Puraflo Peat Fiber Biofilter with Pad Dispersal -Chesapeake Bay Panel -April 27, 2016

Who we are…

- **Anua**→solutions provider
  - **Clean Water**
    - On-site
    - Decentralized
      - Community
      - Commercial
    - Water reuse
      - Capture, treat & use
  - **Clean Air**
    - Odor control

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What is Peat?

- Partially decomposed **organic matter**
  - Mainly of plant origin
  - Remains of roots, stems, leaves, flowers, fruits & seeds
- Accumulates over time
  - Anaerobic conditions
  - Decomposition is very slow

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What is Peat?

Puraflo System Components Overview

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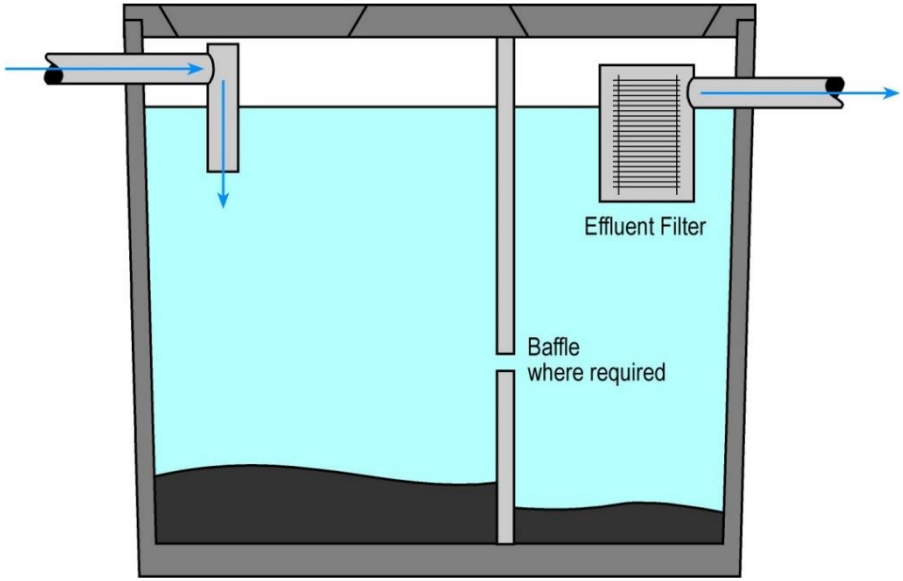
Septic Tank & Effluent Filter Overview

- Tank size & type complies with code
  - Watertight
- Commercial effluent filter, 1/32” filtration



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Pump Tank Overview

- Tank size & type complies with code
  - Watertight
- Effluent pump
  - Timed dosing **12X** per day
  - Dosing **rate**
    - 7 to 12 gpm per module
  - Dose **volume**
    - 5 to 15 gal/dose per module
  - No override

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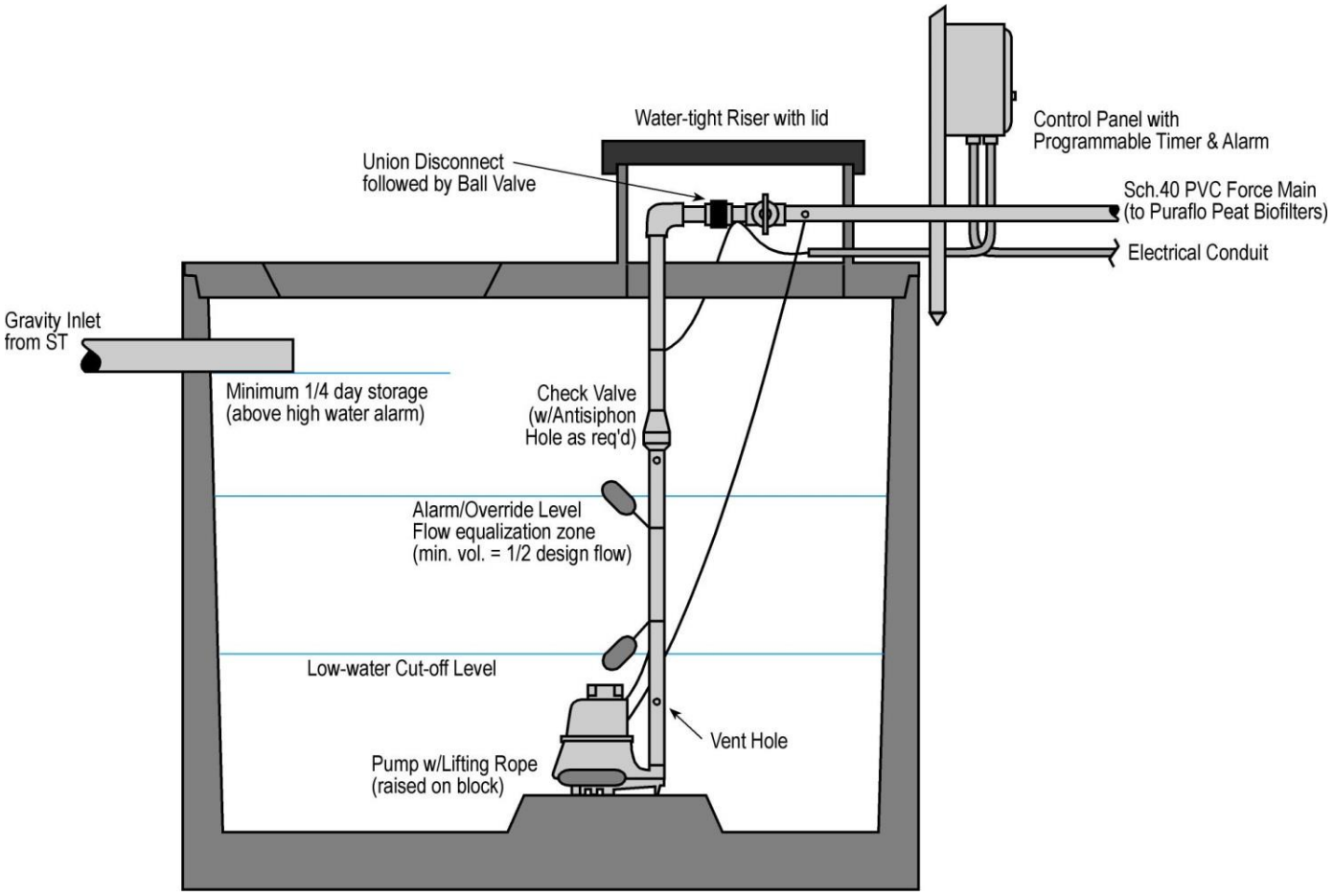
Pump Tank Overview



