



## Why Low Levels of Ethene are So Important to Site Decisions

Reporting limits for ethene are critical to identifying and demonstrating complete natural biodegradation of chlorinated ethenes. In fact, reporting limits for ethene that are 200 times lower can be crucial.

Here's an example why:

The table below shows data collected from the analysis of samples at a minimally contaminated site. There had never been active treatment at the site, yet through the years the contaminants have transformed and the daughter products have dissipated. To assess the nature of this degradation, a suite of MNA parameters was analyzed. A select subset of the results is provided:

Well ID	Event	cDCE (ug/l)	Fe(II) (mg/l)	Ethene (ug/l)	DO (mg/l)
GWC-3	1	7.2	13	0.057	1.9
GWC-1	1	23	<1	<0.025	2.1
GWB-5	1	<1	<1	<0.025	5.9
GWB-2A	1	100	<1	<0.025	3.0
GWC-3	2	8.3	3.6	0.055	3.4
GWC-1	2	33	<1	<0.025	3.4
GWB-5	2	<1	<1	<0.025	5.6
GWB-2A	2	100	<1	<0.025	5.7

The ferrous iron (FeII) clearly indicates that there are at least mildly reducing conditions in well GWC-3. This well is the only well that has observable ethene, indicating complete reductive dechlorination in that well, even though vinyl chloride concentrations were <1 ug/l. This observation is not sufficient to conclude that MNA is a sufficient remedy, but it certainly would change the site manager's assessment of the competency of the local bacteria to carry out complete reductive dechlorination. That observation would have been completely missed without sensitive ethene analysis.

The reason these ethene levels are so low is, presumably, because much of the ethene that gets produced is rapidly oxidized. The table also shows the DO concentrations, and it is clear that the chances of observing ethene increase as the DO decreases.

Figures 1-3 are also informative about these wells. In all figures, we see the cisDCE concentration decline to near or below the MCL during the graphed period. Further, we see that the cisDCE concentration mirrors the DO concentration, suggesting that the DO inhibits reductive dechlorination. In figure 3, this trend can also be seen for VC. The appearance of VC and ethene means that complete reductive dechlorination is occurring. We know from microcosm tests conducted with sediment from other sites that DO above 1 mg/l is poisonous to the bacteria that perform reductive dechlorination. This means that the DO we are measuring is not the DO near the reductive dechlorinating bacteria, but an averaged DO. This means that regions of high DO are very close to the regions where ethene is produced, making it very likely the ethene gets oxidized

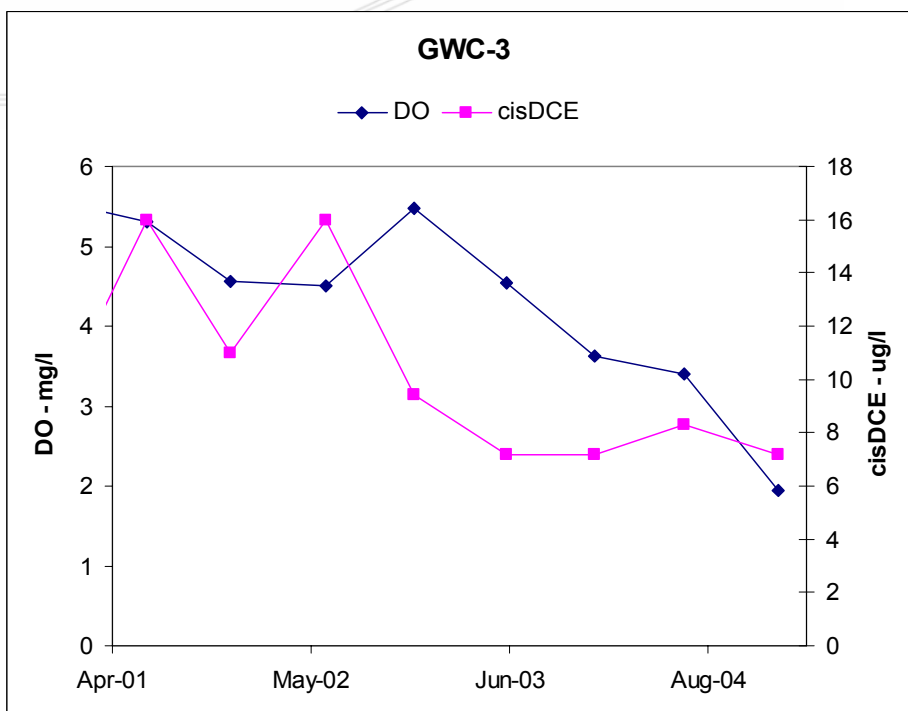
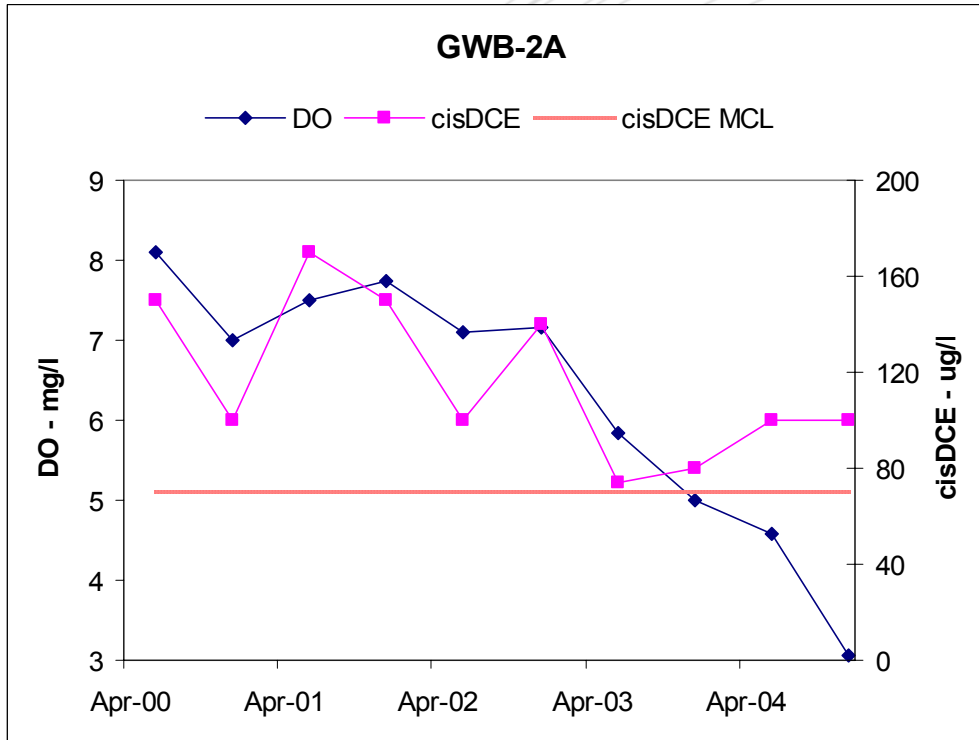


