

What Has Been Learned in the First Two Years of the Unregulated Contaminant Monitoring Rule 3?

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As part of the Safe Drinking Water Act Amendments of 1996, the U.S. Environmental Protection Agency (EPA) is required to create a list every five years of up to 30 unregulated contaminants to be monitored in public water supplies. This list is supposed to be derived from the Candidate Contaminant List (CCL) and to represent compounds for which EPA is in need of occurrence data to determine whether future regulation is warranted. The first Unregulated Contaminant Monitoring Rule (UCMR1) occurred from 2001-2005, the second (UCMR2) from 2008-2010, and the third (UCMR3) is currently in effect. In January 2013 monitoring of more than 5000 public drinking water supplies began for 28 contaminants representing seven different analytical methods. For both UCMR1 and UCMR2, the minimum report limits (MRLs) were based on a combination of analytical method capabilities and the available health reference data, with most reporting limits being in the 1 to 10 parts per billion (ppb) range (ug/L).

The UCMR1 monitoring resulted in a large number of “nondetects.” Perchlorate was detected at ppb levels in nearly 5 percent of systems, and it is now a candidate for regulation in drinking water. The UCMR2 monitoring was similar to UCMR1, with most compounds being nondetects, with the exception of N-nitrosodimethylamine (NDMA), a disinfection byproduct found at parts per trillion (ppt) levels (ng/L) in nearly 25 percent of systems, and metolachlor-ESA, a pesticide, found in <1 percent of systems. Most of the other compounds in UCMR1 and UCMR2 had fewer than three detections nationwide out of more than 30,000 samples.

For UCMR3, EPA changed the paradigm and set MRLs based on the capabilities of the analytical methods. This change was at least in part due to the preponderance of nondetects in UCMR1 and UCMR2. This has led to much lower MRLs in UCMR3, some as low as sub-ppt (ng/L), with, as shown in Figure 1, a resulting much greater frequency of detection (Roberson and Eaton, 2014). The EPA has publicly released

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(USEPA, 2014) multiple sets of results from the first two years of monitoring, representing nearly 4,000 water systems (up to 38,000 samples). In reporting the results, EPA focused on “reference levels” similar to the Health Reference Levels (HRLs) published by EPA when it first evaluated contaminants for potential regulation and compared the results to those levels, rather than on the actual detection frequency.

These results are quite different, however, from the first two UCMR programs, in that there is an overall significant increase in detections. This will represent a significant communications challenge for public water supplies when they have to report their UCMR3 results with their 2014 or 2015 Consumer Confidence Reports (CCRs). The CCRs include the actual detects and not the comparison to HRLs or other reference levels, although it is important to put detections into perspective as to relevance and potential health risk.

Table 1 summarizes the most recent results as a percent of systems with hits and the percent above the reference level, and also looks at the overall frequency of detection. Several things stand out in looking at these data. Five sets of results have been released by EPA (approximately every quarter), and in looking at the patterns of occurrence, there has been little change over that time (Table 2). Not surprisingly, the reduction in MRLs results in increased detections. For some of the metals (strontium), more than 99 percent of systems have detections, although <1 percent are above the reference level. The EPA has recently proposed regulating strontium and the UCMR3 data will undoubtedly have an influence on how that regulation proceeds.

Hexavalent chromium, an element made famous by environmental activist Erin Brockovich that now has a California Maximum Contaminant Level (MCL) of 10 ppb and a current EPA

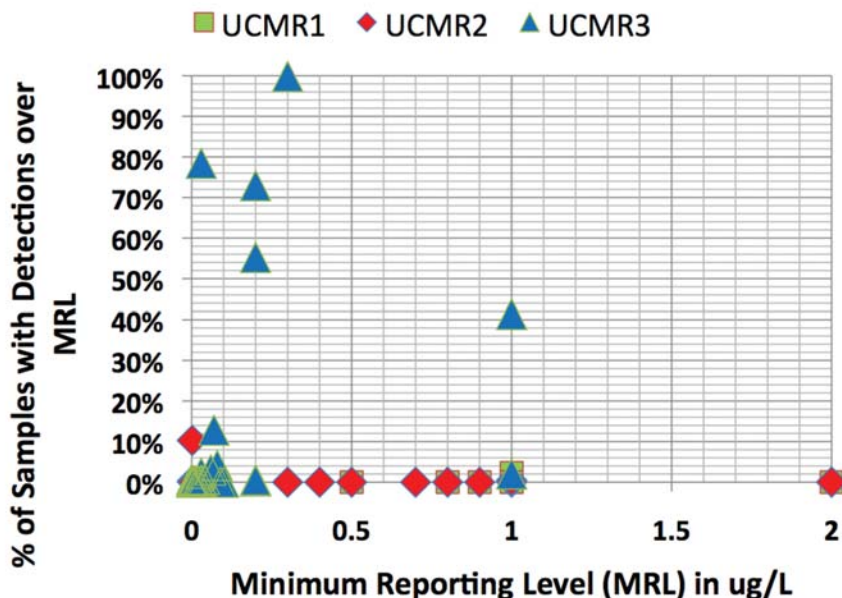


Figure 1

MCL of 100 ppb (which assumes potentially 100 percent hexavalent chromium), is being detected in nearly 90 percent of systems, with 4 percent of groundwater systems above the California MCL. Other metals, notably chromium, molybdenum, and vanadium, are all detected in >40 percent of systems, with vanadium as high as 75 percent. For all of these elements, groundwater sources have higher levels than surface waters. These elements are mainly naturally occurring, but will still likely be issues of concern for consumers, who may well ask, "Why would EPA require monitoring if these are not dangerous?"