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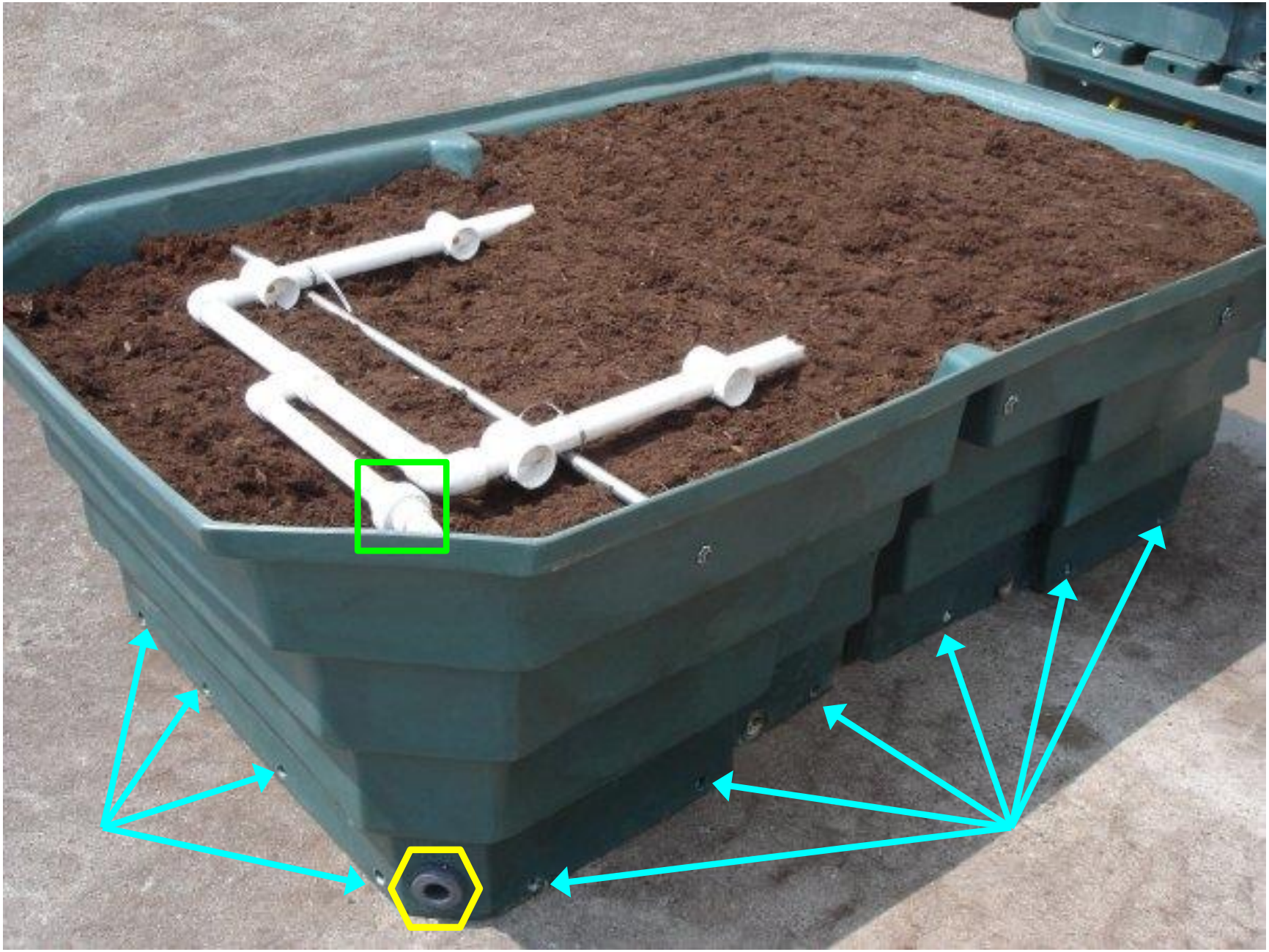

Peat Fiber Overview

- Peat fiber difference
  - It's a natural media…
    - Lignin content…50%+
    - High Cation Exchange Capacity (CEC)…125 meq/g
    - Retention time…36 – 48 hours
    - Water holding capacity…50 – 55%
    - Void space…90 – 95%
    - Surface area…52,000 ft^2/ft^3
    - Longevity…~15 years

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Puraflo Treatment Overview

- Max design organic loading per module
  - = 0.3755 lbs/day
- Max design hydraulic loading per module
  - = 150 gpd residential
  - = 120 gpd commercial
  - = 240-300 gpd recirc denite or polishing filter modes

