Florida Onsite Sewage Nitrogen Reduction Strategies Study (FOSNRS)

PNRS II – Preliminary Results

by:
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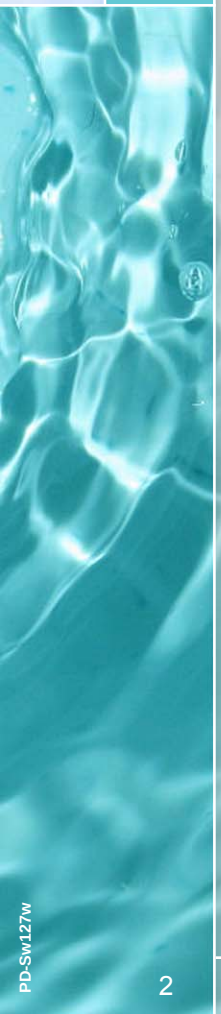
FOSNRS project initiated by Florida legislature

- Laws of Florida, 2008-152, directed FDOH to conduct a study to further develop more “passive” & cost-effective nitrogen reduction strategies for OSTDS
- Initiated the Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Project in 2009
- This presentation focuses on preliminary project results from passive biofilters with sulphur-based denitrification processes



Presentation today focuses on sulphur-based denitrification systems

Previous Studies of Sulphur-based Denitrification

Reference	Denitrification Media	Results
Kanter, Tyler and Converse (1998)	Sulphur/Dolomite Sulphur: <2.5 mm	TN Removal: 87.9% Nitrified Influent: 23.5 mg-N/L Effluent: 3.0 mg-N/L
Sengupta and Ergas (2006)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 4.7 mm	NO_3-N Removal: 80% Influent: 2-32 mg NO_3-N/L Effluent: 4.2 mg NO_3-N/L
Brighton (2007)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 2 - 5 mm	TN Removal: 81.7% Nitrified Influent: 23 mg-N/L Effluent: 4.2 mg-N/L
Smith et al. (2008)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 2 - 5 mm	TN Removal: 93.8% Nitrified Influent: 35.2 mg-N/L Effluent: 2.2 mg-N/L

PNRS I results were encouraging

- Showed feasibility of passive two stage biofiltration
- One pump, no aerators, reactive media
- Continuous 24/7 operation for 8 months
- Proof of passive 2-stage biofiltration concept provided

Treatment Media	Effluent TN (mg/L)	TN Reduction (%)
Zeolite & Sulphur Media	2.2	97
Expanded Clay & Sulphur	2.6	96.2

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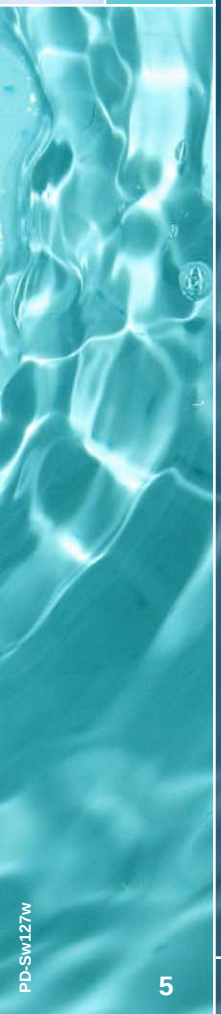
PNRS II



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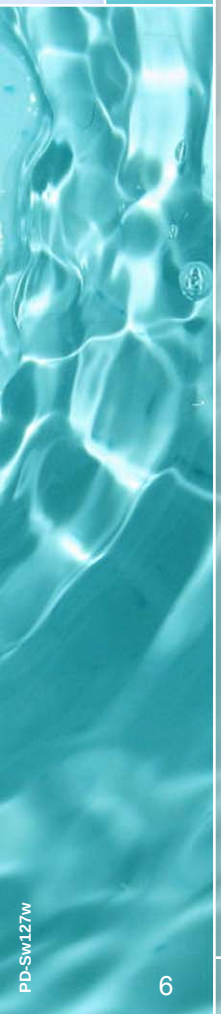
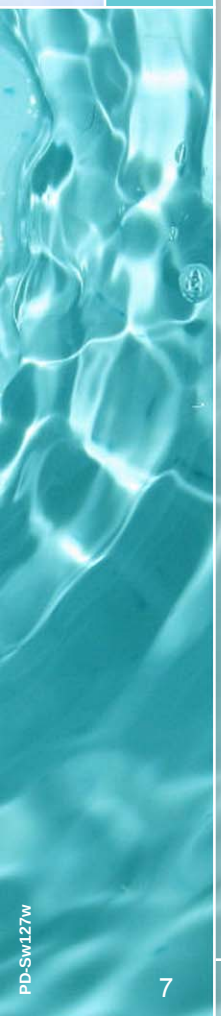
PNRS II was designed to further the concepts developed in PNRS I

- Follow up to PNRS I with larger, pilot scale units and various media combinations
- Developed detailed performance data for passive biofiltration designs
- Produce scalable design criteria from pilot scale biofilters for subsequent full-scale testing



PNRS II test facility was developed

- Established test facility at Gulf Coast Education and Research Center (University of Florida IFAS)
- Test program for in-vessel and in-situ pilot systems
- Operated on septic tank effluent for 12+ months
- Various nitrification and denitrification biofilters have been tested



Test facility includes numerous treatment trains

- All use two-stage biofilters:
  - Stage 1 Nitrification
  - Stage 2 Denitrification
- Stage 1 unsaturated filters included 2 media layers and evaluated 15” and 30” media depths
- We also evaluated single pass vs recirculating stage 1 biofilters
- For denitrification, we evaluated both lignocellulosic and sulphur denitrification biofilters
- We are also testing reactive media in a more in-situ/in-ground system approach