The inorganic that is more problematic is chlorate, a disinfection byproduct formed either from degradation of sodium hypochlorite, on-site generation of hypochlorite, or chlorine dioxide. Chlorate is being detected in more than 68 percent of systems, with nearly 35 percent of systems exceeding EPA's reference level of 210 ppb. However, this HRL results from EPA's cross-the-board use of a relative source contribution of 20 percent for the HRL, whereas a more likely relative source contribution for

chlorate would be in the 60 to 80 percent range because disinfected drinking water is the largest exposure source. This would make a potential standard in the 600 to 800 ppb range.

It is notable that the World Health Organization (WHO) has a limit of 700 ppb, assuming 80 percent relative source contribution, which is more than three times EPA's reference level. Canada's guideline value is 1 mg/L, also assuming 80 percent relative source contribution from drinking water. At this point, it is hard to predict where EPA may choose to regulate chlorate. Recent work in Europe, however, may lead to a significant lowering of that standard. If EPA elects to regulate chlorate near 210 ppb, water supplies will have a difficult time with treatment once chlorate is formed, because there are few effective removal techniques for chlorate. Chlorate formation can be controlled by proper storage of hypochlorite, but that does not address the on-site generation formation or the chlorine dioxide formation.

With the organics being monitored in UCMR3, there are four classes: volatiles; per-

fluorinated compounds (PFCs), such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA); hormones; and 1,4-dioxane. Most of the volatiles are being found in very few systems (<5 percent), but still substantially more frequently than the organics in UCMR1 and UCMR2, again likely due to the low MRLs. Notable is the fact that 1,3-butadiene, considered the most toxic of the volatiles, has been detected only in one system to date. The PFCs are being found in less than 2 percent of systems, with no values approaching the reference levels. Both volatile organic contaminants (VOCs) and PFCs appear to be very localized with respect to occurrence.

Other work by EPA with the United States Geological Survey (USGS) has shown much greater frequency of PFCs in water systems, but at levels even lower than the UCMR3 MRLs, again demonstrating that the lower one looks for things, the more one sees. Hormones have the lowest MRLs in the UCMR3, but there have been few hits (<5 percent of systems). However,

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Table 1. January 2015 UCMR3 Data Summary for Chemical Contaminants

Contaminant	MRL ¹	Reference Concentration ¹	Total number of results	Number of results ≥MRL	% of results ≥MRL	Number of results >Reference Concentration	% of total results >Reference Concentration	Total number of PWSs with results	Number of PWSs with results ≥MRL	% of PWS ≥MRL	Number of PWSs with results >Reference Concentration	% of PWSs with results >Reference Concentration
1,2,3-trichloropropane	0.03	0.0004/0.04 ²	22,733	168	1%	168/134 ²	0.7%/0.6% ²	3,584	49	1%	49/43 ²	1.4%/1.2% ²
1,3-butadiene	0.1	0.0103/1.03 ²	22,733	1	0%	1/0 ²	0.004%/0% ²	3,584	1	0%	1/0 ²	0.03%/0% ²
Chloromethane	0.2	2.69/269 ²	22,731	162	1%	13/0 ²	0.06%/0% ²	3,584	92	3%	7/0 ²	0.2%/0% ²
1,1-dichloroethane	0.03	6.14/614 ²	22,733	575	3%	1/0 ²	0.004%/0% ²	3,584	176	5%	1/0 ²	0.03%/0% ²
Bromomethane	0.2	140	22,733	67	0%	0	0%	3,584	36	1%	0	0%
HCFC-22	0.08	NA	22,733	520	2%	--	--	3,584	194	5%	--	--
Halon 1011	0.06	90	22,733	465	2%	0	0%	3,584	229	6%	0	0%
1,4-dioxane	0.07	0.35/35 ²	22,611	2,613	12%	708/0 ²	3.1%/0% ²	3,587	727	20%	243/0 ²	6.8%/0% ²
Vanadium	0.2	21	38,726	23,599	61%	1,125	2.9%	3,590	2,626	73%	115	3.2%
Molybdenum	1	40	38,742	16,378	42%	103	0.3%	3,590	1,850	52%	27	0.8%
Cobalt	1	70	38,728	580	1%	3	0.008%	3,589	176	5%	3	0.08%
Sroutium	0.3	1,500	38,673	38,503	100%	1,032	2.7%	3,590	3,589	100%	191	5.3%
Chromium	0.2	100	38,588	18,780	49%	1	0.003%	3,589	2,584	72%	1	0.03%
Chromium-6	0.03	NA	38,682	29,120	75%	--	--	3,623	3,201	88%	--	--
Chlorate	20	210	38,513	21,639	56%	6,042	15.7%	3,608	2,471	68%	1,347	37.3%
PFOS	0.04	0.2	22,942	185	1%	24	0.1%	3,605	68	2%	12	0.3%
PFOA	0.02	0.4	22,941	220	1%	0	0%	3,604	72	2%	0	0%
PFNA	0.02	NA	22,942	12	0%	--	--	3,605	9	0%	--	--
PFHxS	0.03	NA	22,942	141	1%	--	--	3,605	37	1%	--	--
PFHxA	0.01	NA	22,942	152	1%	--	--	3,605	55	2%	--	--
PFBS	0.09	NA	22,942	6	0%	--	--	3,605	3	0%	--	--
17_estradiol	0.0004	0.0009/0.09 ²	7,168	3	0%	1/0 ²	0.01%/0% ²	745	1	0%	1/0 ²	0.1%/0% ²
17_ethynylestradiol	0.0009	0.035	7,169	3	0%	0	0%	745	3	0%	0	0%
Estriol	0.0008	0.35	7,168	1	0%	0	0%	745	1	0%	0	0%
Equilin	0.004	0.35	7,169	0	0%	0	0%	745	0	0%	0	0%
Estrone	0.002	0.35	7,169	0	0%	0	0%	745	0	0%	0	0%
Testosterone	0.0001	NA	7,168	47	1%	--	--	745	42	6%	--	--
4-androstene-3,17-dione	0.0003	NA	7,169	60	1%	--	--	745	47	6%	--	--

