

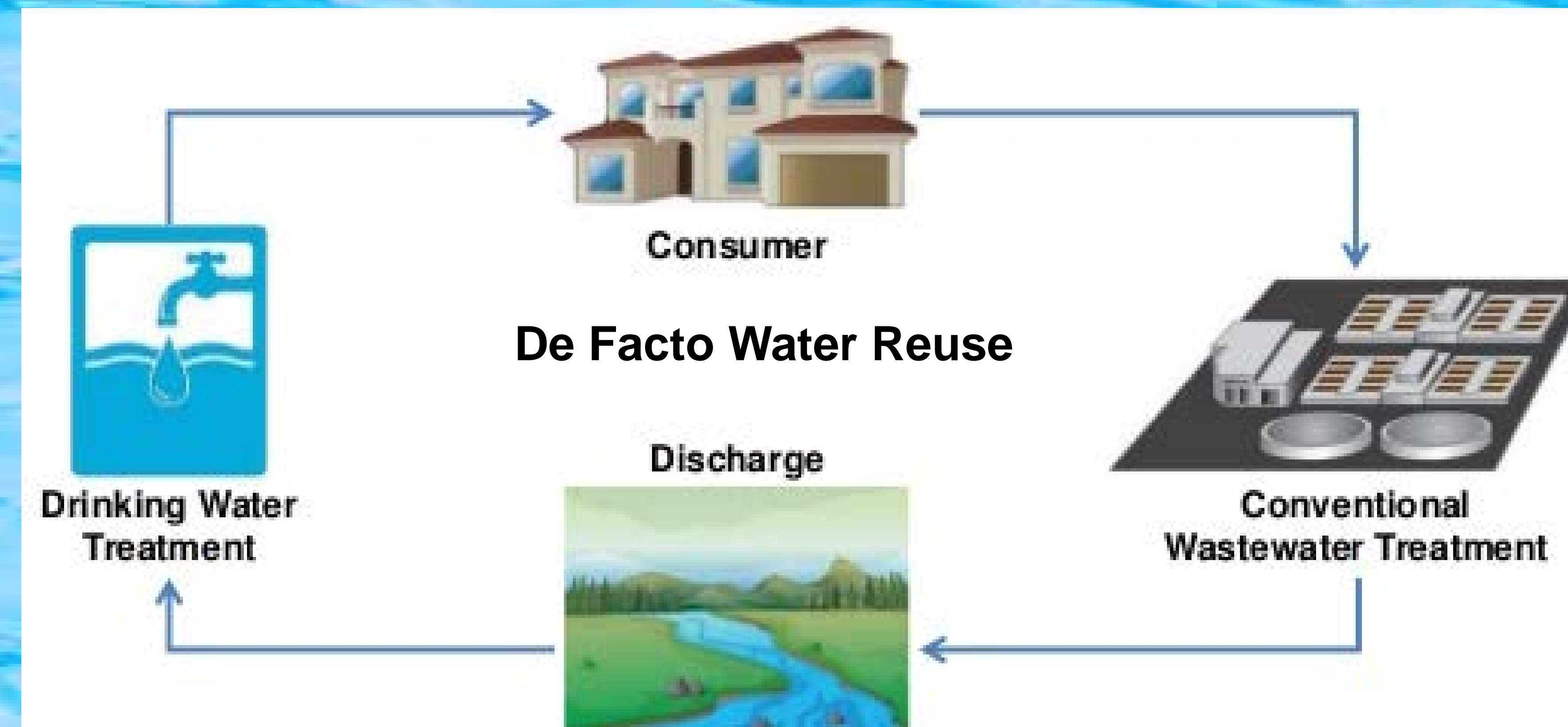
Using the Four R's in the Design of De Facto Potable Reuse Water for Enhanced Public Health