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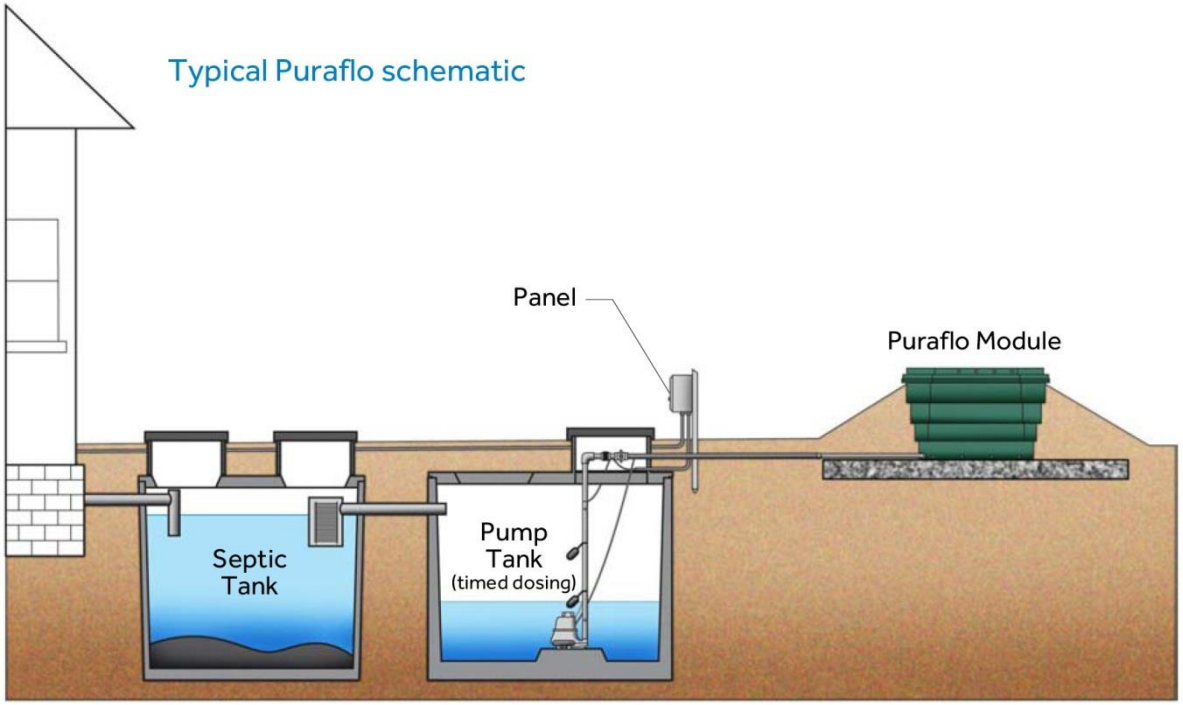
Puraflo Treatment Overview

- Single Pass Mode



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Puraflo Treatment Overview

- Peat fiber treatment mechanisms→Passive process
  - ***Physical*** - filtration & absorption
  - ***Chemical*** - adsorption & ion exchange
  - ***Biological*** - microbial assimilation

- Bulk of treatment→achieved by complex & diverse microfauna
- Higher life forms

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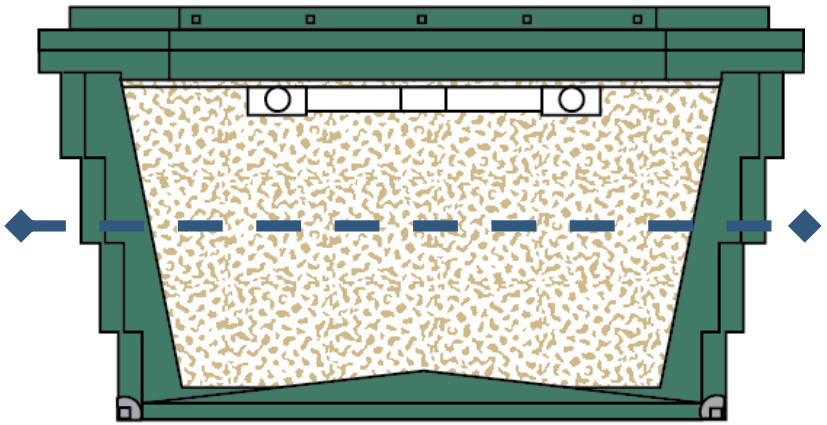
Puraflo Treatment Overview

- **Aerobic** treatment zone
  - Upper portion→BOD & solids treatment
  - Lower portion filter
    - Nitrification→nitrifiers more prevalent at depths of ≥12”
    - Denitrification can occur in microsites or SND



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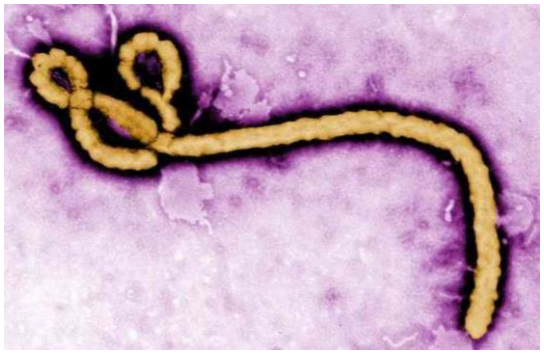
Puraflo Treatment Overview

- Peat fiber anti-microbial properties
  - Microbial antagonism
    - 36 - 48 hour retention time ensures max kill
  - Aggressive nature of peaty media
    - Low pH effects enterobacteria cell walls
    - Significant fungal species populations
      - Produce antibiotics
  - Results…
    - 99.9% removal of coliforms
    - 100% removal of viruses



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Peat vs. Sand Treatment

- NERCC (Duluth, MN) virus inactivation study
  - In-ground peat filter vs. in-ground sand filter
  - Filters spiked with MS2 virus
    - Removal by **peat**
      - 99.99999% summer, 99.99998% winter
      - Time to **90% inactivation**
        - **<1 day**
    - Removal by **sand**
      - 99.8% summer, 98.7% winter
      - Time to **90% inactivation**
        - **23 days** summer, **38 days** winter