Various nitrification media are being studied

Examples of Stage 1 Media

Zeo-Pure clinoptilolite

Expanded polystyrene

Torpedo sand

Expanded clay

Various denitrification media are being studied

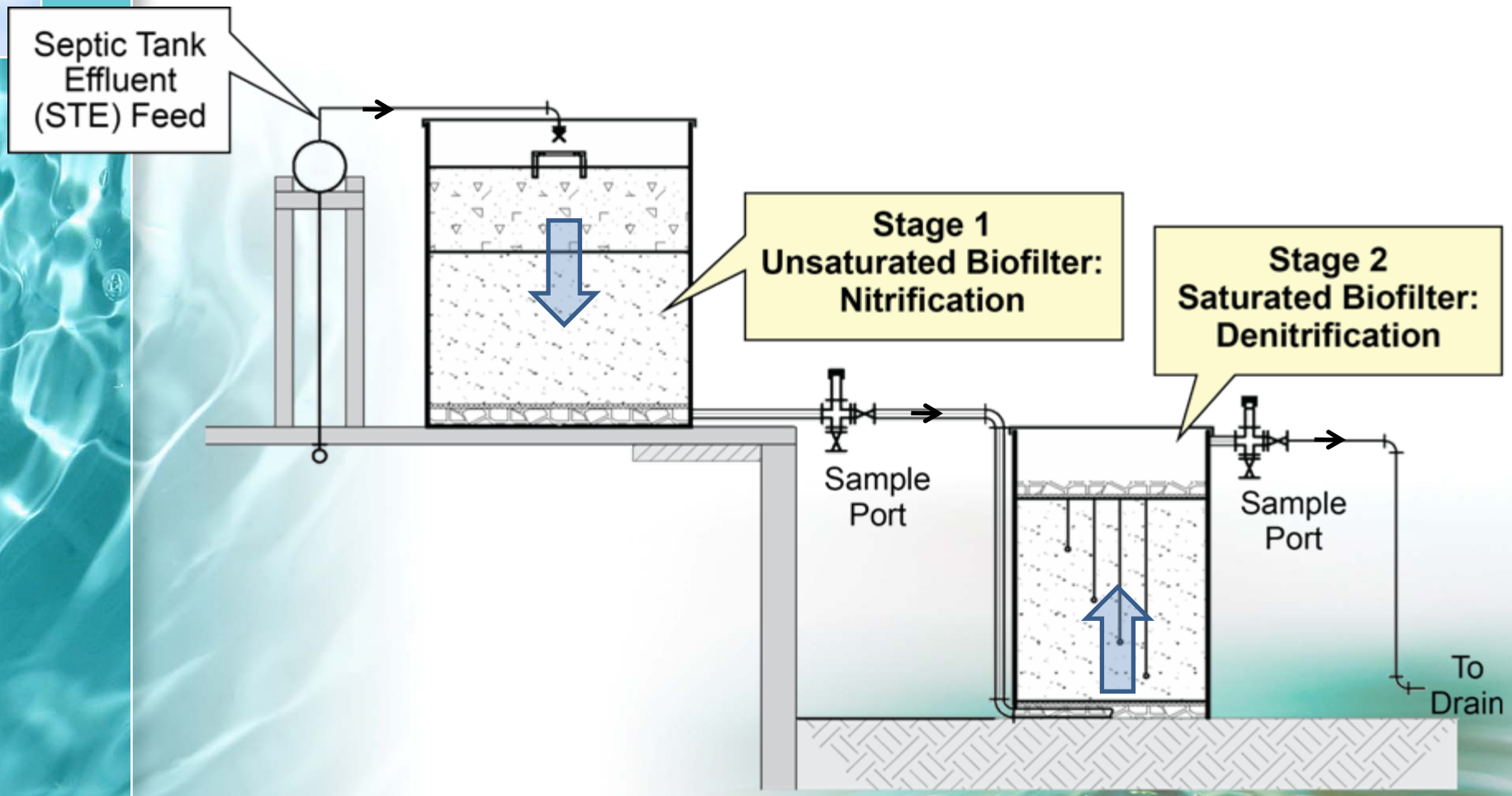
Examples of Stage 2 Media

Lignocellulosics

