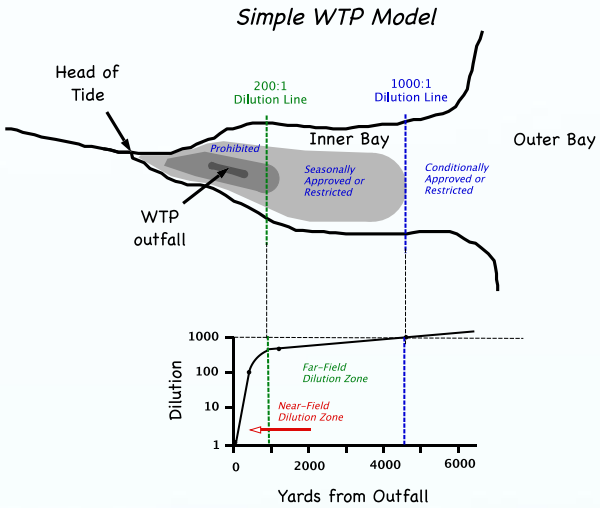
Relative Risk of Virus Contamination from a WTP can now be Accurately Assessed for Adjacent Growing Areas.



Combining Final Effluent MSC Analyses with Dye Study Results

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NESSA April 9, 2019

Final Effluent MSC Analyses with Dye Study Result

Optimized Estimation of Relative Risk of Viral Contamination

Example - Relative MSC level at the 1000:1 dilution line

Typical Levels Expected = Geomean of MSC in Final Effluent/1000

Highest Levels Expected = P95 of MSC in Final Effluent/1000

This normalizing procedure can be used to better assess the relative public-health risk from viruses originating from a particular WTP.

Once normalized and expressed as the MSC concentration at particular locations in the growing area, one can assess the impact on the Growing Area on a relative basis.

“1,000:1” is simply an educated guess, a negotiated default.

When discussing prohibited areas and dilution zones, the most important factor is **final effluent quality** which can vary from <1 to >100,000 PFU/100ml, a factor of 5 logs.

In the far-field zone (generally greater than 300:1), dilution approaches a linear relationship with distance from the outfall.

Final Effluent Quality more important than a particular Dilution Line.

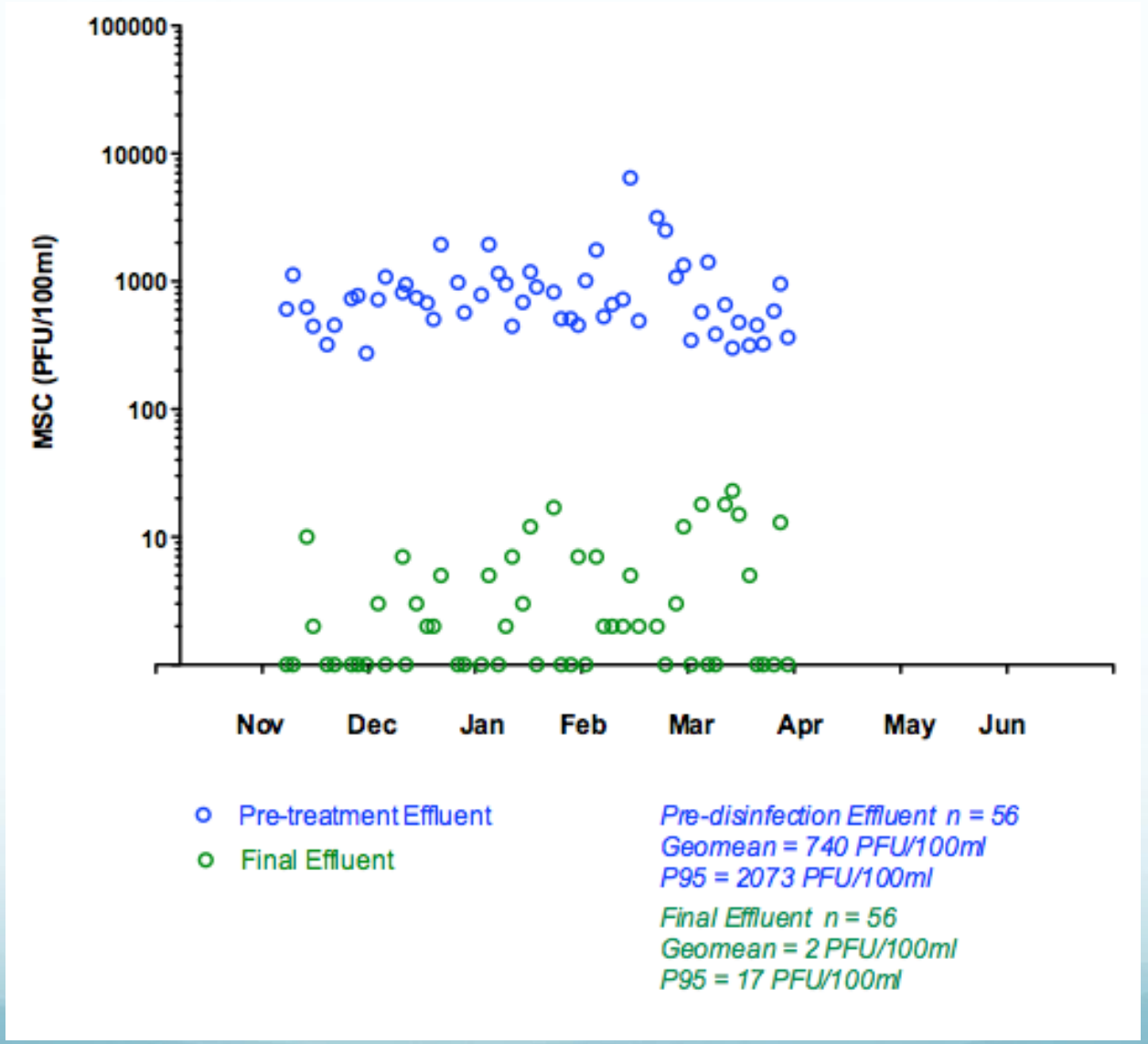
If you really want to know the risk, look at the stats of a time series of MSC from final effluent samples.