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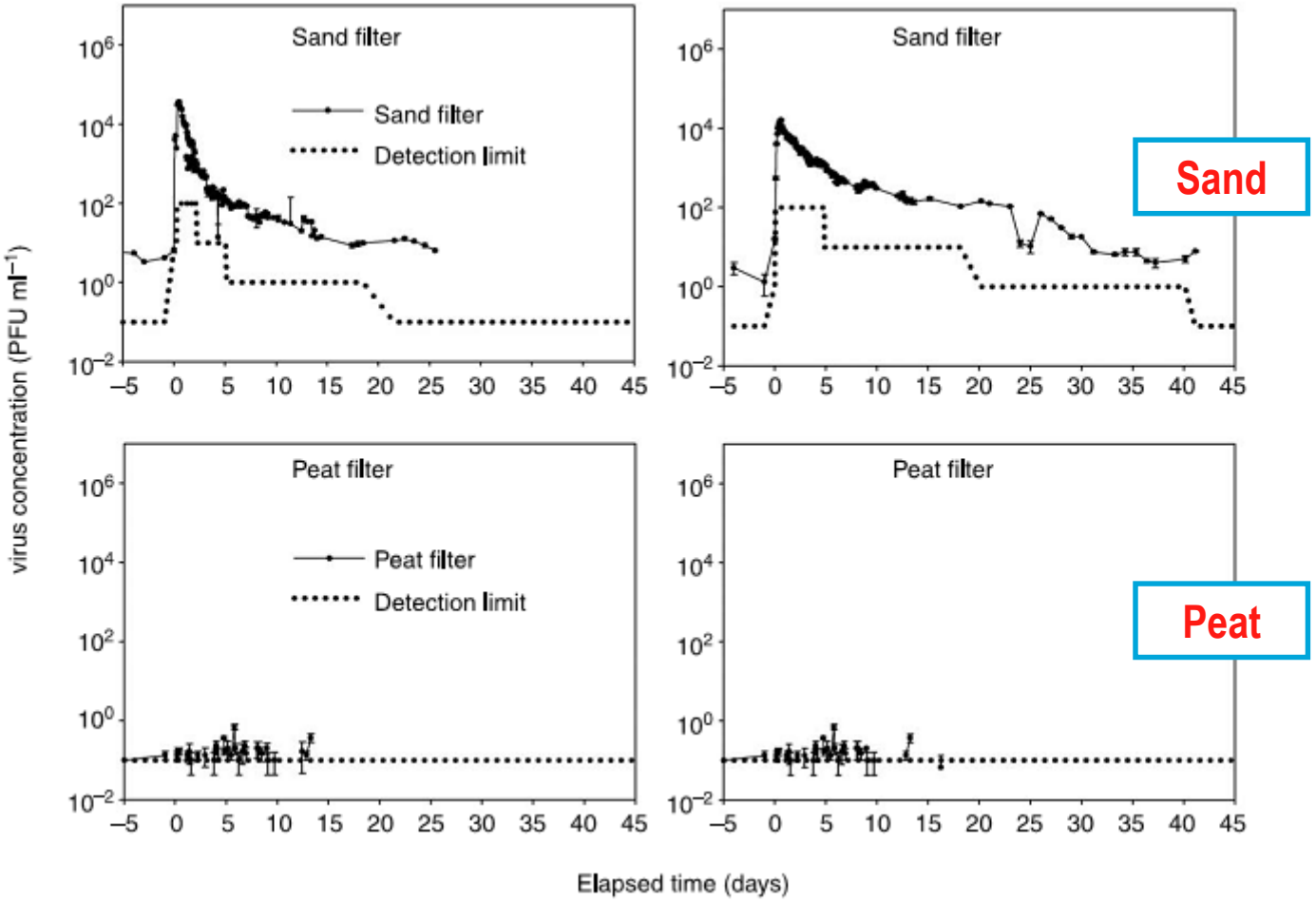
Peat vs. Sand Treatment

- NERCC (Duluth, MN) virus inactivation study



Puraflo Treatment Overview

Puraflo Peat Fiber Biofilter

Fecal Coliform Reduction Summary for 3rd Party Field Tested Systems

Study	System Location	Year(s)	Mode[1]	No. Systems	Sample Location[2]	Fecal Coliform Geo Mean (per 100 ml)
Anne Arundel County National Onsite Demonstration Project	Maryland	1995-97	SP	1	SC	**23.6**
Anne Arundel County National Onsite Demonstration Project	Maryland	1995-97	MP	1	SC	**47.7**
Old Dominion University	Virginia	1997-99	SP	23	SC	**263**
Old Dominion University	Virginia	1997-99	SP	23	PW: 12in below	**154**
Old Dominion University	Virginia	1997-99	MP	1	SC	**41**
Bernalillo County Environmental Health Dept New Mexico Environment Department	New Mexico	1997-98	SP	1	SC	**<200[3]**
North Carolina State University	North Carolina	1997-99	SP	1	SC	**290**
North Carolina State University	North Carolina	1997-99	SP	1	PW	**<200**
Natural Resources Research Institute University of Minnesota-Duluth	Minnesota	1998-2003	SP	1	SC	**Summer: 28** **Winter: 531** **All data: 113**
Clermont County General Health District Ohio EPA 319 Project #98(h) E-1	Ohio	1998-2000	SP	2	SC	**100% met discharge standards** **<2,000 daily** **<1,000 monthly avg**
La Pine National Demonstration Project	Oregon	2001-04	MP	3	SC	**267**

[1] *SP=Single Pass; MP=Multiple Pass (Recirc)*

[2] *SC=Post Puraflo Sample Chamber; PW=Pad Well (Drainfield)*

[3] *Study did additional fecal coliform sampling beyond initial study*

Why is Treatment Reliability Important?

Soil and drainfield “circuit breaker”

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Puraflo Dispersal Options

- Modules COMBINED with dispersal
  - Gravel pad/bed – **Type A** modules (open bottom or bottomless)

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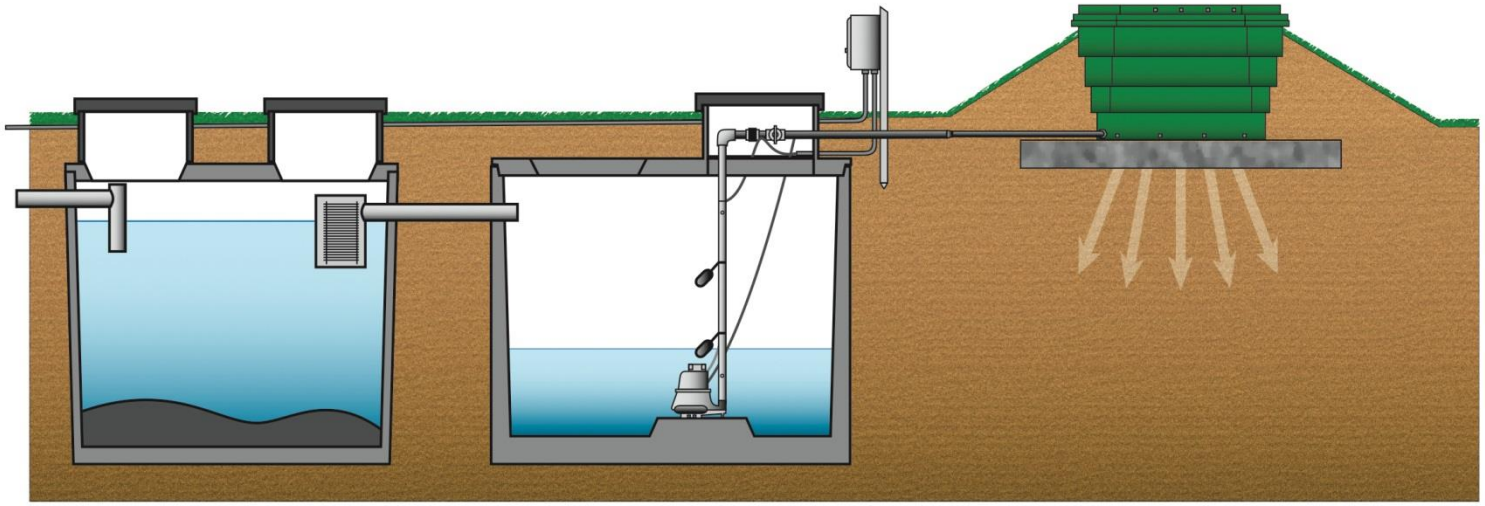
Puraflo with In-Ground Pad