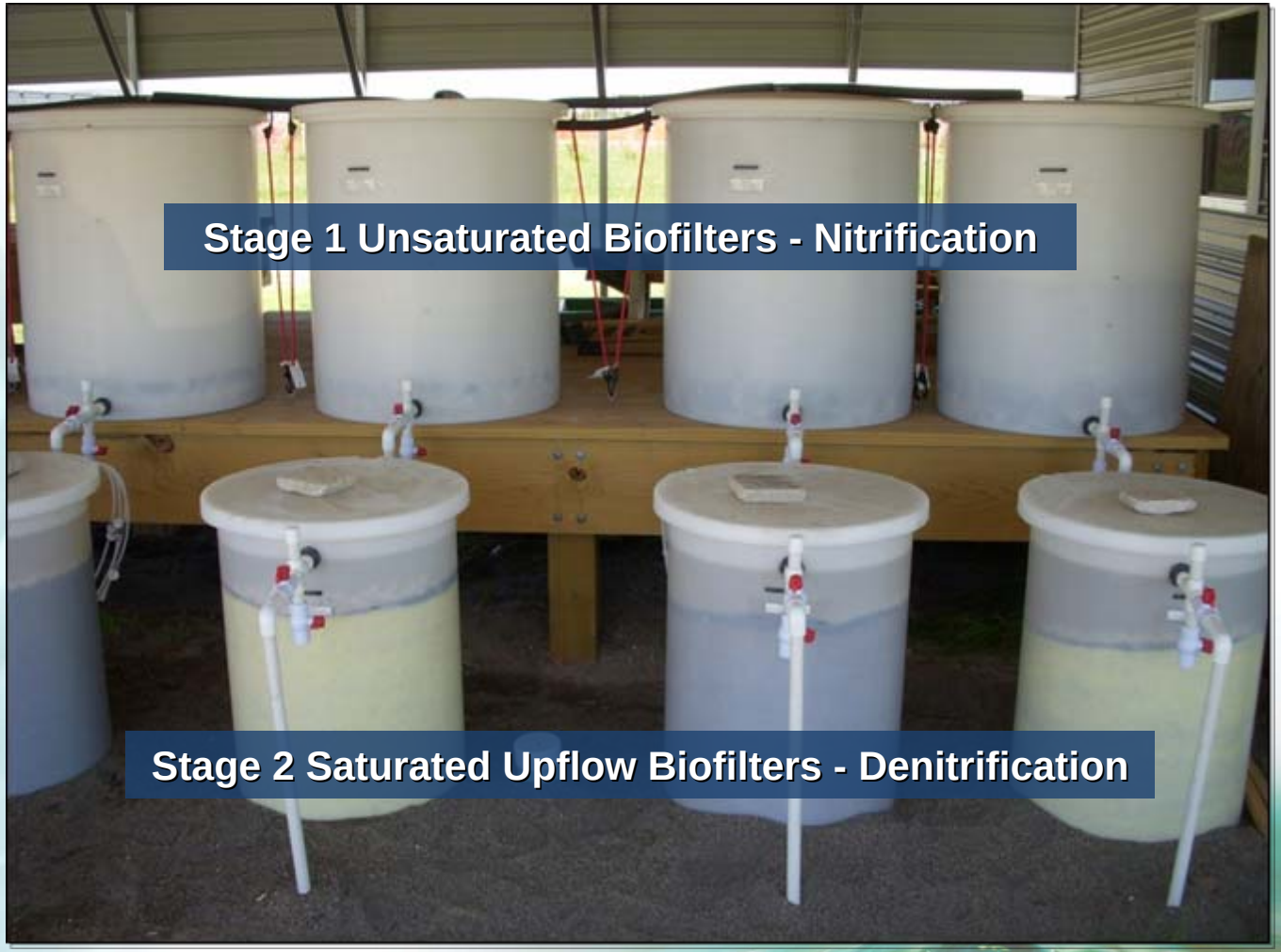
Elemental Sulphur

Expanded Clay

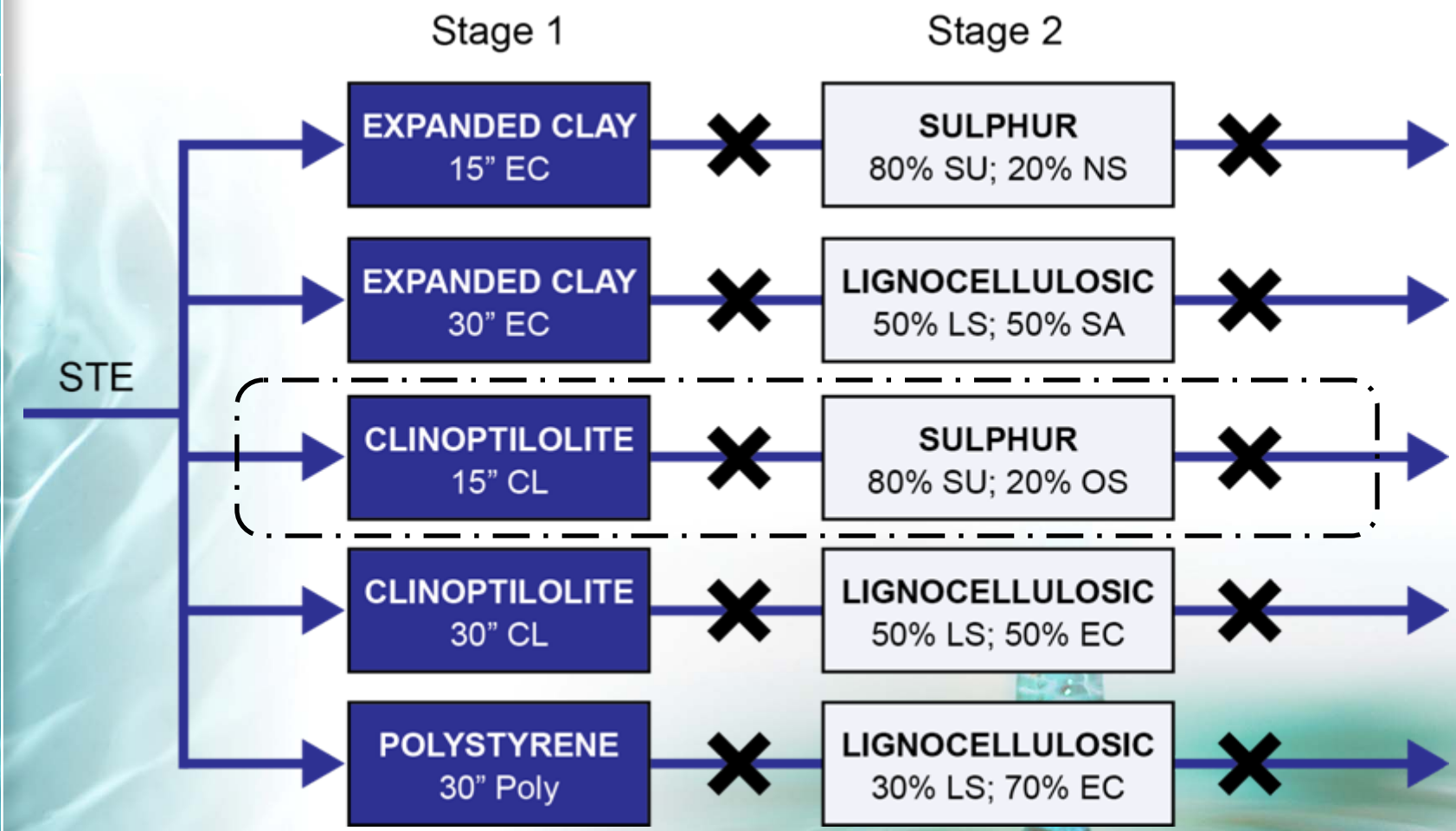
Two stage single pass biofilters



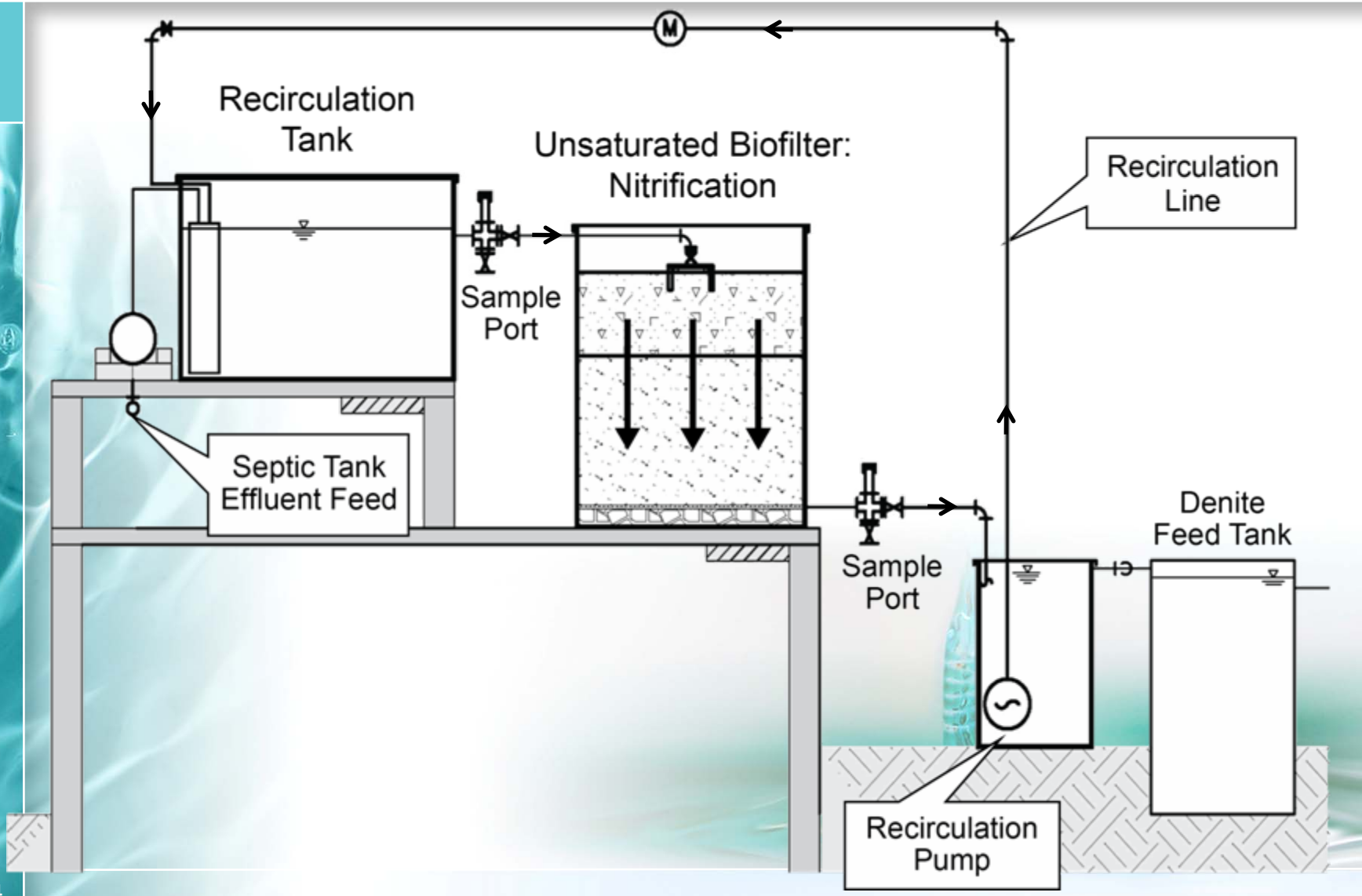
Two-stage single pass biofilters



Two-stage single pass treatment trains under evaluation