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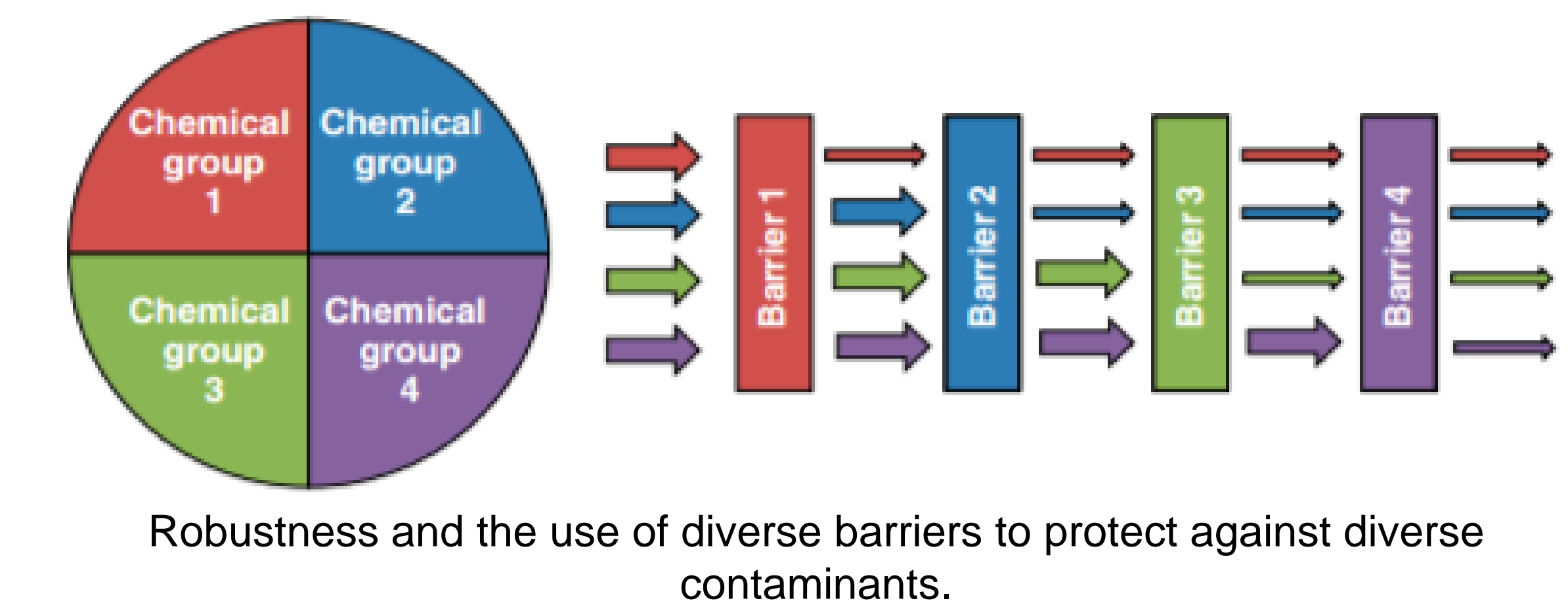
Background

- As industry and human populations expand, the demand for access to a nation's water resources are at an all time high.
- These stakes are only worsened when accompanied with global weather pattern shifts influenced by climate change.
- Although using recycled wastewater in a system, also known as de facto potable reuse, has been used for some time now, there is a new framework being created that broadens the scope of de facto potable water and will provide even more consistent protection of the public health.
- This new paradigm of planned wastewater reuse consists of a general belief in the four R's: reliability, redundancy, robustness, and resilience.