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Puraflo with In-Ground Pad Installation in Minnesota

Puraflo with In-Ground Pad Extreme Site in New York

Puraflo with In-Ground Pad Extreme Site in Alabama

Puraflo with In-Ground Pad Coastal Site in North Carolina

Puraflo In-Ground Pad Extreme Site in Ontario

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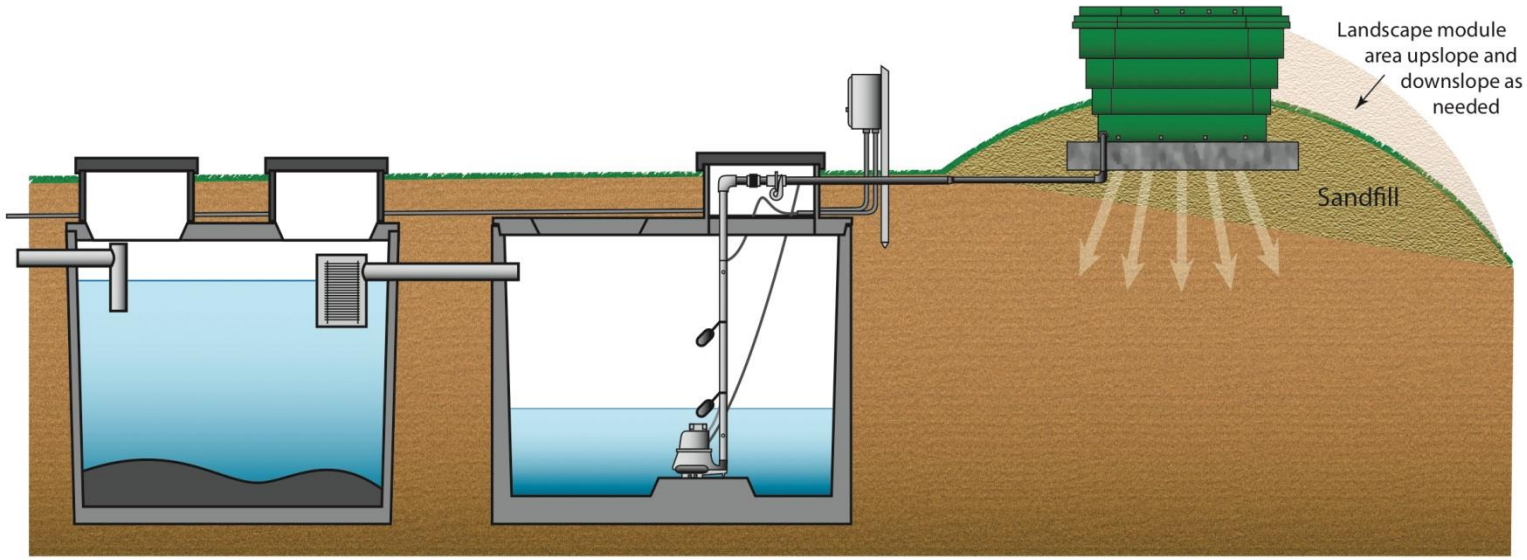
Puraflo with Mounded Pad



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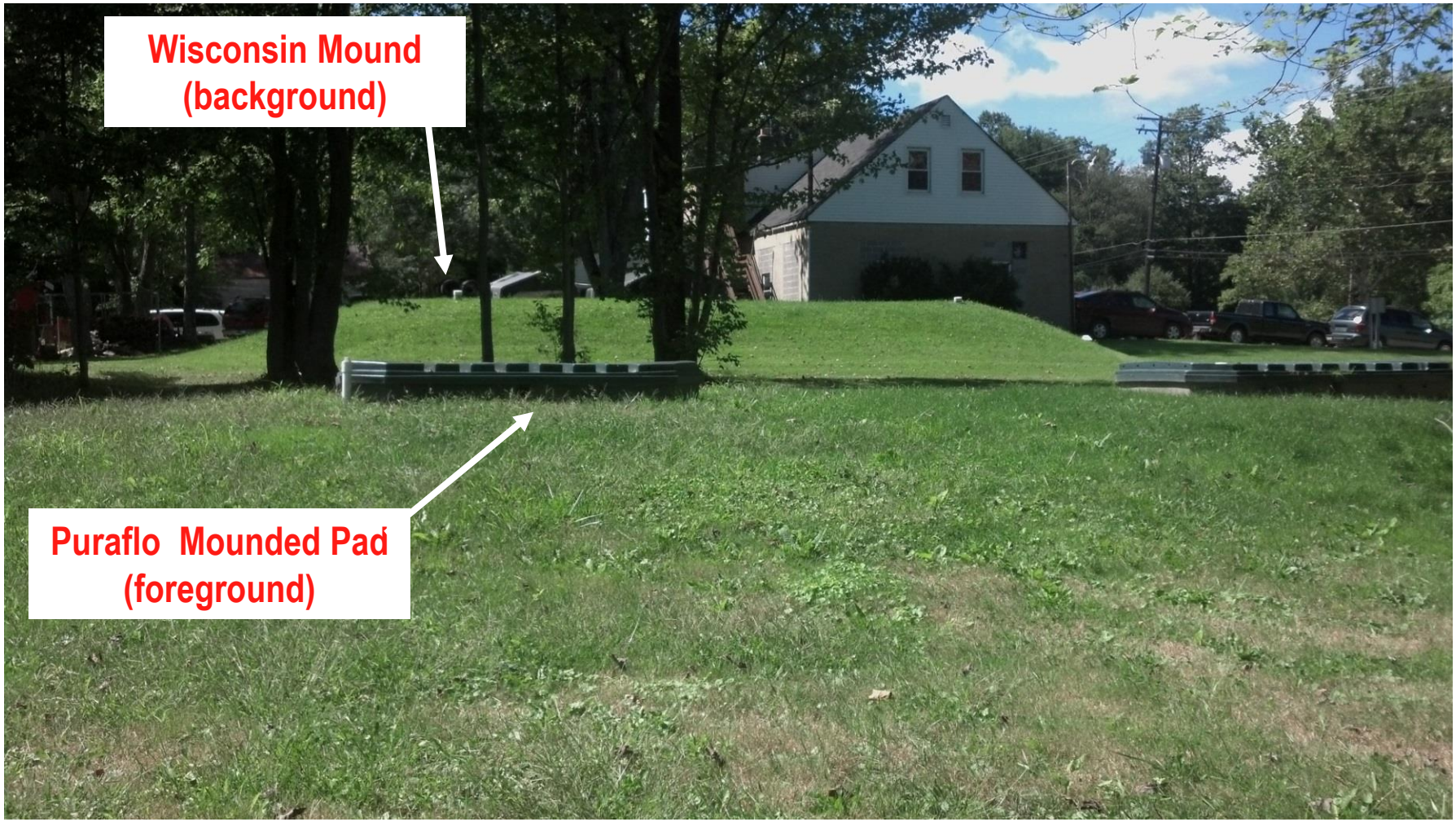
Puraflo with Mounded Pad
Difficult Site in New Jersey