Stage 1 recirculating biofilters

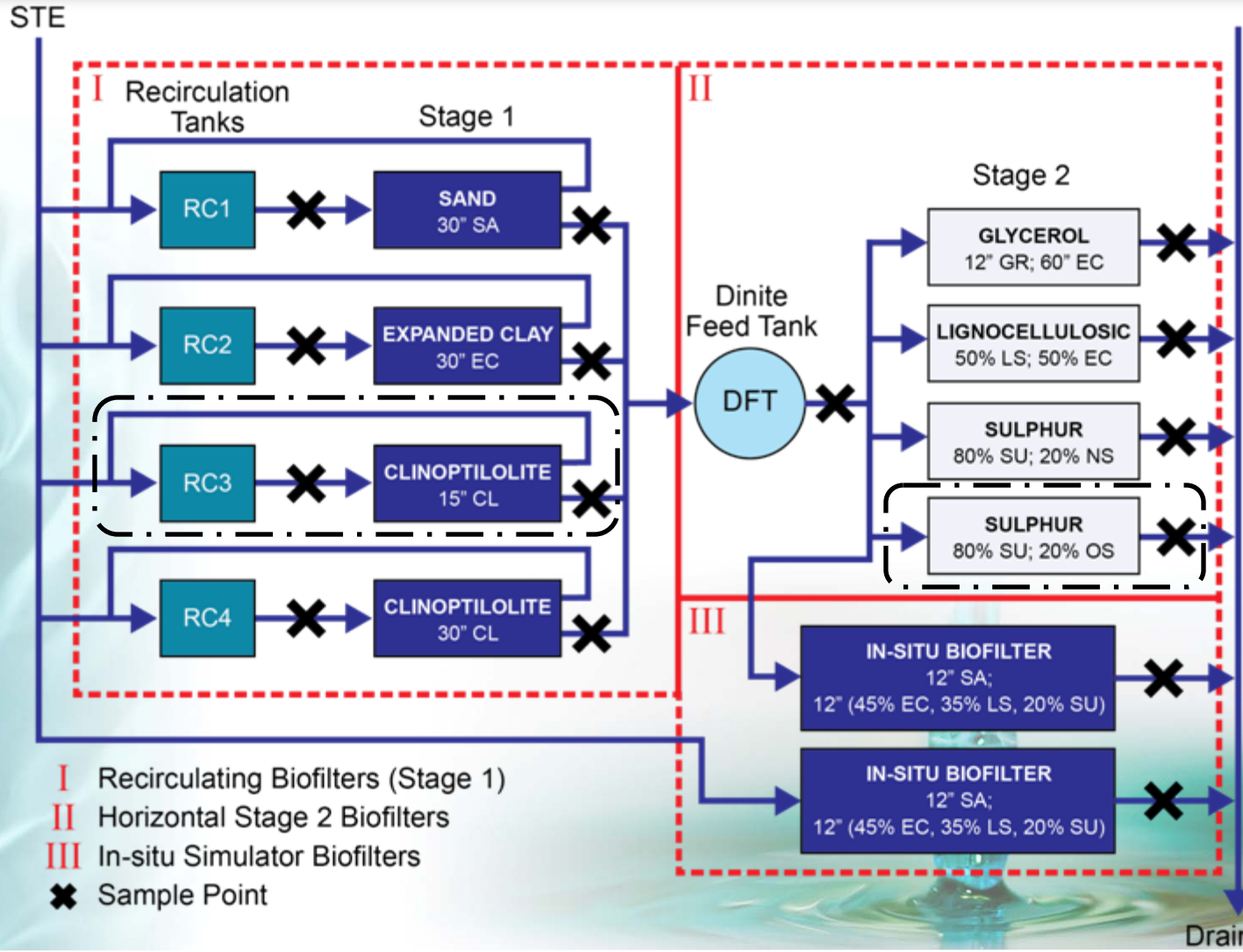


Stage 1 recirculating biofilters & Stage 2 horizontal saturated biofilters

Stage 1
Recirculating Biofilters

Stage 2
Saturated Biofilters

We are also evaluating recirculating biofilters and horizontal saturated biofilters