Interpretation Matrix for Final Effluent MSC Time-series Analyses

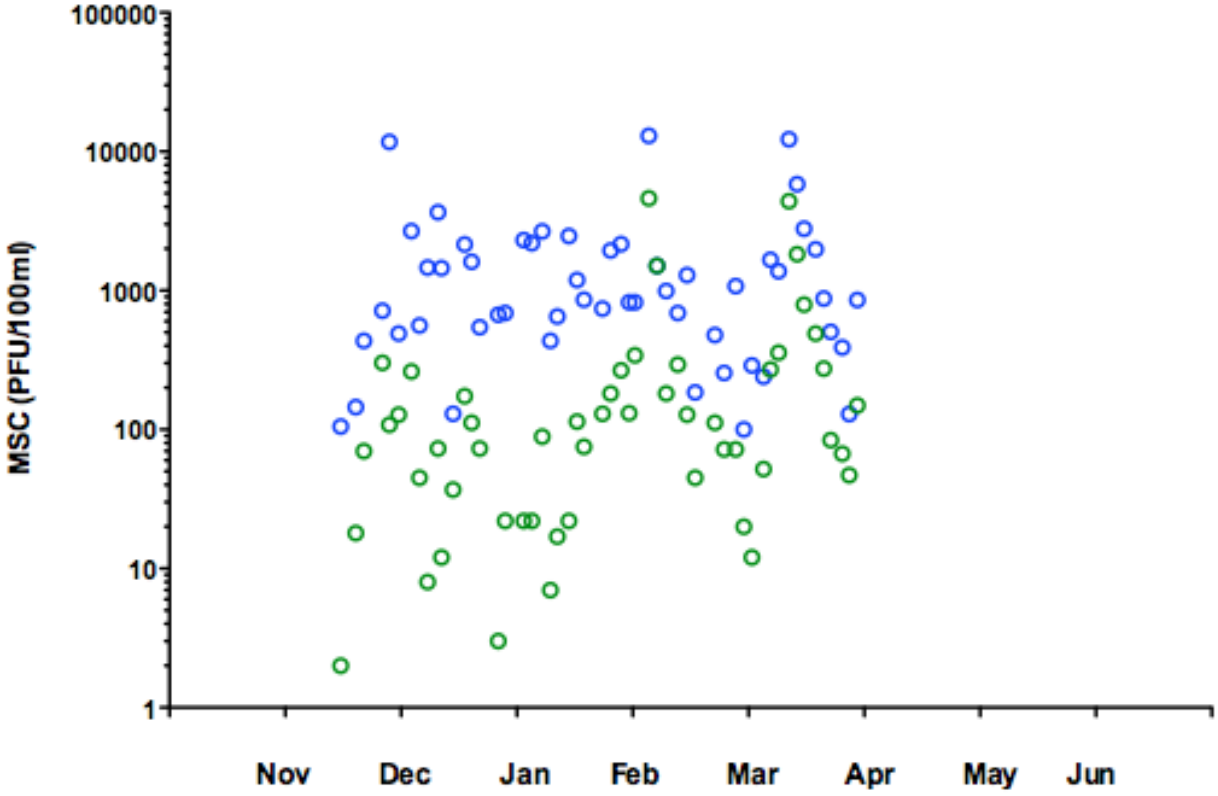
Effluent Quality at Outfall	MSC Levels PFU/100ml	Minimum Dilution Required	Est. Max MSC at Min. Dilution	Recommended Max P95(3)
Untreated Sewage	±230,000 (2)	100,000:1 (1)	2.3 PFU/100ml	
Partially Treated	<50,000	100,000:1	0.5 PFU/100ml	50,000
Secondary Effluent	<5,000	10,000:1	0.5 PFU/100ml	5,000
Chlorinated Effluent	<500	1,000:1 (4)	0.5 PFU/100ml	500
UV-disinfected Effluent	<50	300:1 (5)	0.16 PFU/100ml	50

