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TO: PA Senate Democratic Policy Committee

FROM: Mark W. LeChevallier, Ph.D.

DATE: May 5, 2021

SUBJECT: Testimony related to Senate Bill 1285, "Legionnaires' Disease Prevention and Reporting Act"

My name is Mark LeChevallier. In 2018, I retired as Vice President and Chief Environmental Officer for American Water – the parent company to Pennsylvania American Water Company. In that position, I was ultimately responsible for the drinking water quality, environmental compliance, and environmental stewardship for 15 million customers across the company, including 2.3 million people in Pennsylvania. In my retirement I continue to advocate and consult in activities that promote safe drinking water. I have served on the USEPA Science Advisory Board Drinking Water Committee and the National Academy of Science, Engineering and Medicine Water Science & Technology Board. I also served on the National Academy of Science workgroup that produced the report "Management of *Legionella* in Water Systems." I have attached as an Appendix a brief biography and the link to my website (www.drwaterconsulting.com) where my full *curriculum vitae* and links to recent publications can be found.

I applaud the intent and scope of Senate Bill 1285, as I myself have encouraged increased testing and management of *Legionella* in water systems. I have lectured and published on simplified methods that water utilities and water managers can use to test for *Legionella pneumophila* in water systems, developed recommendations for actions based on the test results, and have provided training and guidance on how to develop *L. pneumophila* monitoring programs (see Appendix). As our country (hopefully) comes out of pandemic lockdown, the need for awareness and management of *Legionella* in buildings is never as important. The following comments are provided to help improve the public health protections of Senate Bill 1285.

1. **Focus on *Legionella pneumophila*.**

The scientific literature is quite clear that the primary risk of Legionnaires' Disease is from *L. pneumophila.* The genus *Legionella* currently includes more than 61 species and 3 subspecies, only half of which have ever been associated with human infections (Hazel et al., 1987; Jaeger et al., 1988; Khodr et al., 2016; Vaccaro et al., 2016).

Over 95% of Legionnaires' disease cases are linked to *L. pneumophila* (Beauté et al., 2013; Cross et al., 2016; Dooling et al., 2015; von Baum et al., 2008; Yu et al., 2002), and of these infections, *Legionella pneumophila* serogroup 1 is responsible for about 95% of the Legionnaires' disease cases in the United States (Fields, Benson, & Besser, 2002).

Table 1 shows that *L. pneumophila* accounts for more than 95% of the culture confirmed cases (ECDC 2019). The next most common strain (*L. longbeachae)* is commonly associated with exposure to soil (especially potting soil) and is not associated with drinking water. There is good reason why most cases are associated with *L. pneumophila* because this species (particularly serogroup 1) is well adapted to grow in humans and is able to evade human immune responses so that it survives better in human lungs (NAS, 2019).

Species	Culture-confirmed cases	
	n	%
L. pneumophila	777	95
L. longbeachae	14	2
L. micdadei	6	1
L. bozemanii	2	<1
L. macaechernii	1	<1
L. sainthelensi	1	<1
L. other species	6	<1
L. species unknown	12	1
Total	**819**	**100**

Table 1. *Reported culture-confirmed cases of Legionnaires' disease and Legionella isolates by species, EU/EEA, 2014.*

In people with weakened immune systems, species other than *L. pneumophila* are infrequently isolated, and include: *L. micdadei, L. bozemanii, L. dumoffi* and *L. longbeachae* (Cunha et al., 2016; Rucinski et al., 2018). These species cause infections primarily in patients undergoing cancer treatment or immunosuppression due to organ transplants. With few exceptions, reported clusters of pneumonia due to non-pneumophila *Legionella* species have been hospital acquired (nosocomial) (Muder and Victor, 2002). Community outbreaks of pneumonia due to species other than *L. pneumophila* are uncommon, and most cases are sporadic. Exceptions to this generalization are community outbreaks of *L. longbeachae* which are typically associated with exposure to potting soil – not water systems (Whiley and Bentham, 2011; NAS 2019).

According to Muder and Victor (2002), there are no reported outbreaks of pneumonia due to non-pneumophila *Legionella* species that have been associated with large aerosol-generating devices, such as cooling towers. Yu and Stout (2004) recommended not to implement disinfection procedures when *L. anisa* was detected in hospital water supplies because of the low pathogenicity of this strain.

