-flow purge sampling method for 119 of 180 paired measurements (66%)."
- "In addition to negative bias, the results obtained using the HydraSleeve were significantly more variable across the six rounds of sampling compared to those obtained using low-flow purge or the Snap Sampler."

Utah Site:

- "TCE concentrations measured using the HydraSleeve were lower than the concentration measured using the year earlier purge samples for 283 of the 410 paired measurements (69%) and the median bias was −20%. This bias was statistically significant ($p < 0.001$) by the Wilcoxon Signed-Rank test."
- "At this site, there was a statistically significant correlation between bias in TCE concentration and amount of water above the monitoring well screened intervalFor wells with <0 to 10 feet of water above the well screen (count = 192), the median bias was −21% and for wells with more than 10 feet of water above the well screen (count = 146) was −26%."
- "Similar to the California site, the results obtained using the HydraSleeve were significantly more variable…. For the 194 monitoring wells, the median TCE concentration range obtained from the four purge sampling events was 1.5×. The median concentration range obtained using the HydraSleeve was 2.7×. The variability

associated with the HydraSleeve sampling method was significantly higher than purge ($p < 0.001$) by the Wilcoxon Signed-Rank test."

Synopsis:

"At the two sites (California and Texas) with data available for an alternative no-purge sampling method (i.e., the Snap Sampler), this alternative method did not yield a statistically significant negative bias compared to purge sampling. This suggests that the negative bias observed in the HydraSleeve results at these sites is specific to the HydraSleeve sampler and is not indicative of a general problem with no-purge sampling."

"For the Texas Site, Hydrasleeve results were >10× lower than that of the paired purge sample in 17 of 55 sample pairs and were >10× higher in none of the sample pairs. For the California site, Hydrasleeve results were >10× lower in 26 of 480 sample pairs and were >10× higher in only five of the sample pairs. For the Utah site, Hydrasleeve results were >10× lower in 26 of 410 sample pairs and were >10× higher in none of the sample pairs."

"In contrast, when comparing paired Snap Sampler results to purge sample results, few Snap samples were either much higher or much lower in concentration. For the California site, Snap Sampler results were >10× lower in 3 of 480 sample pairs and were >10× higher in two of the sample pairs."

"Increased bias and variability in this study is attributed to the specific device (HydraSleeve) rather than to differences between purging and not purging wells. Snap Samplers demonstrated no negative statistical difference from purging both in terms of concentration and data variability at multiple sites with large data sets."

A.1.6 References

McHugh, T.E., P.R. Kulkarny, L.M. Beckley, C.J. Newell, M. Zumbro 2016, Negative Bias and Increased Variability in VOC Concentrations using the Hydrasleeve in Monitoring Wells. *Groundwater Monitoring & Remediation* 36, no. 1, Winter 2016, pages 79–87.