Q-084

Evaluation of a Revised Microscopic Particulate Analysis (MPA) to Access Groundwater Under Direct Influence of Surface Water

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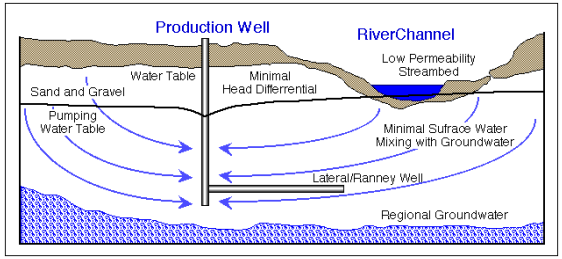
Introduction

The Surface Water Treatment Rule (SWTR) requires the public water supplies derived from "ground water under the direct influence of surface water" (GWUDI) to receive the same treatment as water supplies derived directly from surface-water sources. Microscopic Particulate Analysis (MPA) has been used as a primary tool to assess GWUDI of surface water.



Major Limitations of the current MPA:

- MPA focus is mostly on microscopy. Microscopy needs lots of training and it has a high chance of false identification
- Does not include Smaller Sized Indicators (1-2 µm)
- MPA does not reflect the current understanding of fate and transport of pathogens and indicators in the subsurface

Objectives

- Identify solutions to overcome these limitations
- Lab-scale research to test the validity of suggested protocol and to refine suggested protocol improvements
- Full-scale field site testing to prove the practicability of the revised protocol in comparison to the existing MPA methodology

Comparison of Yarn & Envirochek Filters

Conventional Yarn Filter

- Process only one sample at a time
- Elution is a time and labor intensive process
- Reuse of filter housing may cause cross-contamination

Proposed Envirochek Capsule

- Process requires less time and labor
- Disposable design eliminates cross-contamination
- Good Capture: 1 µm pore size membrane
- Higher efficiency in capture of *Cryptosporidium* and *Giardia*

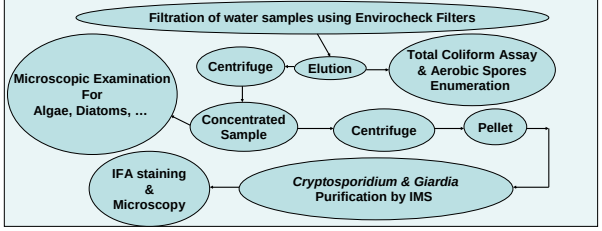
Materials & Methods

- ✓ Die-Off Study
- ✓ Capture and Recovery Efficiency
- ✓ Environmental Field Sampling
  - Monthly Sampling from May 2007-June 2008
  - Two River Bank Filtration Site Selected for Monthly Sampling
  - Samples Collected Using Both Current and Revised Methods

Die-off study for selection of the best elution buffer

- 40 ml of Tween 20, Glycine and Laureth 12 elution buffers was spiked with *E.coli*
- Samples were collected immediately and after 2 hrs of incubation
- The samples were processed for *E.coli* using m-Endo agar and the die-off rate was calculated

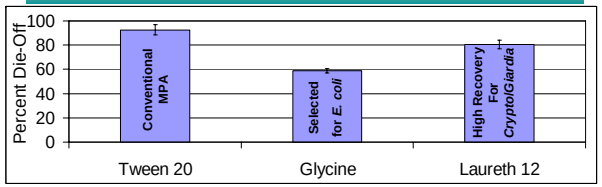
Sample Processing Strategy for Revised MPA Analysis



MPA Risk Score, Risk Score > 20 ⟶ high risk

Indicators of Surface Water	Extremely Heavy	Heavy	Moderate	Rare	Not Significant
Giardia	>30	16-30	6-15	1-5	<1
Risk Factor	40	30	25	20	0
Coccidia	>30	16-30	6-15	1-5	<1
Risk Factor	35	30	25	20	0
Diatoms	>150	41-149	11-40	1-10	<1
Risk Factor	16	13	11	6	0
Other Algae	>300	96-299	21-95	1-20	<1
Risk Factor	14	12	9	4	0
Insects/Larvae	>100	31-99	16-30	1-15	<1
Risk Factor	9	7	5	3	0
Rotifers	>150	61-149	21-60	1-20	<1
Risk Factor	4	3	2	1	0
Plant Debris	>200	71-200	26-70	1-25	<1
Risk Factor	3	2	1	0	0

Results



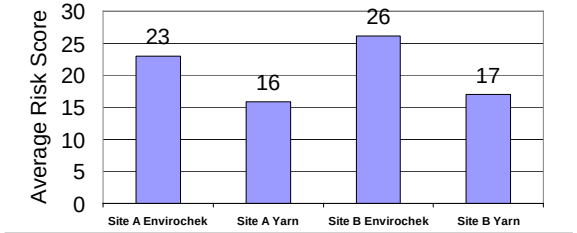
Percent die-off of *E. coli* in different eluent solutions after two hours of incubation

Capture and recovery efficiency of conventional and revised MPA protocols

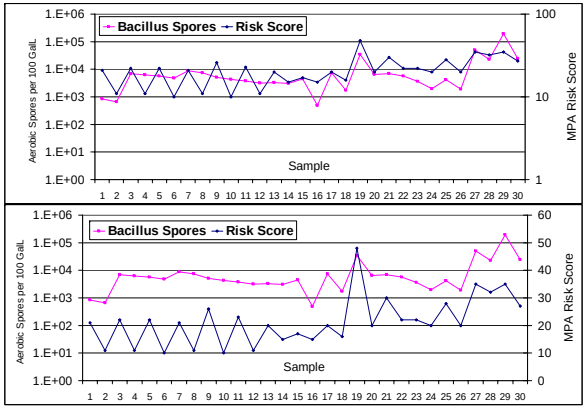
	Protocol	*E. coli*	PRD1	MS2	Algae/ Diatoms	*Cryptosporidium*	*Giardia*
Retention Efficiency (%)	Revised MPA	70.58	3.65	2.85	ND	-	-
	Conventional MPA	53.33	0.62	0.53	ND	-	-
Recovery Efficiency (Over all %)	Revised MPA	62.94	2.5	1.88	48	83	56
	Conventional MPA	42.22	0.33	0.27	25	-	-

Environmental Field Sampling Results

- Nineteen and 20 samples collected and processed according to the current MPA and the new MPA, respectively.
- *Cryptosporidium* oocysts were detected in two of the samples using the new method, however no *Giardia* cysts were detected . To this point, no *Cryptosporidium oocysts* or *Giardia cysts* were detected using the current MPA method.
- Overall, the new protocol has demonstrated a better recovery for most of the indicators including Diatoms, Algae, Rotifers and *Bacillus* spores.



***Environmental Field Samples* – Resulted Risk Score**



Good correlation between *Bacillus* Spore & MPA Risk Score

Significance

- **Recovery efficiency experiments proved better retention and recovery of the indicators using our new method.**
- **Analyses of field samples confirmed that the new protocol has a better recovery for most of the indicators including Diatoms, Algae, Rotifers and *Bacillus* spores.**
- **Die-off study demonstrated that *E. coli* is more stable in the Laureth 12 and Glycine buffer than Tween 20 buffer, which is used in conventional MPA.**
- ***Bacillus* Spores data from environmental sampling demonstrated a good correlation with MPA Risk Score.**
- ***Bacillus* spores seems to be a good predictor of risk score of GWUDI and should be considered as an easy primary tool in the MPA Risk Score Table under MPA protocol.**

Acknowledgements

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