Therefore, for public buildings and water supplies not associated with health care facilities (hospitals, nursing homes, etc.) monitoring for *L. pneumophila* is appropriate as illnesses caused by non-pneumophila species are rare (Yu and Stout, 2004). Moreover, water management plans to control for *L. pneumophila* will also have benefit for managing other species of *Legionella*.

Non-pneumophila species were detected by molecular methods (qPCR) in 98% of New York city drinking water samples – despite complete compliance will all drinking water standards (Omoregie 2019). These occurrences were completely unrelated to any *Legionella* disease. Similarly, in The Netherlands, 96.9% of the buildings positive for *Legionella* were due to non-pneumophila species (van der Lugt et al. 2019). These data show that non-pneumophila species can be found in public water systems and buildings and be unrelated to any waterborne disease. Outside of clinical settings, the cost to remediate these bacteria would be a huge burden to building owners with little public health benefit.

There are a number of new and emerging techniques for *L. pneumophila* monitoring that have significant advantages over the conventional culture methods that should be embraced in Senate Bill 1285. In a paper that I published in 2019, research shows that water utility laboratory analysts could readily use the Legiolert method and produce reliable results (LeChevallier 2019a). These results are confirmed by nine other studies showing that the Legiolert assay works as well or better than the conventional buffered charcoal yeast extract (BCYE)-based methods for recovery and detection of *L. pneumophila* in: cooling towers (Barrette, 2019); drinking water in distribution systems (LeChevallier,

2019 b); public bathing water and hot springs (Inuoe et al, 2020), potable and non-potable water (Petrisik and Hall, 2018); cooling towers (Rech et al, 2018)]; building potable and non-potable water (Sartory et al, 2017); potable water (Scaturro et al, 2020); building potable and non-potable water (Spies et al, 2018) and hospital plumbing systems (McCuin et al. 2021). Legiolert offers many advantages over BCYE culture methods including: ease of use; minimal equipment; lower initial cost to set up and lower cost per sample; faster time to results; larger volumes analyzed, increased sensitivity, specificity for L. pneumophila, and ability of more labs to do testing.

In addition to the Legiolert test, there are a number of other commercially available tests, each with their specific characteristics. The Spartan Cube is a polymerase chain reaction (qPCR) -based assay that detects the DNA of L. pneumophila in a sample within an hour (Ahmes et al., 2019). The assay uses a proprietary qPCR primer set and the results expressed as genomic units/mL. Similarly, LuminUltra also provides a commercially available qPCR test that provides results in 90 minutes (https://www.luminultra.com/legionella-testing/). Both assays could be used for rapid screening as recommended by the National Academy of Science report (NAS 2019). Other qPCR kits are available (Biotecon) but must be used on conventional qPCR platforms. There are also a number of commercial immunological tests for *L. pneumophila* detection (e.g., lateral flow immunoassays, solid-phase cytometry, and flow cytometry). The ScanVIT method uses a 72-hour incubation followed by microscopic counting of microcolonies using fluorescent gene-probe detection (Bargellini et al., 2010; Di Maio et al., 2020). I am aware of other tests in development for *L. pneumophila* which will continue to provide cost competition and incentives for testing.

I should point out that there are a number of problems with the conventional BCYE method specified in Senate Bill 1285. The method is complex, time consuming, requires a high level of training by the analyst, and is subject to interferences (ISO 2017). One purported advantage is that the culture method can recover other *Legionella* species – but this claim is inaccurate and misleading. Culture methods include several buffered charcoal yeast extract (BCYE) agars with or without added selective agents that inhibit competing flora. These methods were developed primarily to recover *L. pneumophila* and may have lower recovery efficiencies for other *Legionella* species. Lee et al. (1993) examined 28 *Legionella* species on four commercial BCYE media and found that 11 of the species (notably *L. micdadei* and *L. bozemanii*) did not grow on media containing on cefamandole and 8 of the 28 species only grew marginally. Luck et al. (2004) reported that glycine-containing BCYE media (called GVPC) inhibited some of the non-pneumophila strains tested. It is clear from these reports that the ability of BCYE media to detect "all" *Legionella* is not true. Moreover, procedures (like acid pretreatment or heat) to inhibit other bacteria that can grow on the media also inhibit to varying degrees the recovery of non-pneumophila species.