Mound vs. Mounded Pad
Ohio Sites Comparison



Commercial Overview

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Puraflo In-Ground Pad
Los Angeles County Fire Station

Puraflo In-Ground Pad
Mobile Home Park in New Jersey

- Tall Timbers
  - Summer use only
  - Vacationers from New Jersey, New York, & Pennsylvania

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Puraflo In-Ground Pad
Mobile Home Park in New Jersey

Puraflo In-Ground Pad
Mobile Home Park in New Jersey

Puraflo Mounded Pad Commercial Site in Ontario

Puraflo Mounded Pad Commercial Site in Manitoba

- Quesnel/Caribou Lodge (seasonal)
- Northern Manitoba

Puraflo Mounded Pad
Commercial Site in Manitoba

Chesapeake Bay BMP

- NSF 245 gravity treatment box + gravity trench

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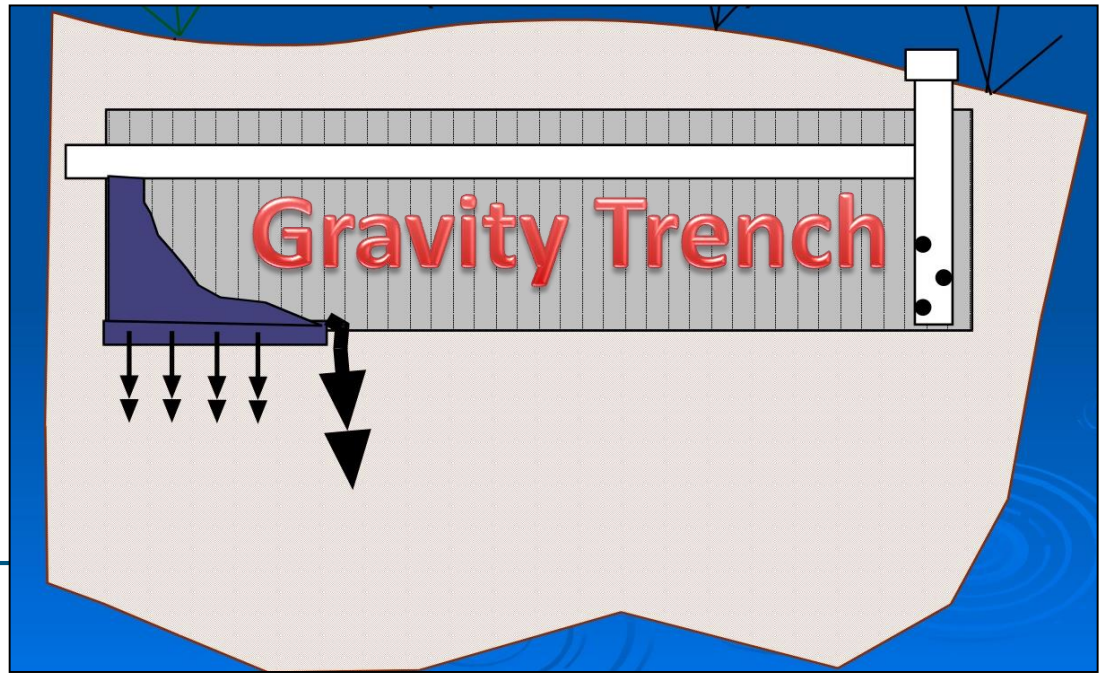
BMP system specified the most



Chesapeake Bay BMP

- Puraflo system
  - Septic tank
    - Recognized treatment for decades
    - Flattens peaks of hydraulic & organic load (buffering)
  - Timed dose pumping
    - Process control
    - Allows for correct balance of water, air, time, & food