(1) NSSP recommends dilution from 1,400,000 FC/100ml to 14 FC/100ml from a source of untreated sewage to the approved growing area. This represents a dilution of 100,000:1 based on the FC standard.
(2) Estimated average of MSC level in sewage from influent data.
(3) P95 calculated from 45 final effluent samples collected biweekly or preferable tri-weekly.
(4) 1,000:1 from NSSP Guidance
(5) 300:1 RMZ from Guidance

Hampton, NH (secondary plus chlorination) 4/1/19



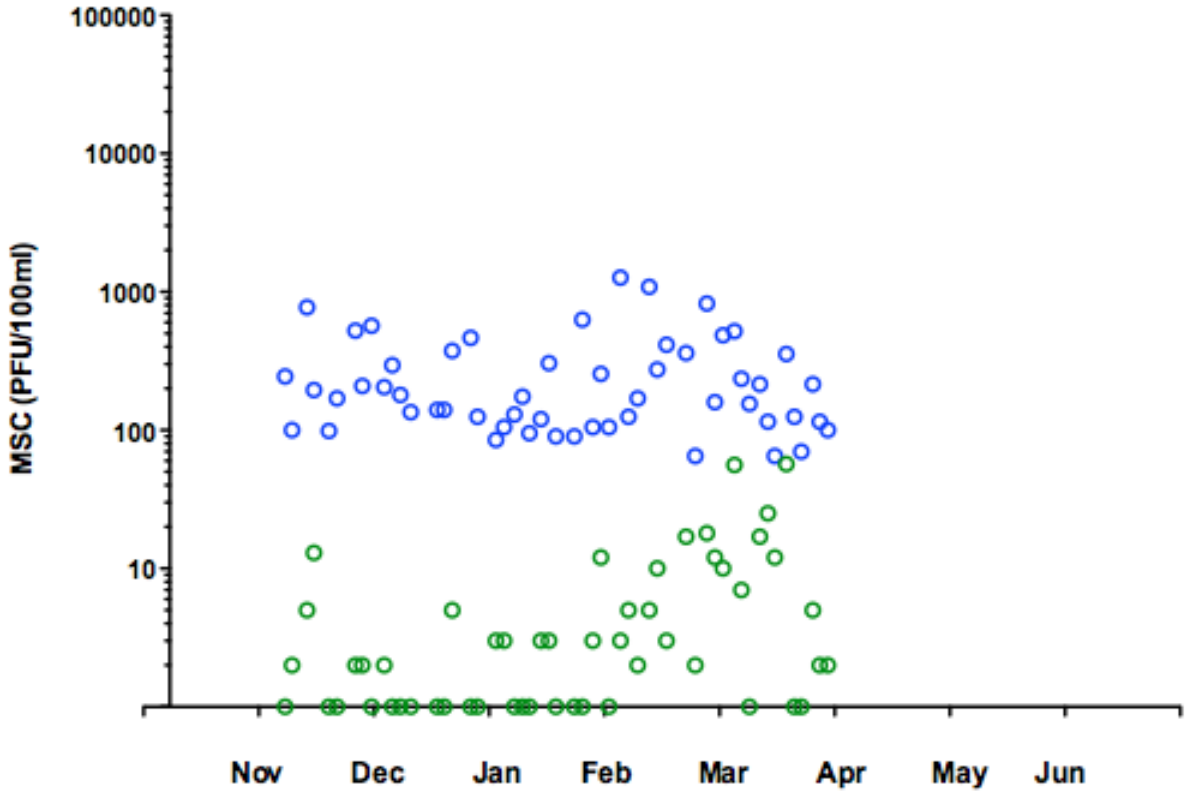
Newmarket, NH (secondary plus chlorination) 4/1/19