PNRS II Preliminary Results

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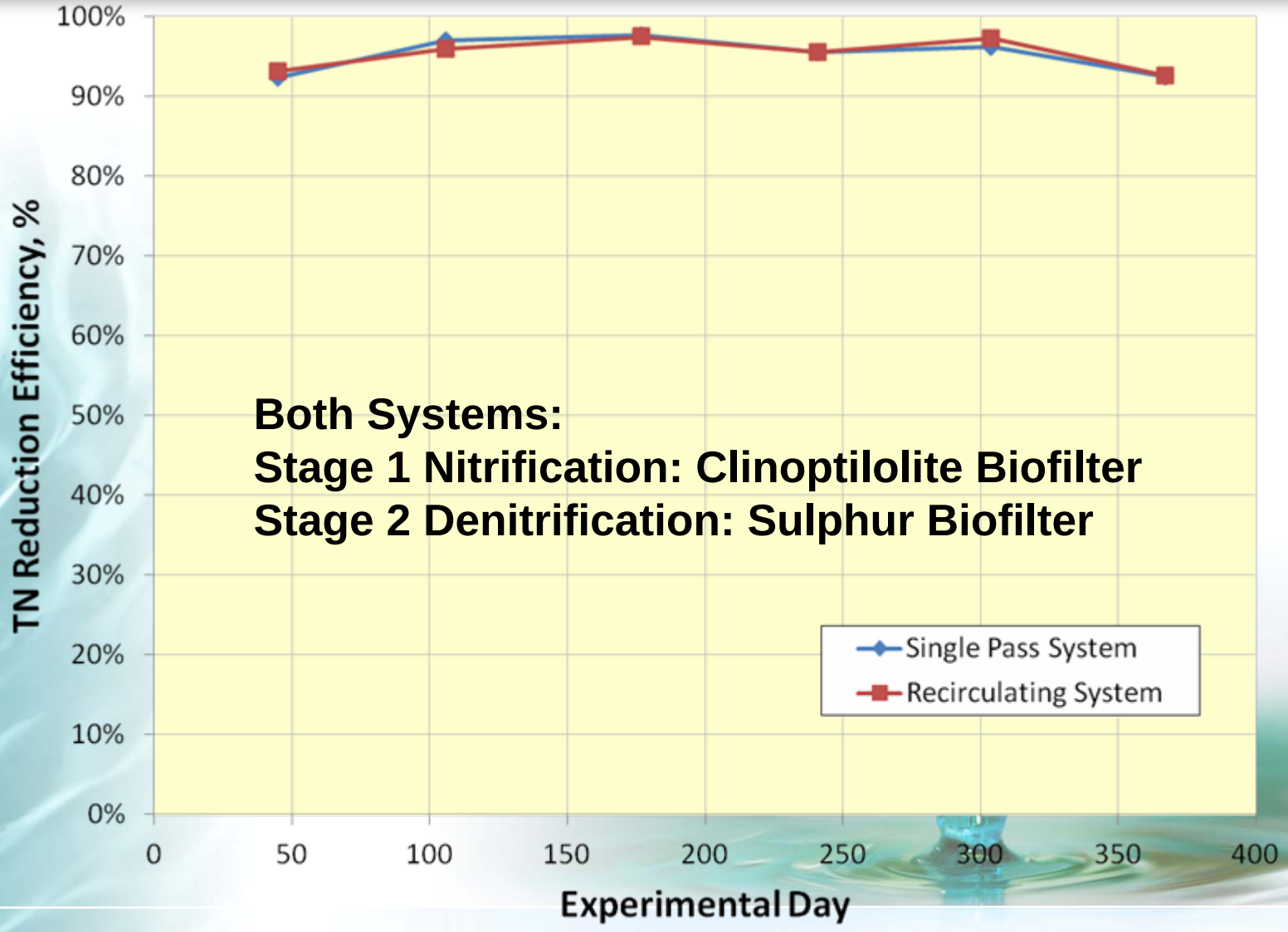
Preliminary results are encouraging