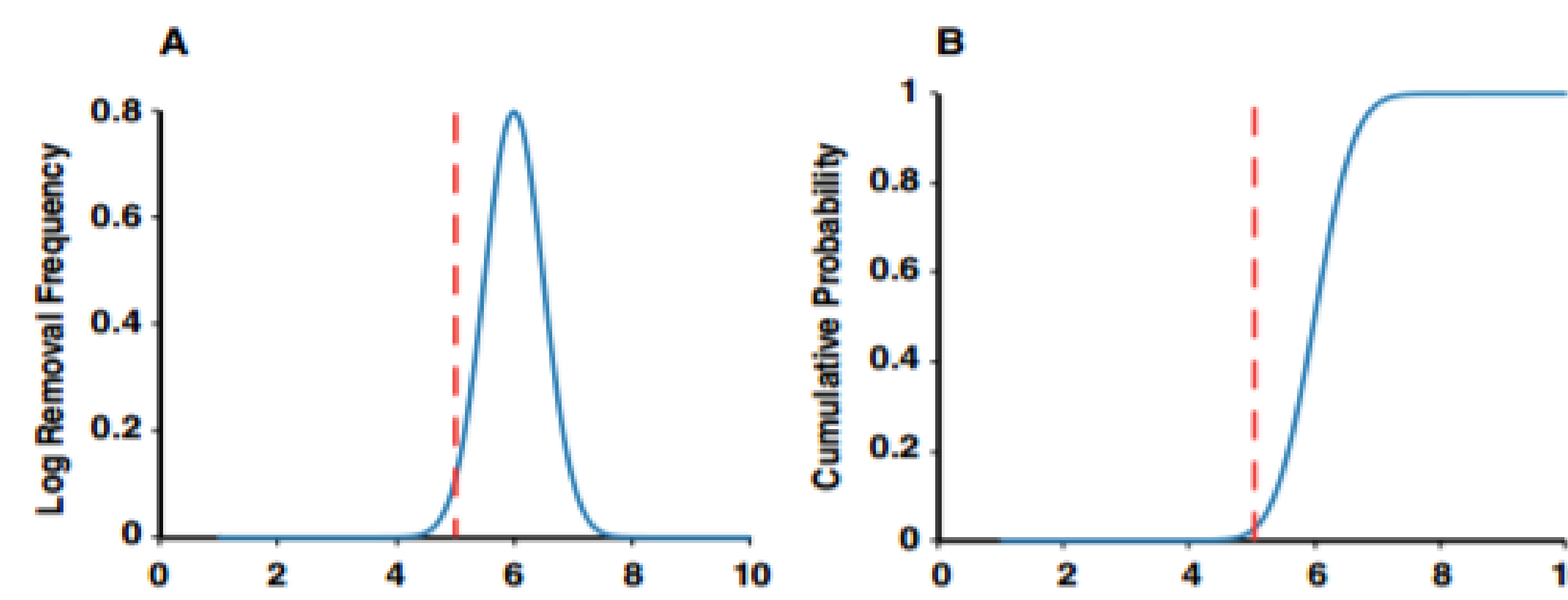
Robustness

- The ability of a potable reuse system to address a broad variety of contaminants and resist catastrophic failures



Reliability

- The ability of a potable reuse system to provide water that consistently meets or exceeds the public health protection provided by existing drinking water supply.



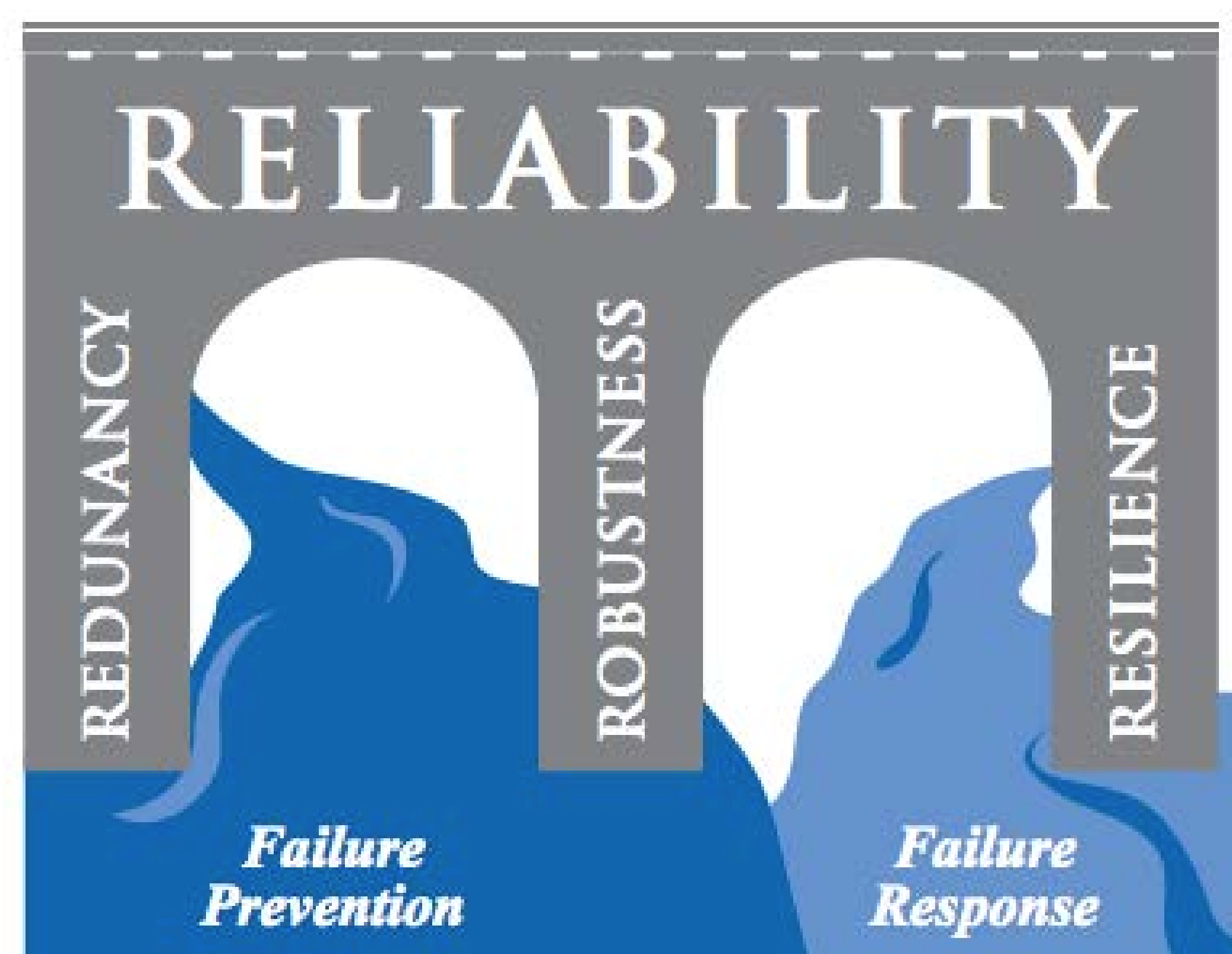
Sample probability distribution function of an ozone system designed to achieve 5-log removal of *Giardia* cysts: (A) continuous and (B) cumulative distributions