I am aware that the above discussion has been technical, so to recap:

1. Over 95% of Legionnaires' disease cases are linked to *L. pneumophila*.
2. Outside of clinical settings, outbreaks of pneumonia due to species other than *L. pneumophila* are uncommon.
3. Non-pneumophila species can be found in public water systems and buildings causing no public health effects. Targeting these species would increase costs with little benefit.
4. Easy, rapid, and more sensitive methods are available for *L. pneumophila* testing.
5. Conventional BCYE methods were developed primarily for detection of *L. pneumophila* and can have variable and unreliable recovery for non-pneumophila species.

2. **Pennsylvania DEP Recently Increased the Requirements for Disinfectant Residuals.**

The Pennsylvania Department of Environment Protection (PADEP) published a revised Disinfection Requirements Rule (DRR) in the PA Bulletin on April 28, 2018 (25 PA Code Ch 109). This rule considerably strengthened the requirements for maintaining a disinfectant residual in public drinking water systems, primarily to control *Legionella*. Therefore, the requirements in Senate Bill 1285 are unnecessary and duplicative of this recently enacted rule.

Key provisions of the DRR include:

- All disinfectant residual measurements must be at least 0.2 mg/L.
- Disinfectant residual measurements must be taken concurrent to total coliform bacterial testing.
- A distribution system disinfectant residual must be collected each week, even if it exceeds the number of bacteriological tests.
- If a disinfectant residual is less than 0.2 mg/L, the site must be resampled next month.
- All individual disinfectant residual measurements must be reported to state authorities.
- No more than 5% of the residual measurements can be below 0.2 mg/L over a two-month interval.
- Failure to collect the correct number or timing of disinfectant residual samples, or failure to maintain at least 95% of the residual measurements at least 0.2 mg/L would result in a violation that would require public notice.

The USEPA is currently in the process to revise the Surface Water Treatment Rule to enact requirements similar to those passed by the PADEP. One of the objectives of the EPA is to better manage *Legionella* occurrences. The combination of PADEP's recent DRR and the pending EPA regulations means that specific potable water disinfection requirements in Senate Bill 1285 are not needed.

3. Increased Public Communication.

Senate Bill 1285 includes a number of provisions for public water systems to increase customer notifications regarding risks from *Legionella*. Current regulations already require notifications/actions for low pressure events and as outlined in the prior section for low chlorine residuals. However, because public water systems are partners with building owners in providing comprehensive management of *Legionella*, it would be feasible to require utilities to provide information to customers (including building owners) on steps that can be taken to better manage *Legionella* risks through the existing Consumer Confidence Report (CCR) notification. CCRs are required to be sent to all water systems customers each July. Senate Bill 1285 could modify the requirements for PA utilities to include language on the importance of building water management programs and steps that consumers can do to limit their risks from *Legionella*. The Water Research Foundation published a report in 2018 that outlined communication techniques that could be used by water utilities to communicate with customers on microbes in plumbing systems (Masters et al., 2018). The document contains examples of messages that could be included in CCRs, web sites, brochures, etc. that could be used for this purpose. Under existing regulations, utilities must certify with the PADEP that CCRs have been sent to all customers, and versions have been supplied in languages appropriate for the customers served by the water utility.

4. Testing of Water Systems for *L. pneumophila.*

In the papers I have published and the presentations I've given, I've encouraged water utilities to test for *L. pneumophila* in their distribution systems – not necessarily because growth of *L. pneumophila* is a big problem in public water systems, but to ensure that the utility is providing the highest quality of water to its customers (LeChevallier 2020). Also, a few outbreaks of Legionnaires' Disease have been associated with growth of *L. pneumophila* in utility distribution systems (Cohen et al., 2015; SunJournal 2019). *Legionella* is an organism that grows only in warm water (typically greater than 25°C (77°F) although it's been detected in drinking water supplies when water temperatures were 18°C (65°F) (LeChevallier 2019b, 2020). Therefore, I would recommend that the PADEP consider requiring testing for *L. pneumophila* in the month following disinfectant residuals less than 0.2 gm/L and when water temperatures are 18°C (65°F) or greater. This requirement to test for *L. pneumophila* when disinfectant residuals are low and water temperatures are warm will reduce the cost burden on water utilities and focus the monitoring when the risk of *Legionella* growth is the highest. This would be consistent with recommendation #5 of the National Academy of Science report on *Legionella* (page 263) that stated:

> "EPA should require a minimum disinfectant residual throughout public water systems and validate treatment performance by routine monitoring for *L. pneumophila* from sampling sites representative of the distribution system" (NAS 2019).