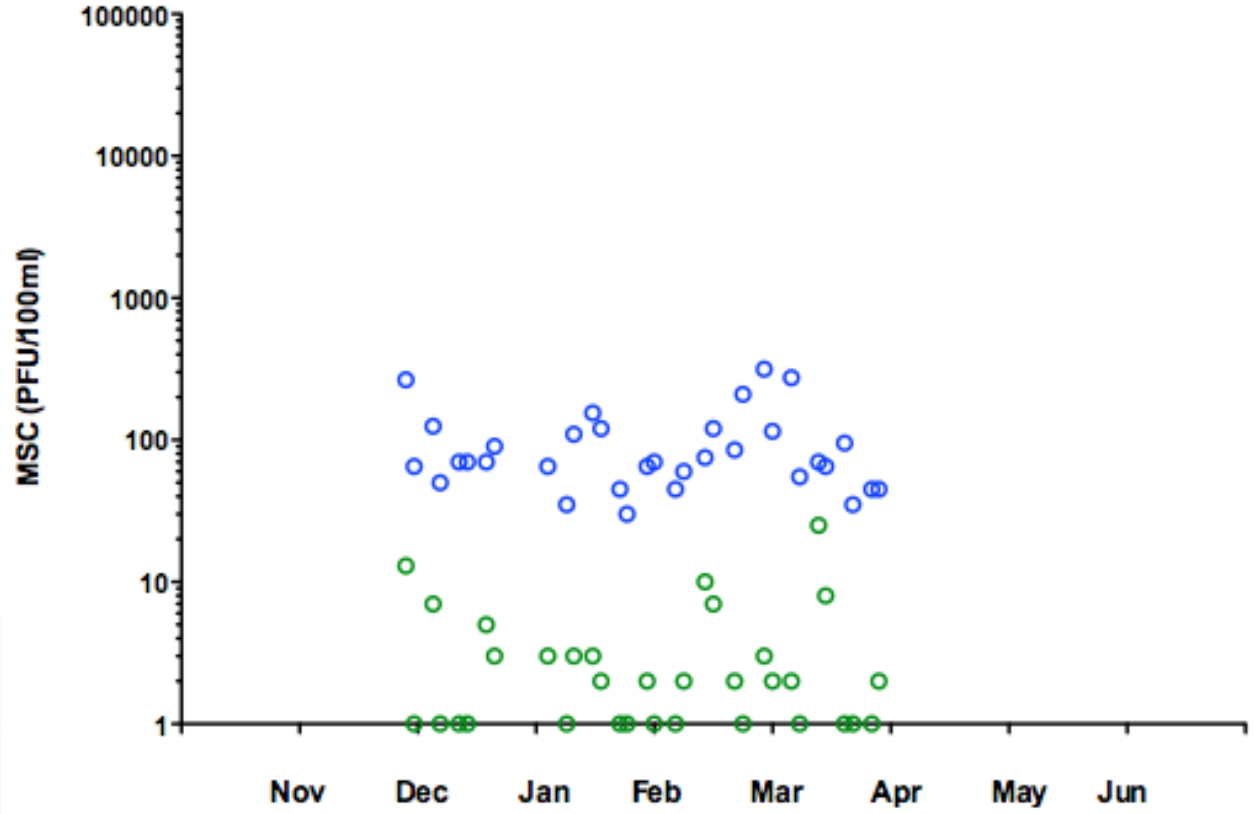
Pre-disinfection Effluent n = 53
Geomean = 941 PFU/100ml
P95 = 7710 PFU/100ml