A		B		
Train 1		Removal	Train 1	Train 2
Process A	99%, 6 logs 1%, 0 logs	6 log	361 days	350 days
Train 2		4 log		11 days
Process B	99%, 2 logs 1%, 0 logs	2 log		2.6 hours
Process C	99%, 2 logs 1%, 0 logs	0 log	3.7 days	32 seconds
Process D	99%, 2 logs 1%, 0 logs			

(A) Treatment performance and (B) the benefit of the multiple-barrier approach

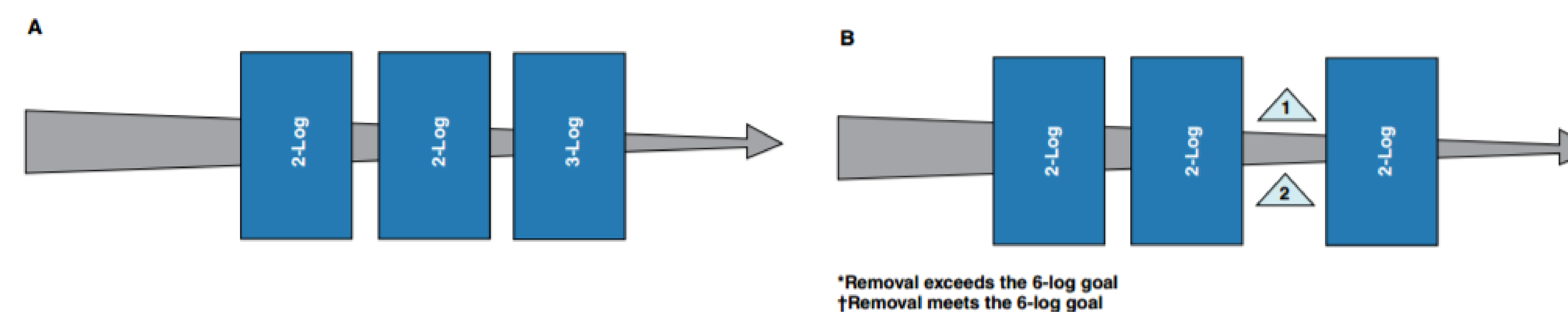
Objectives

- Framework for developing potable reuse systems that provide consistent protection of public health.
- Reliability is the guardian of public health.
- Redundancy and robustness prevent failures.
- Resilience is the ability to respond to failures.



Redundancy

- The use of measures beyond minimum requirements to ensure that treatment goals are more reliably met or that performance can be more reliably demonstrated.



Types of redundancy, including (A) treatment* and (B) monitoring† redundancies

Resilience

- The ability of a treatment train to successfully adapt to failure.
- Natural disasters, failure response

[1] Pecson, Brian M., R. Shane Trussell, Aleks N. Pisarenko, and R. Rhodes Trussell. "Achieving Reliability in Potable Reuse: The Four Rs." *Journal - American Water Works Association* 107 (2015): 48-58. Web

[2] <https://www.slideshare.net/tolivito/meeker-the-new-frontier>