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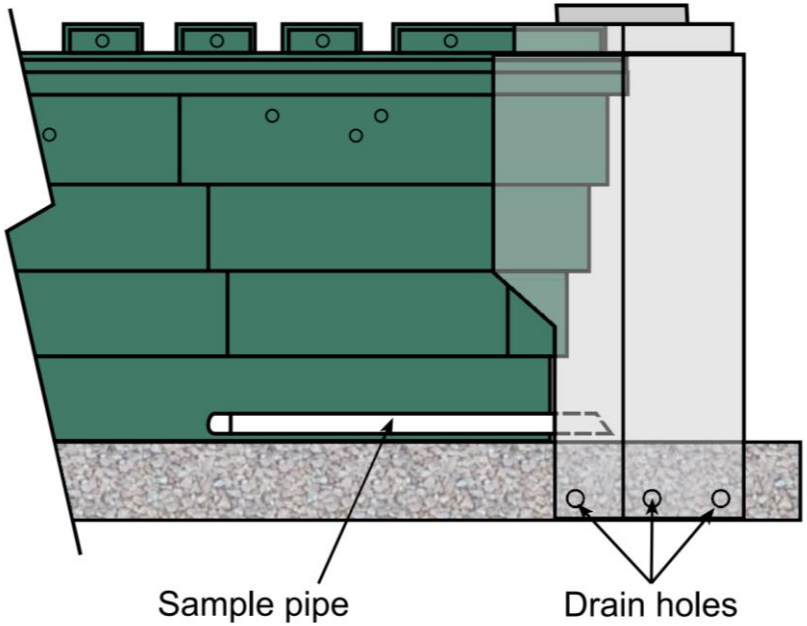
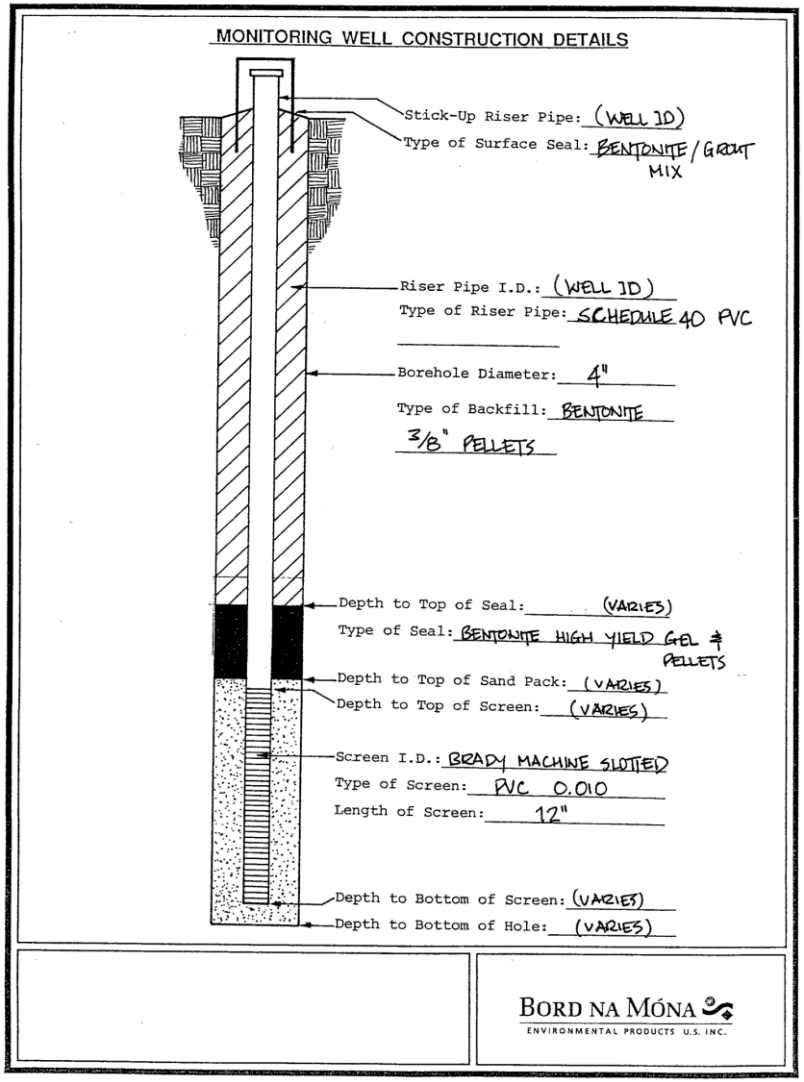
Chesapeake Bay BMP

- Puraflo system, cont'd
  - Puraflo peat fiber
    - Highest level nitrification
    - Denitrification
    - Provides double timed dosing mechanism→retention



Chesapeake Bay BMP

- Puraflo system, cont'd
  - Pad dispersal
    - Shallow placed stone pad, 6" tall
    - Peat retention provides effluent weeping into pad
    - Low volume & rate of water application allows natural processes to polish the effluent
  - Sample well



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Chesapeake Bay BMP

- Virginia
  - 24 sites monitored & sampled from July 1997 to July 1999
  - Sites were in all soil types
  - Presented by D. Alexander & A. Jantrania at ASAE in 2001
  - Abstract states:

    "*The data obtained from this study indicated a very high level of treatment by the filter and no major hydraulic problems with the effluent dispersal beds that were sized according to the company's sizing criteria.*"

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Chesapeake Bay BMP

Puraflo Peat Fiber Biofilter

Total Nitrogen Summary for 24 Systems Field Tested in Virginia
1997-1999 Single Pass Mode Data

	Samples	Monthly Avg (mg/l)	% Reduction From PT	% Reduction From SC	% Reduction From PW	Monthly Avg PW/DG-BG (mg/l)	% Reduction From PT	% Reduction From SC	% Reduction From PW
Background (BG)	n=72	1.84							
Pump Tank (PT)	n=108	58.12							
Puraflo Sample Chamber (SC)	n=146	34.83	**40.1%**						
Pad Well (PW)	n=83	14.65	74.8%	**58.0%**		12.80	78.0%	63.2%	
10-ft Down-gradient (DG)	n=85	6.04	89.6%	82.7%	58.8%	4.20	92.8%	88.0%	67.2%

BMP Calculations

	Baseline	Puraflo (SC)	Pad Well (PW)	Down-gradient (DG)
Nitrogen Loading, kg/yr	5.0	**3.0**	**1.3**	**0.5**
Net Reduction %, 4 kg/yr basis	20%	**25%**	**69%**	**87%**

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Chesapeake Bay BMP

Puraflo Peat Fiber Biofilter

Total Nitrogen Summary for 24 Systems Field Tested in Virginia
1997-1999 Single Pass Mode Data

