Supplemental Material:

Mass transfer limitations from a fixed volume:

Assuming all of the mercury is reduced upon exposure to the stannous chloride; the molar quantity of mercury is fixed in the sample space above the water sample. As clean air is driving the flow this sample space is being dilute. Thus the concentration, C, which the film sees at any time, t, can be estimated as an exponential decay:

$$C(t) = C_{initial} e^{-\frac{\dot{V}}{V}t}$$

Where $C_{initial}$ is the initial concentration or the mass divided by the container's air volume (V=0.5L) and $\dot{V}$ is the flow rate (0.25LPM). This gives us a time constant, τ, of about 2min.

The response of the sensor at any time $\dot{R}$ (shift in nm per unit time) is proportional to the concentration which it sees. Integrating this relationship would yield the total response R:

$$\int_0^T \dot{R}(t)dt = \int_0^T A\, C_{initial} e^{-t/\tau}\, dt$$

$$R(T) = AC_{initial}\tau[1 - e^{\frac{t}{\tau}}]$$

A is a conversion factor estimated from the results to be approximately 0.1 nm/min per 1 µg/L. Setting T to infinity and solving for $C_{initial}$ can give an estimate of the necessary initial concentration given a minimum detectable response, R, conservatively estimated as 0.25 nm. This estimated mass based limit of detection, 0.0125 µg/L, is roughly consistent with the y-intercept of the calibration curve given in Figure 8, and shift rate read as the overshoot for that lowest samples on that same graph.

Table S1. The concentration of inorganic species, and Biogenic Oxygen Demand, present in field samples as measured by the Novato Sanitary District, CA. Note: the bacteria enterococci and fecal coliform were also found at 4.1 and 8 MPN/100ml respectively. ND indicates a non-detect.

Species	Concentration (µg/L)
Ammonia, Total (as N)	0.786
Ammonia, Unionized (as N)	40
Arsenic	0.550

Biogenic Oxygen Demand (5-day @ 293 K)	600
Cadmium	ND
Chromium	0.26
Copper	1.200
Cyanide	ND
Lead	0.70
Mercury	0.0015
Nickel	3.00
Selenium	0.41
Oil and Grease	ND
Silver	ND

Table S2. Composition of solutions to examine effects of contaminants on sensor performance. Reference values in solution one are from a USDA analysis of typical drinking water [1]. Reference values for solution two are Maximum Contaminant Levels as regulated by the U.S. E.P.A. [2]. + indicates a Secondary Maximum Contaminant Level [3], and ++ indicates a California Drinking Water Standard [4]. – indicates no stated standard.

Solution 1		
Compound	**Concentration (mg/L)**	**Reference Value (mg/L)**
Ca	100	30
K	10	10
Mg	20	0
Na	50	40
Solution 2		
Compound	**Concentration (mg/L)**	**Reference Value (mg/L)**
Al	2	0.2^{+}
As	0.2	0.01
B	5	-
Ba	2	2
Be	0.5	0.004
Cd	0.5	0.005
Co	0.5	-
Cr	1	0.1
Cu	1	1.3
Fe	5	0.3^{+}
Mn	0.5	0.05^{+}

Ni	1	0.1^{++}
Pb	2	0.015
Se	5	0.05
Ti	5	-
V	2	-
Zn	5	5^{+}

References:

[1] USDA, “Basic Report: 13311, Water, tap, drinking.” 26-Aug-2013.

[2] O. US EPA, “Drinking Water Contaminants.” [Online]. Available: http://water.epa.gov/drink/contaminants/index.cfm#one. [Accessed: 23-Aug-2013].

[3] O. US EPA, “Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals.” [Online]. Available: http://water.epa.gov/drink/contaminants/secondarystandards.cfm. [Accessed: 26-Aug-2013].

[4] California Department of Public Health, “Maxium Contaminant Levels and Regulatory Dates for Drinking Water U.S. EPA Vs California.” Nov-2008.