Regulating Drinking Water Quality in the United States

The 1996 Safe Drinking Water Act Amendments established regulatory framework that more than any of the other current federal environmental statutes in the United States transparently considers the available science, public health benefit, and the cost of rule implementation. In keeping with the Pareto Principle, the Amendments did a few things, very well. First it set the stage for the rapid development of a list of regulations for which there was an ample body of evidence to begin the rulemaking process and secondly, it established very clear criteria and expectations for rulemakings.

In the wake of the 1996 Amendments EPA has promulgated eleven regulations for the express purpose of improving the quality of water systems provide consumers. Those rules include:

1. Arsenic Rule
2. Radionuclides Rule
3. Filter Backwash Recycle Rule
4. Stage 1 Disinfectants and Disinfection Byproducts Rule
5. Stage 2 Disinfectants and Disinfection Byproducts Rule
6. Interim Enhanced Surface Water Treatment Rule
7. Long-Term 1 Enhanced Surface Water Treatment Rule
8. Long-Term 2 Enhanced Surface Water Treatment Rule
9. Ground Water Rule
10. Lead and Copper Rule Short-Term Revisions
11. Revised Total Coliform Rule

Based on EPA estimates, these rules represent a total regulatory implementation burden of $2.8 billion each year. While the arsenic rule was specific to arsenic and the "enhanced" SWTRs were nominally to regulate *Cryptosporidium*, the SWTRs, FBRR, DBP rules, GWR, and Revised TCR establish more stringent performance criteria through treatment techniques that reduce risks from hundreds of pathogens and disinfection byproducts.

Rule	Year	Named Contaminants	Annual Burden ($million, 2017)+
Stage 1 Disinfectants and Disinfection Byproducts Rule	1998	TTHM, HAA5, Bromate, Chlorate	$728
Interim Enhanced Surface Water Treatment Rule	1998	*Cryptosporidium*	$299
Lead and Copper Rule Minor Revisions*	1999	Lead, Copper	--
Radionuclides Rule	2000	radium-226, radium-228, gross alpha, beta particle and photon activity, uranium	$220
Arsenic Rule	2001	Arsenic	$129
Filter Backwash Recycle Rule	2001	*Cryptosporidium*	$7.2
Long-Term 1 Enhanced Surface Water Treatment Rule	2002	*Cryptosporidium*	$44.8
Lead and Copper Rule Minor Clarifications	2004	Lead, Copper	--

Stage 2 Disinfectants and Disinfection Byproducts Rule	2006	TTHM, HAA5	$254
Long-Term 2 Enhanced Surface Water Treatment Rule	2006	*Cryptosporidium*	$150.5
Ground Water Rule	2006	Fecal contamination (i.e., bacteria, viruses, and *Cryptosporidium*)	$62.3
Lead and Copper Rule Short-Term Revisions	2007	Lead, Copper	$6.3
Revised Total Coliform Rule	2012	E. coli	$23.8

Note:* Burden, $926 million annually, reflects 1991 rule as implemented post-1999 revision.
Note: + EPA annual burden estimate adjusting to 2017 dollars based on ENR CCI.

No other federal environmental statute managed by the U.S. Environmental Protection Agency has promulgated as many standards targeting the same regulated entities over this period. And this list is limited to the list of regulations that target delivered water quality. By comparison, under the Clean Air Act the list of new hazardous air pollutants has decreased by four contaminants since 1996, and only one new contaminant is being considered for listing.[1] Under the Resource Conservation and Recovery Act, there were no new regulations to manage additional hazardous substances rather the focus has been on the applicability and application of the existing risk management targets.[2,3]

In 1996 – early 2018 timeframe EPA published 15 drinking water health advisories. A number of these advisories complement primary standards, but not all. While not strictly regulatory requirements, health advisories have implications. Most recently in 2015 and 2016, health advisories for microcystins, cylindrospermopsin, perfluorooctanoic acid, and perfluorooctanesulfonate, which are all identified as having semi-acute health effects for children at very low concentrations in water, have led to numerous water systems taking water supplies off-line, modifying treatment, expanding monitoring, and taking other steps. In 1998 the advisory for Methyl tertiary butyl ether and again in 2008 the advisory for perchlorate had similar impacts on the drinking water sector.