Final Effluent n = 53
Geomean = 88 PFU/100ml
P95 = 1107 PFU/100ml

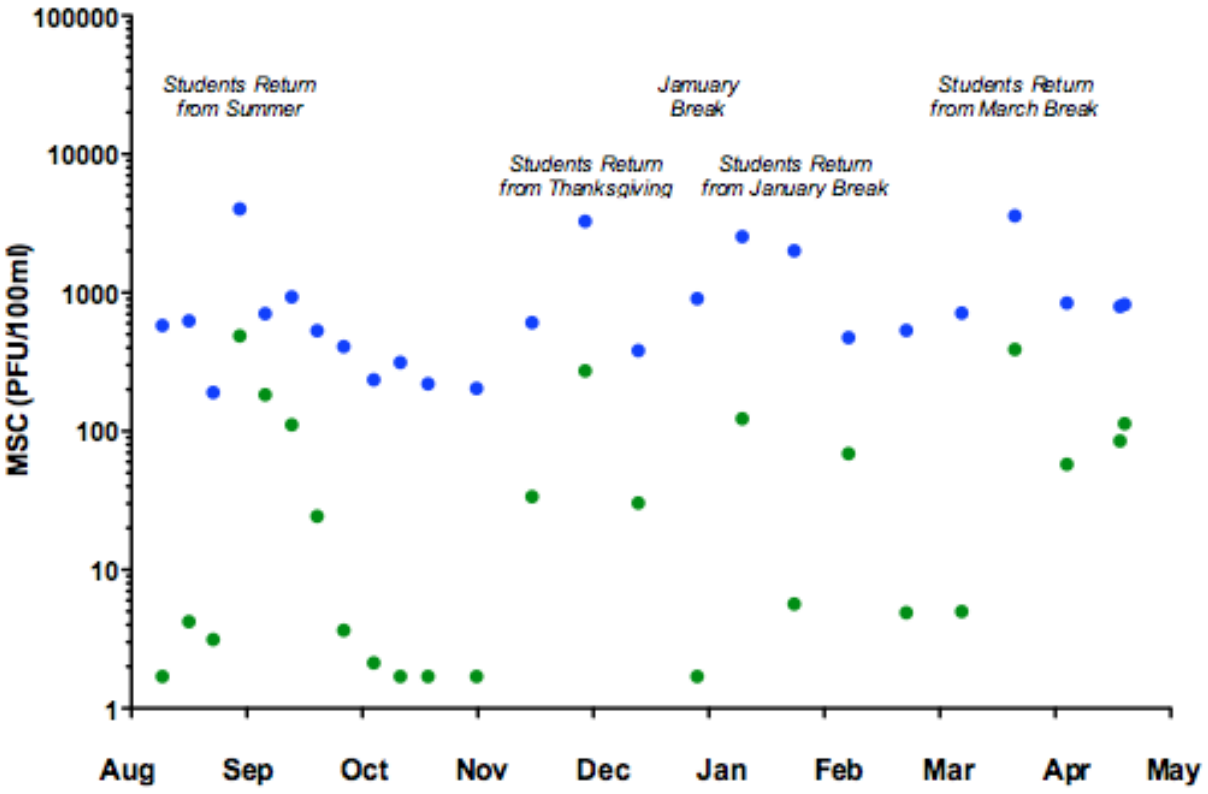
Dover, NH (tertiary treatment UV) 4/1/19