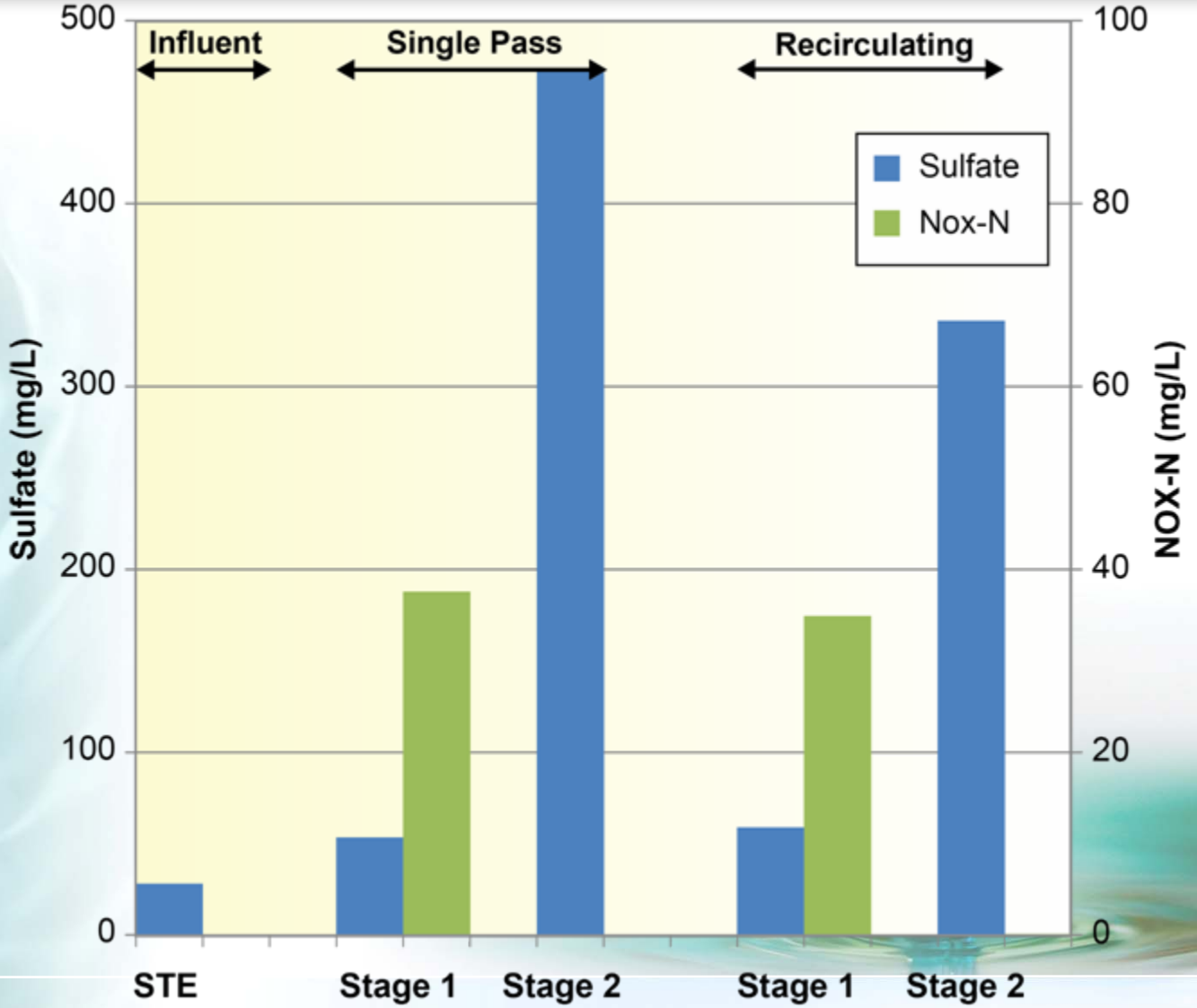
Both Systems:
Stage 1 Nitrification: Clinoptilolite Biofilter
Stage 2 Denitrification: Sulphur Biofilter

Detailed results show consistent treatment

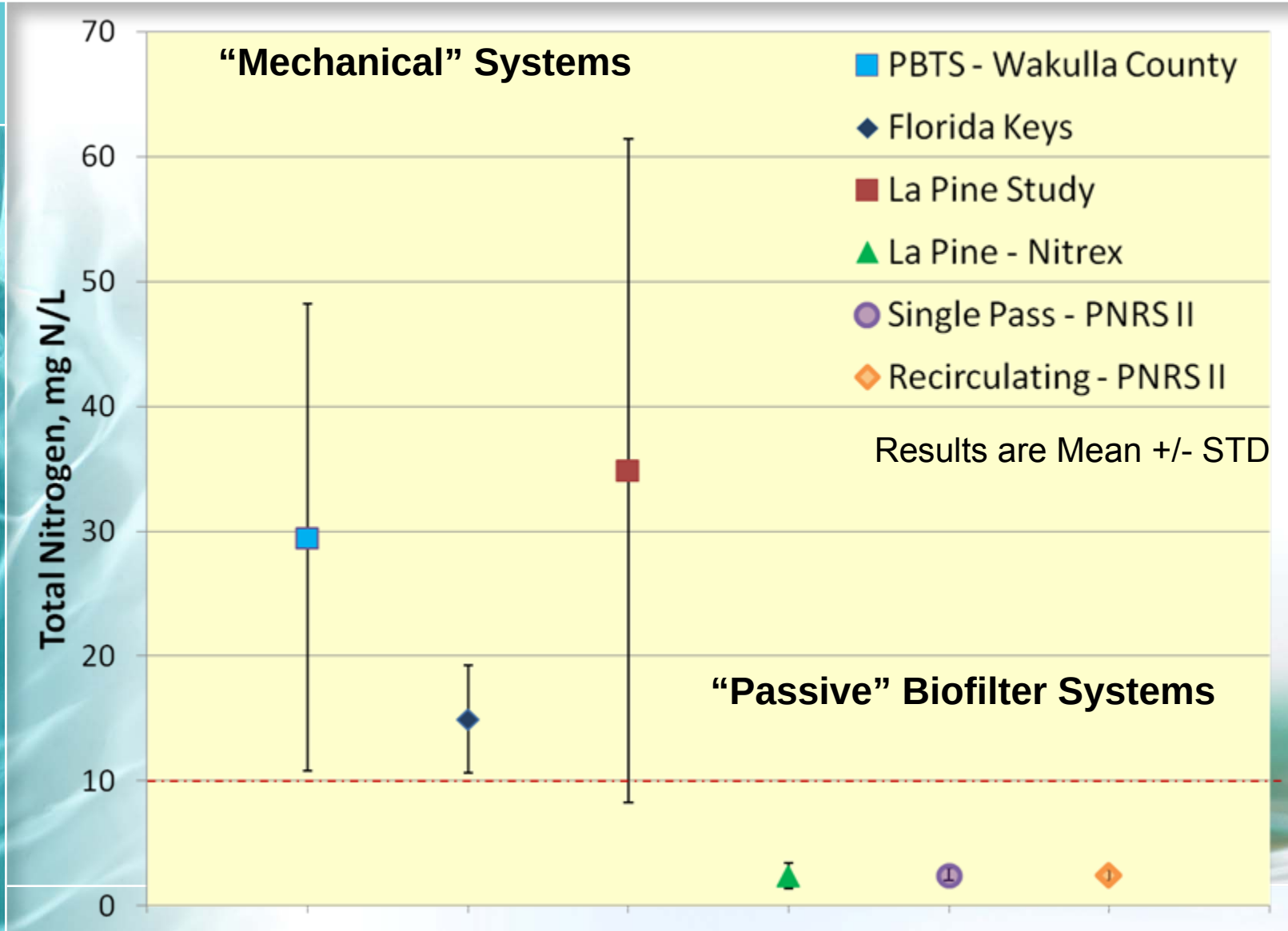
	Stage 1 Treatment Media	Stage 2 Treatment Media	Effluent TN[1] (mg N/L)		TN Reduction (%)
STE			MEAN	61.04	
			STD DEV	19.12	
			MIN	35.02	
			MAX	80.01	
Single Pass	Clinoptilolite	Sulphur	MEAN	2.60	95.2
			STD DEV	0.52	
			MIN	1.85	
			MAX	3.02	
Recirculation	Clinoptilolite	Sulphur	MEAN	2.54	95.3
			STD DEV	0.40	
			MIN	2.04	
			MAX	2.96	