	Samples	All Avg (mg/l)	% Reduction From PT	% Reduction From SC	% Reduction From PW	All Avg PW/DG-BG (mg/l)	% Reduction From PT	% Reduction From SC	% Reduction From PW
Background (BG)	n=72	1.69							
Pump Tank (PT)	n=108	49.54							
Puraflo Sample Chamber (SC)	n=146	34.16	**31.0%**						
Pad Well (PW)	n=83	12.52	74.7%	**63.4%**		10.82	78.2%	68.3%	
10-ft Down-gradient (DG)	n=85	4.91	90.1%	85.6%	60.7%	3.22	93.5%	90.6%	70.3%

BMP Calculations

	Baseline	Puraflo (SC)	Pad Well (PW)	Down-gradient (DG)
Nitrogen Loading, kg/yr	5.0	**3.4**	**1.3**	**0.5**
Net Reduction %, 4 kg/yr basis	20%	**14%**	**68%**	**88%**

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Chesapeake Bay BMP

- NCSU-CES (Gates County, NC) study
  - Presented at ASAE in 2001
  - 3rd Party data

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Chesapeake Bay BMP

Puraflo Peat Fiber Biofilter

Total Nitrogen Summary for 4 Systems Field Tested in Gates County, North Carolina*
1997-1999 Single Pass Mode Data

Type A Pad - 3 Sites	Avg (mg/l)	% Reduction From PT	% Reduction From SC	% Reduction From PW	Avg PW/DG-BG (mg/l)	% Reduction From PT	% Reduction From SC	% Reduction From PW
Background (BG)	1.70							
Pump Tank (PT)	29.20							
Puraflo Sample Chamber (SC)	23.10	**20.9%**						
Pad Well (PW)	7.00	76.0%	**69.7%**		5.30	81.8%	77.1%	
Down-gradient (DG)	3.70	87.3%	84.0%	47.1%	2.00	93.2%	91.3%	62.3%

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Chesapeake Bay BMP

PREMIER TECH AQUA

Virginia Field Monitoring Program

Soil type		Influent	Ecoflo eff				L1: 12" of soil underneath the Ecoflo				L2: After 12" of soil and 10' down slope from the toe of the Ecoflo				L3: 3' up slope from the edge of the Ecoflo			Flow Rate
		TKN	TKN	NNOx	TN	% TN red.	TKN	NNOx	TN	Total % TN red.	TKN	NNOx	TN	Total % TN red.	TKN	NNOx	TN	app. GPD
Type I	Arithmetic mean	48	12.8	20.5	33.4		3.1	6.8	10.0		4.4	3.5	7.9		1.8	4.5	6.3	159
	Median	35	7.7	19.6	27.3		1.5	2.1	3.6		1.5	1.2	2.7		0.8	3.6	4.4	138
	Percentille 80	63	14.0	31.7	45.6		2.6	12.2	14.8		3.6	3.6	7.2		2.1	7.8	9.9	195
	Standard deviation	44	18.0	17.6		31%	6.7	9.6		79%	10.7	5.8		84%	2.8	4.5		67
	MIN	0.80	0.18	0.10	0.28		0.10	0.10	0.20		0.10	0.01	0.11		0.10	0.10	0.20	62
	MAX	234	77	62	139		32	34	66		53	21	73		10	14	24	435
	n	27	24	25			24	24			24	24			12	12		69
Type II	Arithmetic mean	35	6.8	22.6	29.4		1.4	6.5	7.8		0.9	4.1	5.0		0.5	2.4	2.9	126
	Median	31	2.3	21.2	23.4		1.1	2.7	3.8		0.3	1.5	1.7		0.3	1.2	1.5	123
	Percentille 80	47	5.7	35.1	40.8		1.9	13.9	15.7		1.5	6.9	8.3		0.6	3.4	4.0	147
	Standard deviation	17	13.0	15.8		16%	1.6	7.9		78%	1.2	6.0		86%	0.6	3.1		40
	MIN	8.1	0.10	0.10	0.20		0.10	0.01	0.11		0.09	0.01	0.10		0.03	0.01	0.04	11
	MAX	68	58	56	114		7	23	30		4.4	22	26		2.2	12	14	295
	n	25	25	24			24	24			25	25			17	18		60
Type III	Arithmetic mean	69	9.9	20.7	30.6		5.6	2.0	7.6		2.7	0.9	3.6		1.0	1.7	2.7	186
	Median	63	5.4	17.0	22.4		0.8	1.0	1.8		0.5	0.5	1.0		0.4	0.9	1.3	111
	Percentille 80	81	18.9	37.2	56.1		11.3	3.7	15.0		1.0	1.8	2.8		1.0	1.9	2.9	238
	Standard deviation	53	11.8	17.5		56%	9.4	2.4		89%	9.9	1.1		95%	1.4	3.1		205
	MIN	19.0	0.20	0.10	0.30		0.10	0.10	0.20		0.10	0.01	0.11		0.09	0.10	0.19	31
	MAX	280	50	57	107		31	7	38		50	4.0	54		4.2	11	16	798
	n	25	25	25			24	24			25	24			13	13		65
Type IV	Arithmetic mean	66	7.0	33.2	40.2		0.4	4.2	4.6		0.4	0.9	1.3		0.4	0.4	0.8	106
	Median	69	6.2	34.8	41.0		0.3	2.4	2.7		0.4	0.9	1.2		0.4	0.4	0.8	79
	Percentille 80	84	11.0	37.5	48.5		0.7	6.7	7.4		0.4	1.5	1.9		0.5	0.5	1.0	161
	Standard deviation	17	6.8	7.9		39%	0.3	4.1		93%	0.3	0.7		98%	0.3	0.4		83
	MIN	30.1	0.20	23.00	23.20		0.20	0.30	0.50		0.20	0.10	0.30		0.20	0.10	0.30	2
	MAX	86	19	48	66		1	13	14		1.0	1.9	3		0.6	0.6	1	402
	n	10	9	9			9	9			8	8			2	2		35

Chesapeake Bay BMP

- Summary
  - Single pass peat biofilters provide 20 – 40%+ TN reduction
  - Shallow pad dispersal provides >50% TN reduction
  - Field testing verifies what's already recognized or assumed in BMP
  - BMP TN reduction goal is satisfied
  - Treatment process provides effluent by-pass protection & is fail-safe
  - History & longevity of peat biofilters is documented for almost three decades

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Questions?

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