Over this same period, EPA has promulgated five rulemakings to collect data to support regulatory decision-making. Occurrence data is already compiled for more than 80 contaminants and data is being gathered now for an additional 30 contaminants.

Rule	Year	Number of Named Analytes	Estimated Burden (million $)
Information Collection Rule	1996	27	$129
Unregulated Contaminant Monitoring Rule 1	1999	26	NA
Unregulated Contaminant Monitoring Rule 2	2007	25	$44.4
Unregulated Contaminant Monitoring Rule 3	2012	30	$69.8
Unregulated Contaminant Monitoring Rule 4	2016	30	$97.2

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[1] USEPA, Initial List of Hazardous Air Pollutants with Modifications, https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications#mods
[2] USEPA, Resource Conservation and Recovery Act Timeline, https://www.epa.gov/rcra/resource-conservation-and-recovery-act-timeline
[3] ATSDR has developed or updated 164 minimal risk levels for use by RCRA and CERCLA program between 1996 and May 2018. https://www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls.pdf one or more of which may be monitored and managed at individual clean-up sites.

Note: The ICR required sampling for 27 contaminants, as well as an extensive list of supporting analytes, ancillary data, and treatment studies from 500 large water systems.
Note: NA, available historical information are not sufficient to prepare a complete estimate.

With the data available from UCMR and the peer reviewed literature EPA has prepared three regulatory determination rulemakings. And, through those rulemakings identified 24 contaminants that were initially believed to be present at a level that might warrant regulations, none but perchlorate has warranted further warrant further action.[4] EPA did issue guidance for *Acanthamoeba* particularly for contact lens wearers.

While perchlorate is the only contaminant for which EPA made a positive regulatory determination, the process established in the 1996 Amendments has not only focused the sector's attention on contaminants for which there is a scientific basis to consider regulation, not just with respect to the 80 contaminants investigated in the UCMR process, but also the more than 100 contaminants that are identified every five years through the contaminant candidate list process. The CCL process, which utilizes a protocol developed with the assistance of the National Academy of Sciences and the National Drinking Water Advisory Council evaluates the available information on occurrence and health effects for thousands of chemicals and hundreds of microbes. The current CCL4 includes 97 chemicals or chemical groups and 12 microbial contaminants.

Contaminant Candidate List 4

Chemicals	Equilin	o-Toluidine
1,1-Dichloroethane	Erythromycin	Oxirane, methyl
1,1,1,2-Tetrachloroethane	Estradiol (17-beta estradiol)	Oxydemeton-methyl
1,2,3-Trichloropropane	Estriol	Oxyfluorfen
1,3-Butadiene	Estrone	Perfluorooctanesulfonic acid (PFOS)
1,4-Dioxane	Ethinyl estradiol (17-alpha ethynyl estradiol)	Perfluorooctanoic acid (PFOA)
17alpha-estradiol	Ethoprop	Permethrin
1-Butanol	Ethylene glycol	Profenofos
2-Methoxyethanol	Ethylene oxide	Quinoline
2-Propen-1-ol	Ethylene thiourea	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
3-Hydroxycarbofuran	Formaldehyde	sec-Butylbenzene
4,4'-Methylenedianiline	Germanium	Tebuconazole
Acephate	HCFC-22	Tebufenozide
Acetaldehyde	Halon 1011 (bromochloromethane)	Tellurium

[4] Regulatory Determinations 3 (dimethoate, 1,3-dinitrobenzene, terbufos, and terbufos sulfone); Regulatory Determinations 2 (Boron, Dacthal mono-acid (MTP) degradate, Dacthal di-acid (TPA) degradate, 1,1-Dichloro-2,2-bis(p-chlorophenyl) ethylene (DDE), 1,3-Dichloropropene (Telone), 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, s-Ethyl propylthiocarbamate (EPTC), Fonofos, Terbacil, 1,1,2,2-Tetrachloroethane); Regulatory Determinations 1 (*Acanthamoeba*, Aldrin, Dieldrin, Hexachlorobutadiene, Manganese, Metribuzin, Naphthalene, Sodium, Sulfate)