Conclusion

Thank you for the opportunity to provide comments on Senate Bill 1285. As a person who has been dedicated to protecting the drinking water quality for water utility customers, I applaud the intent of Senate Bill 1285, but suggest the following to better focus the public health benefits and reduce the regulatory burden:

1. Focus the testing on *L. pneumophila* – it is the overwhelming cause of Legionnaires' Disease from water.
2. Do not duplicate the intent of the April 2018 Disinfection Requirements Rule but supplement the follow up action with a requirement for *L. pneumophila* testing when disinfectant residuals are low (less than 0.2 mg/L) and water temperatures are warm (greater than 18°C).
3. Improve public education by requiring language to be included in the existing Consumer Confidence Reports on the importance of building water management programs and steps that consumers can take to limit their risks from *Legionella*.

I note that the National Academy of Science report on *Legionella* (page 261) recommends that "water management plans [be] a requirement for all public buildings" (NAS 2019). Towards this end, Senate Bill 1285 could help advance this protection.

I can be contacted if there are any questions, or if the committee would like to follow up on any of the issues raised in this testimony, at lechevallier1@comcst.net or 856-287-2538.

Sincerely,

Mark Le Chevallier

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Appendix

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Dr. Mark LeChevallier is the principal and manager of Dr. Water Consulting, a part-time consulting business, after retiring from American Water at the end of 2017. Dr. LeChevallier received his Bachelor of Science and Master's degrees in Microbiology from Oregon State University, and his Ph.D. in Microbiology from Montana State University. Dr. LeChevallier's expertise is in water quality, treatment, and innovation for potable water, reclaimed water, and desalination.

Research areas have included bacterial regrowth, disinfection of biofilms, corrosion, bacterial nutrients, AOC measurement techniques, biological treatment, *Legionella*, *Mycobacterium*, microbial recovery and identification, modeling and impact of pressure transients on water quality, and detection, treatment and survival of *Giardia* and *Cryptosporidium*. He has authored or coauthored over 300 research papers, book chapters, or reports; most in peer-reviewed journals. Several of his papers have received awards from the American Water Works Association for outstanding contributions to the science of water treatment. He was the recipient of the George Warren Fuller award in 1997 from the New Jersey section of the American Water Works Association, the Abel Wolman Award from the American Water Works Association in 2012, and the A.P. Black award for research from the American Water Works Association in 2015. He is a fellow of the American Academy of Microbiology. Dr. LeChevallier has been the principal investigator, co-investigator or participant on over 100 research grants totaling over $43 million from the US Environmental Protection Agency, American Water Works Association, the Water Research Foundation, WateReuse Research Foundation, WERF, and various State agencies. Dr. LeChevallier was named by *Public Works* magazine as a 2005 Trendsetter to "recognize leaders in the public works community who have defined policy, brought their community or an issue into the spotlight, or set the standard within the industry."

Dr. LeChevallier currently serves as a member of the Water Science Technology Board of the National Academy of Science and was appointed in 2019 to the Drinking Water Subcommittee of the USEPA Science Advisory Board. He was a member of the National Academy of Science workgroup on *Legionella*. He is a past member of the *Journal of the American Water Works Association* editorial advisory board. He was a negotiator representing the National Association of Water Companies on the USEPA Federal Advisory Committee for revisions to the Total Coliform Rule and served on the Research and Information Collection Partnership panel for research to develop the Distribution System Rule. He was a member of the Distribution System Committee for the National Academy of Science, National Research Council. Dr. LeChevallier has served on a variety of professional committees and was the past-chair of the AWWA Water Science and Research Division, past-chair of Division Q of the American Society for Microbiology, past chair of the Peer Review Editorial Board for the *Journal of the American Water Works Association*, past chair of the AWWA Total Coliform Rule Technical Action Workgroup (TCR TAW), past member of the *Applied and Environmental Microbiology* editorial board, and past chair of the Unsolicited Proposal Review Committee for the Water Research Foundation. He has served several terms as a member and

subgroup chair of the AWWA Research Foundation Research Advisory Committee and as a member of the Strategic Initiative group that directed a $5 million, 5-year program on distribution system research. He was a member of the Water Environment & Reuse Foundation (WE&RF) Research Advisory Council. He has been an active participant in several USEPA committees: the Disinfection By-Product Council Technical Advisory Group, the STAR peer review panel, SBIR review panels, and the Drinking Water Advisory Committee. He is a member of the American Water Works Association, the American Society for Microbiology, and the International Water Quality Association.

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