[1]Continuous operation for 367 days

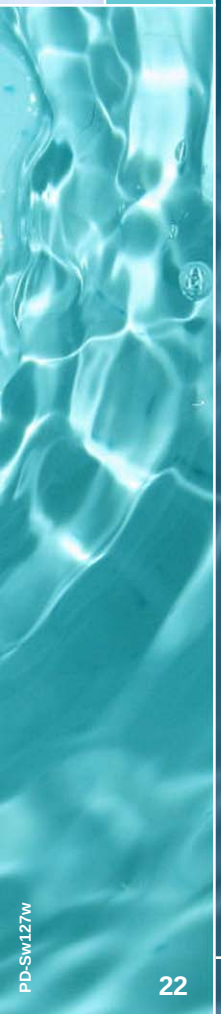
Single pass vs recirculating biofilters: sulfate



Comparison with other N-reduction studies



Next Steps



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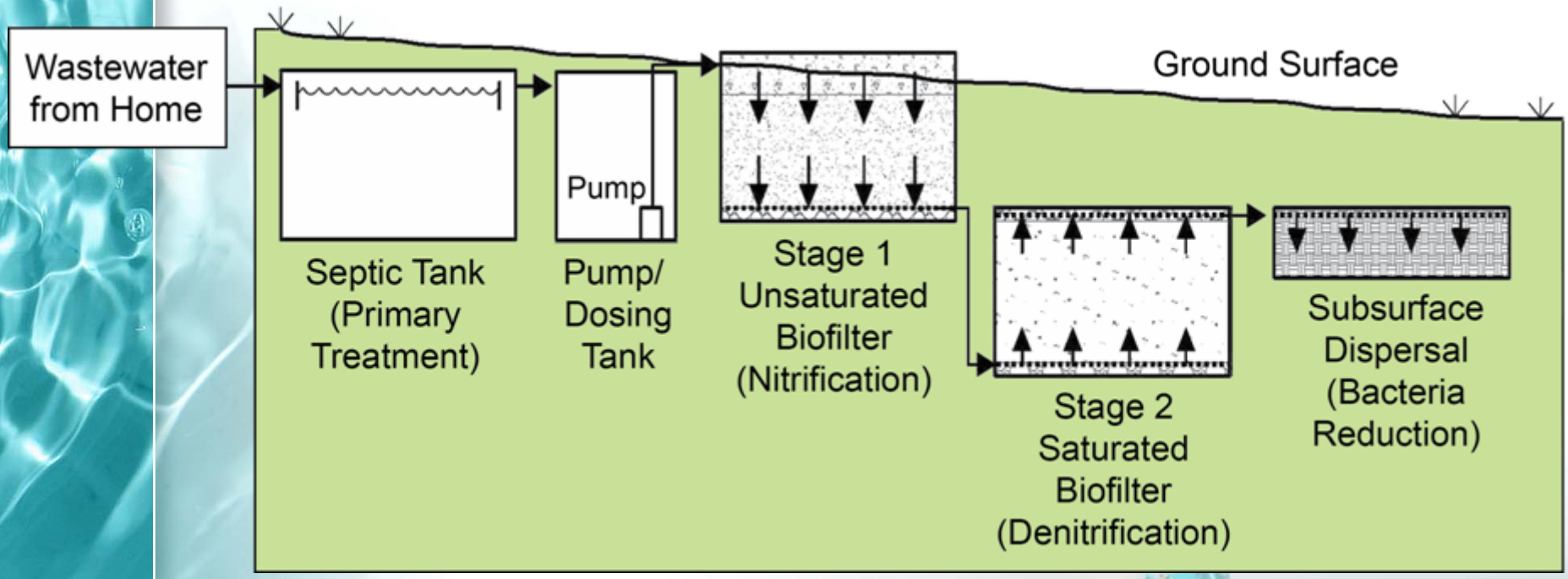
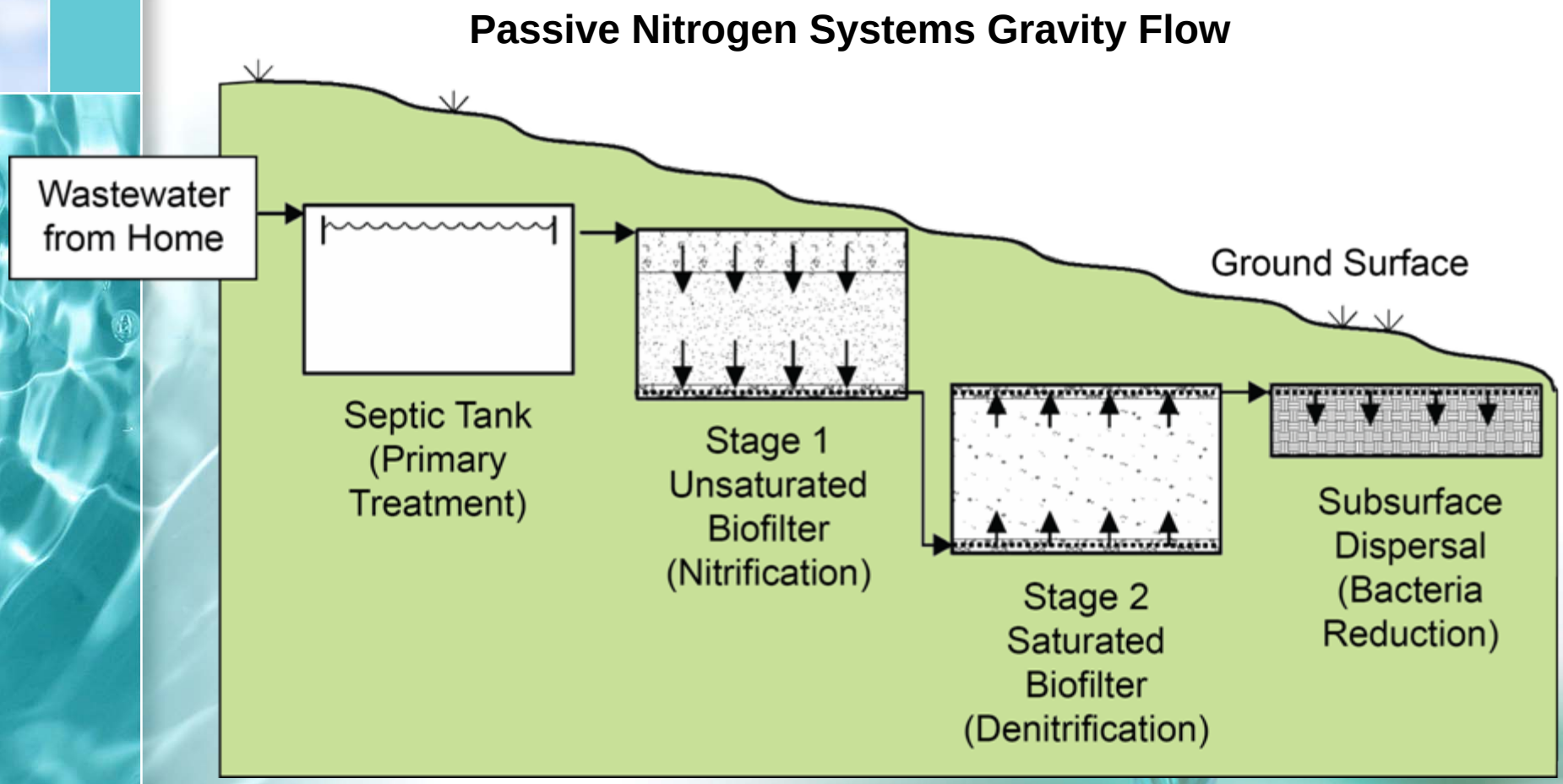
Install full-scale systems at actual home sites