Greenwich, CT (Advanced with UV) 4/1/19



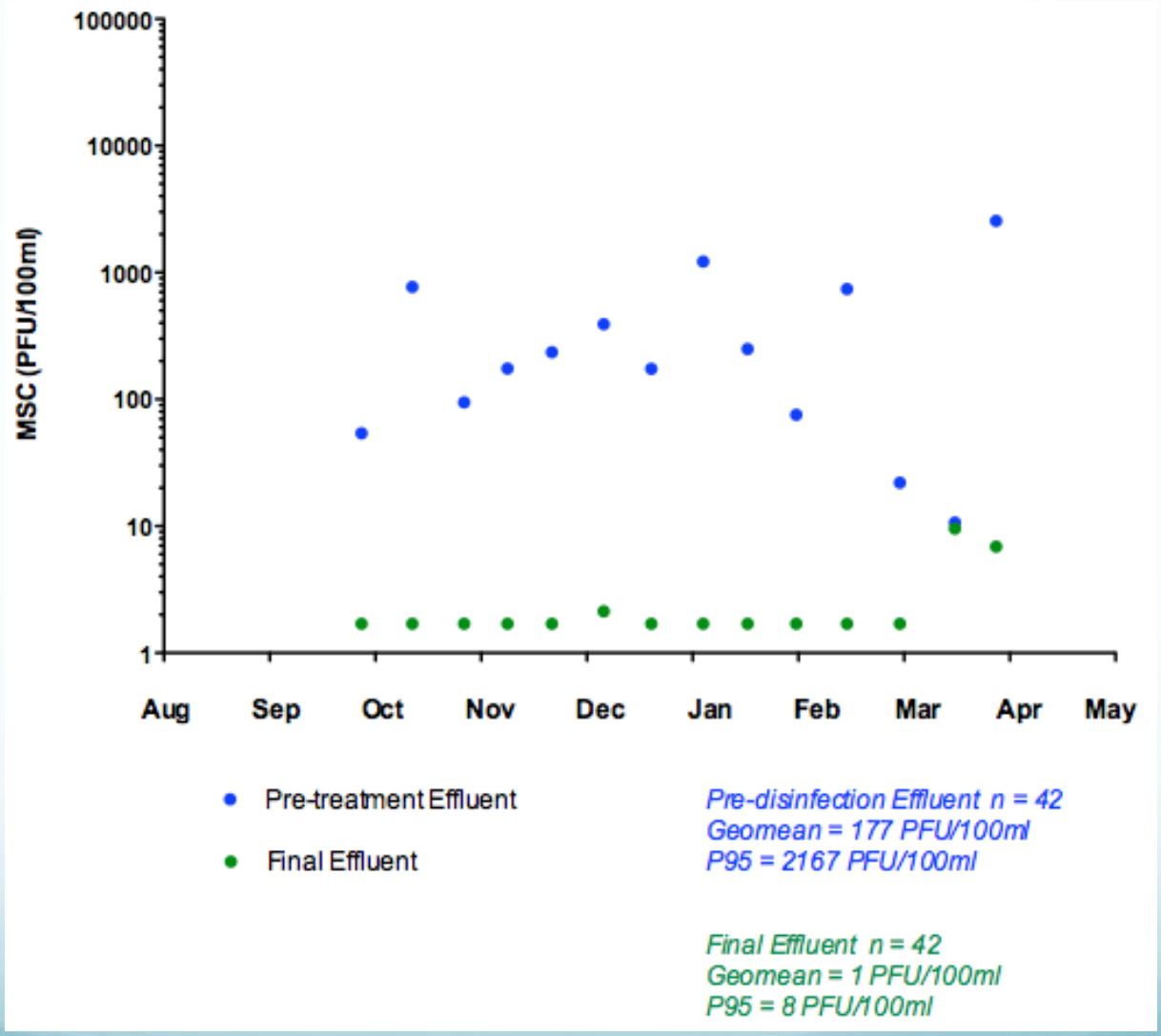
Durham, NH (Secondary Chlorination) 5/1/18



Pre-disinfection Effluent n = 75
Geomean = 689 PFU/100ml
P95 = 3496 PFU/100ml

Final Effluent n = 75
Geomean = 15 PFU/100ml
P95 = 326 PFU/100ml

Mystic, CT (Secondary Bio-mag UV) 5/1/18



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UV-disinfected Effluent	<50	300:1	0.16 PFU/100ml	50

WTP Facility	Geomean	P95	Recommendation		Max MSC
Hampton, NH	2	17	300:1		0.05
Newmarket, NH	88	107	1000:1	0.11	
Dover, NH	2	20	300:1		0.07
Greenwich, CT	2	11	300:1		0.04
Durham, NH	15	326	1000:1	0.33	
Mystic, CT	1	8	300:1		0.03

Considerations of the Time-series Analysis Approach for the Assessment of **Final Effluent** Samples

- Only final effluent released under “normal operating conditions” is impactful on adjacent growing areas in a predictable way.
- Combining the results of dye studies with final effluent assessments gives the best estimate of **MSC concentration at any given dilution line**.
- Using the P95 value from the assessment database gives an upper limit to variation under normal operating conditions
- Estimated maximum MSC at a minimum dilution line gives an independent estimate of **relative viral risk** from the evaluated WTP.
- Final Effluent Assessments are more meaningful for classification purposes than shellfish meat assessments which can be challenging to interpret.
- Approach more consistent with NSSP evaluation of growing area W/Q

Benefits of the Time Series Analysis Approach for the Assessment of **Pre-treatment Effluent** Samples

- Yields important insight into the viral performance of the WTP before the final step of disinfection.
- Helps to understand the challenge presented to the disinfection system
- Log Reduction Values (LRVs) can be readily calculated for the disinfection process (less meaningful with indeterminates)
- Turbidity is easily measured in the laboratory and at times can impact the LRVs and final effluent quality.
- Running the single pre-treatment is adequate for this purpose.
- **Sampling Influent is not recommended**; hazardous, unpleasant often in confined spaces, variable by nature, and un-needed.

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