¹Measured in µg/L (ppb)

²Where two reference concentrations are listed, the first number is associated with a 10⁻⁶ cancer risk; the second number a 10⁻⁴ cancer risk.

Where two results are presented the first number is associated with the first reference concentration; the second number is associated with the second reference concentration.

Compounds shown in pink have a high occurrence frequency exceeding the reference concentration.

Compounds shown in yellow have either high occurrence (>10%), but not at significant levels or could impact public opinion.

Compounds shown in green have low occurrence and almost no exceedances of the HRL.

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given the public interest in “drugs in the water,” those systems that have detects will again have a challenge in explaining the results to their consumers. It’s interesting that the hormones being detected most frequently, testosterone and 4-androstene-3,17-dione, are not on the CCL3 list and thus have no reference levels.

The last of the organics, 1,4-dioxane, is a bit of a surprise because it is being found in over 19 percent of water systems, with 6.5 percent of samples exceeding the 0.35 ppb reference level. This compound is used as a stabilizer in chlorinated solvents and as a purifying agent in pharmaceutical production, and is found in many personal care products (e.g., shampoos and cosmetics). Like chlorate, 1,4-dioxane is very diffi-

cult to remove, with advanced oxidation being the only effective technique. Although initially expected to be mainly a groundwater supply issue, many of the highest levels have been found in surface water supplies. Thus, the widespread occurrence of 1,4-dioxane in UCMR3 monitoring results could well result in a move towards national regulation in drinking water, as many states (over 12 at last count) already have regulatory limits for it.

So, what does this all mean? First, in UCMR3 there have been a lot of detects, albeit at very low concentrations, raising some questions about EPA’s decision logic for selecting MRLs and chemicals to be analyzed in UCMRs. Second, it demonstrates that “the lower you look, the more you find” in drinking water and

could well cause EPA to rethink its approach for the next UCMR (UCMR4). Third, there are a few contaminants (chlorate and 1,4-dioxane) that are a cause for concern due to their widespread occurrence at levels above “health reference levels,” which could well result in a need for additional regulation and treatment. Fourth, the fact that patterns have not changed much as additional data have been released raises questions over whether UCMR4 should require the same degree of monitoring (number of samples/sites and/or frequency of monitoring). The EPA draft UCMR4 proposal, which will be out later in 2015, will indicate how it is considering the UCMR3 data as a guideline for changes in UCMR4.

References

- Roberson, A. and Eaton, A. 2014. Retrospective Analysis of Mandated National Occurrence Monitoring and Regulatory Decision Making, *Journal of the American Water Works Association*.
- USEPA, 2014. Occurrence Data: Accessing Unregulated Contaminant Monitoring Data. <http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/data.cfm#ucmr2013>. ♾

Table 2.

% of PWS with Detections as a Function of Data Release						
Contaminant	13-Oct	14-Jan	14-Apr	14-Jul	14-Oct	15-Jan
1,4-dioxane	19%	19%	20%	20%	20%	20%
PFOS	1.5%	1.6%	1.8%	1.6%	1.8%	1.9%
Vanadium	75%	77%	74%	70%	72%	73%
Hex Chrome	89%	90%	90%	87%	88%	88%
Testosterone	4.0%	5.0%	4.6%	4.7%	5.0%	5.6%