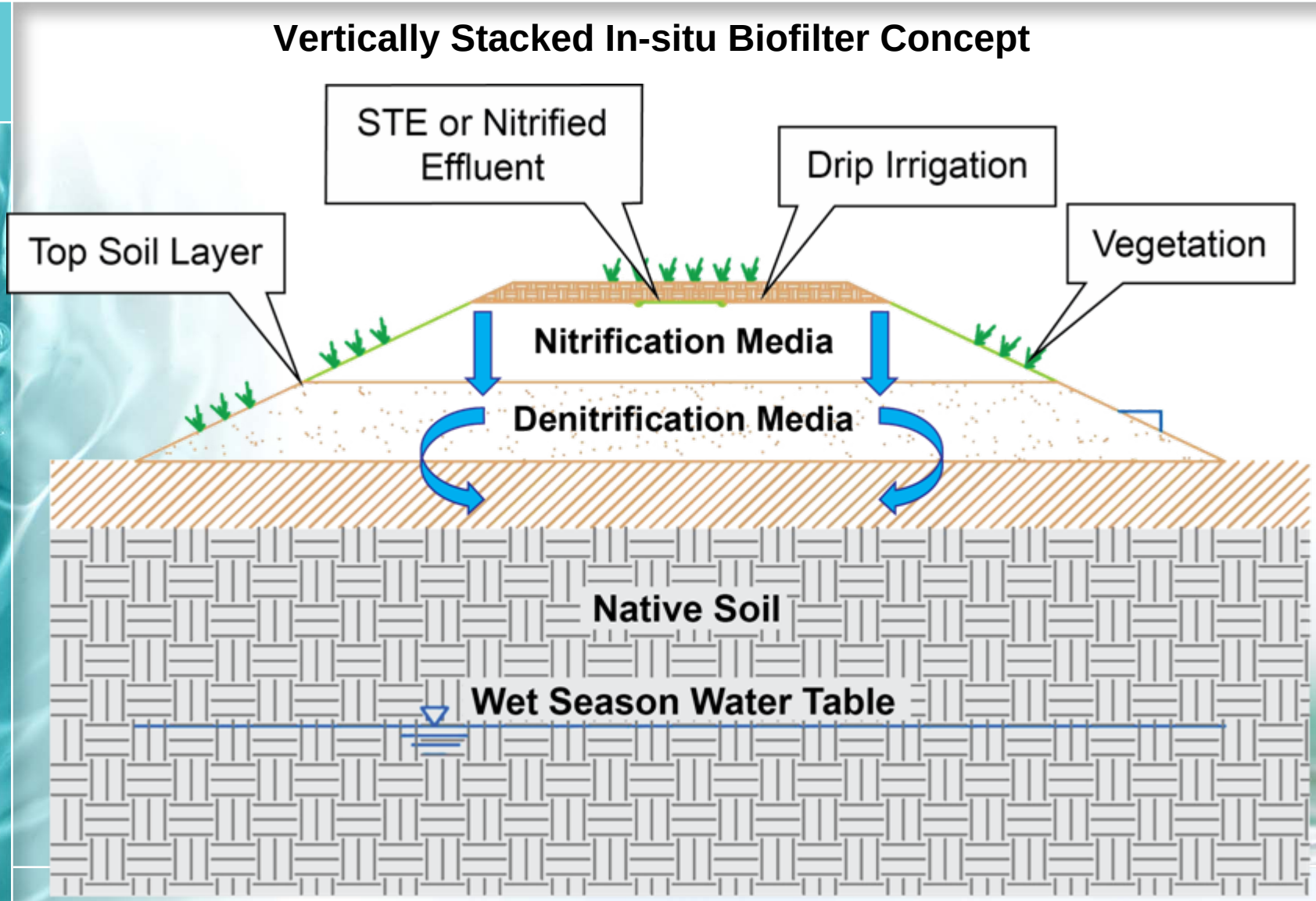
Passive Nitrogen Systems Pumped Flow



If topography allows, we will try gravity systems



Also will be investigating in-situ or mounded biofilters



Questions?

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