Figure 1. DO and cisDCE concentrations in GWC-3. MCL for cisDCE is 70 ug/l

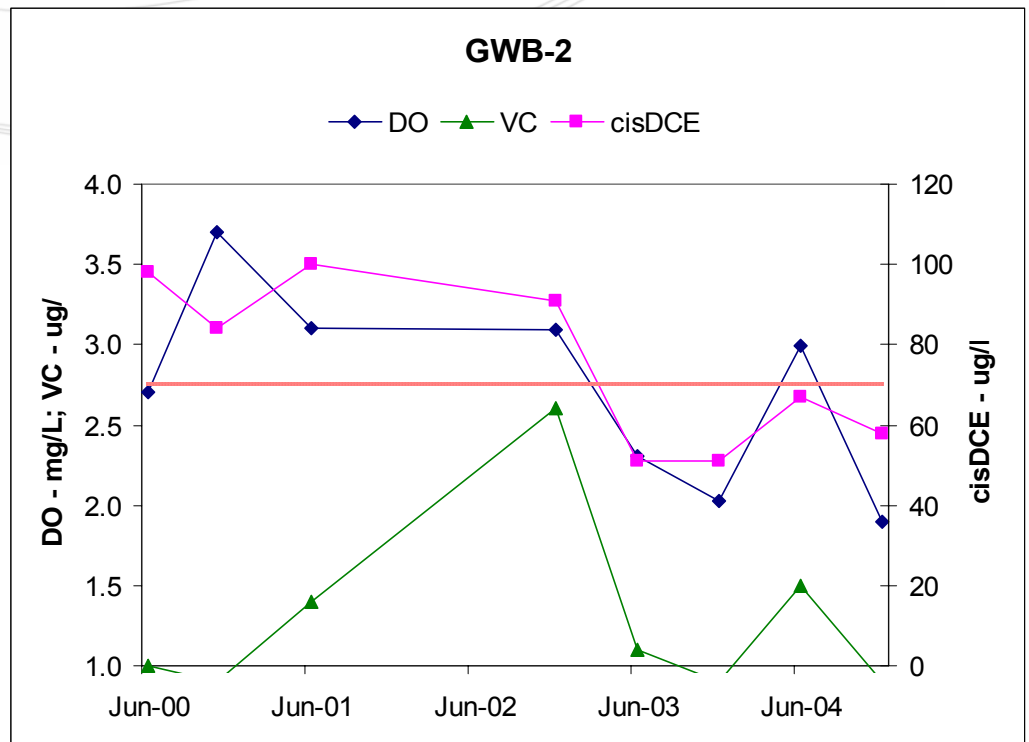


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**Figure 2.**  
DO and cisDCE  
concentrations in GWB-2A.  
MCL for cisDCE is 70 ug/l

**Figure 3.**  
DO, VC and cisDCE  
concentrations in GWC-1.  
MCL for cisDCE is 70 ug/l





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### Sampling Dilution

If the world were ideal, ground water sampling would allow us to look at the chemical concentrations exactly in the area of interest. But the reality is that the concentrations we look at are macroscopic numbers that reflect the chemistry averaged throughout the entire screened interval we sample. That means that if the contaminated area is only 3 inches thick, sampling through a 10 foot screen introduces a dilution factor of 40!

Further, in an aquifer that is only mildly contaminated there is a lot of mixing of the products of degradation into new redox zones, so things like ethene may degrade before you get a chance to sample them. The driving force to oxidize ethene is very high under all but the most reducing conditions, so ethene may be produced by reductive dechlorination, but never seen.

### A Word on Method Definition

That is why it is so important to use a very sensitive analysis when looking at ethene concentrations. By using AM20Gax, Microseeps is able to provide that sensitivity. For methane, ethane and ethene our reporting limits are 0.10, 0.025 and 0.025 ug/l. Other laboratories have typical reporting levels of 5 ug/l for those compounds. For ethene, Microseeps reporting limit is a factor of 200 lower!

### Make Sure you have the Lowest Reporting Limits

Many laboratories will subcontract ethene analysis to Microseeps only if specifically directed to do so by their client. There are two ways to do that: specify the reporting levels or AM20Gax in your QAP, or specify AM20Gax on your COC.