Acetamide	Hexane	Thiodicarb
Acetochlor	Hydrazine	Thiophanate-methyl
Acetochlor ethanesulfonic acid (ESA)	Manganese	Toluene diisocyanate
Acetochlor oxanilic acid (OA)	Mestranol	Tribufos
Acrolein	Methamidophos	Triethylamine
Alachlor ethanesulfonic acid (ESA)	Methanol	Triphenyltin hydroxide (TPTH)
Alachlor oxanilic acid (OA)	Methyl bromide (bromomethane)	Urethane
alpha-Hexachlorocyclohexane	Methyl tert-butyl ether (MTBE)	Vanadium
Aniline	Metolachlor	Vinclozolin
Bensulide	Metolachlor ethanesulfonic acid (ESA)	Ziram
Benzyl chloride	Metolachlor oxanilic acid (OA)	**Microbes**
Butylated hydroxyanisole	Molybdenum	Adenovirus
Captan	Nitrobenzene	Caliciviruses
Chlorate	Nitroglycerin	*Campylobacter jejuni*
Chloromethane (Methyl chloride)	N-Methyl-2-pyrrolidone	Enterovirus
Clethodim	N-nitrosodiethylamine (NDEA)	*Escherichia coli* (0157)
Cobalt	N-nitrosodimethylamine (NDMA)	*Helicobacter pylori*
Cumene hydroperoxide	N-nitroso-di-n-propylamine (NDPA)	Hepatitis A virus
Cyanotoxins	N-Nitrosodiphenylamine	*Legionella pneumophila*
Dicrotophos	N-nitrosopyrrolidine (NPYR)	*Mycobacterium avium*
Dimethipin	Nonylphenol2	*Naegleria fowleri*
Diuron	Norethindrone (19-Norethisterone)	*Salmonella enterica*
Equilenin	n-Propylbenzene	*Shigella sonnei*

Today more than ever, the concept of science-based regulatory policy is a topic of discussion. In crafting the 1996 SDWA, Congress described the fundamental decision criteria for sound rulemaking in a way that focuses public resources on the best risk reduction opportunities and does so based on the best available science. When evaluating whether to regulate, EPA must ask and answer three key questions: (1) is the contaminant likely to occur in drinking water, (2) is the contaminant likely to pose a risk to public health, and (3) is there a meaningful opportunity for risk reduction. And, EPA must not only answer these questions but substantiate the basis for the rulemaking (1) using best available science and (2) enumerating both quantifiable and nonquantifiable costs and benefits. When setting a regulatory standard benefit-cost and feasibility must be taken into account when considering regulatory alternatives.

Beyond the water quality regulations, there have been federal regulations that establish standards for public notification, requirements for routine consumer confidence reports, and structure variances and exemptions. In addition to federal requirements, state requirements also continue – back flow prevention, operator certification, water loss control, water supply plans, and other initiatives.

While we most often focus on water systems when we think about SDWA implementation. *Insufficient Resources for State Drinking Water Programs Threaten Public Health*, a report prepared by the Association of State Drinking Water administrators illustrates that appropriately targeting regulatory activity is important, because available resources are limited and need to be focused where they provide the most public health protection. The last edition of this report in 2014 documented a yearly shortfall of at least $230 million between program needs and available resources available in state primacy agencies.

There are opportunities for additional risk reduction in the drinking water sector. First and foremost is addressing pressing needs for infrastructure investment. With an estimated trillion dollar 20-year capital investment need to assure that the current water supply is reliable, it is danger that inadequate investment will ultimately lead to public health risk. We know that when funding is not adequate to support utility operations, shortcomings in ongoing maintenance can occur. Adequate ongoing attention to reservoirs, water treatment plants, and distribution system facilities are an essential aspect of managing infrastructure renewal costs, they contribute to maintaining the quality and reliability of water service. We saw in Flint, MI that a failure to invest in facilities and personnel ultimately led to a crisis in water quality, a loss of public confidence, and potentially illness and death in the community.