Alternative leach fields: nitrogen removal and response to saltwater intrusion

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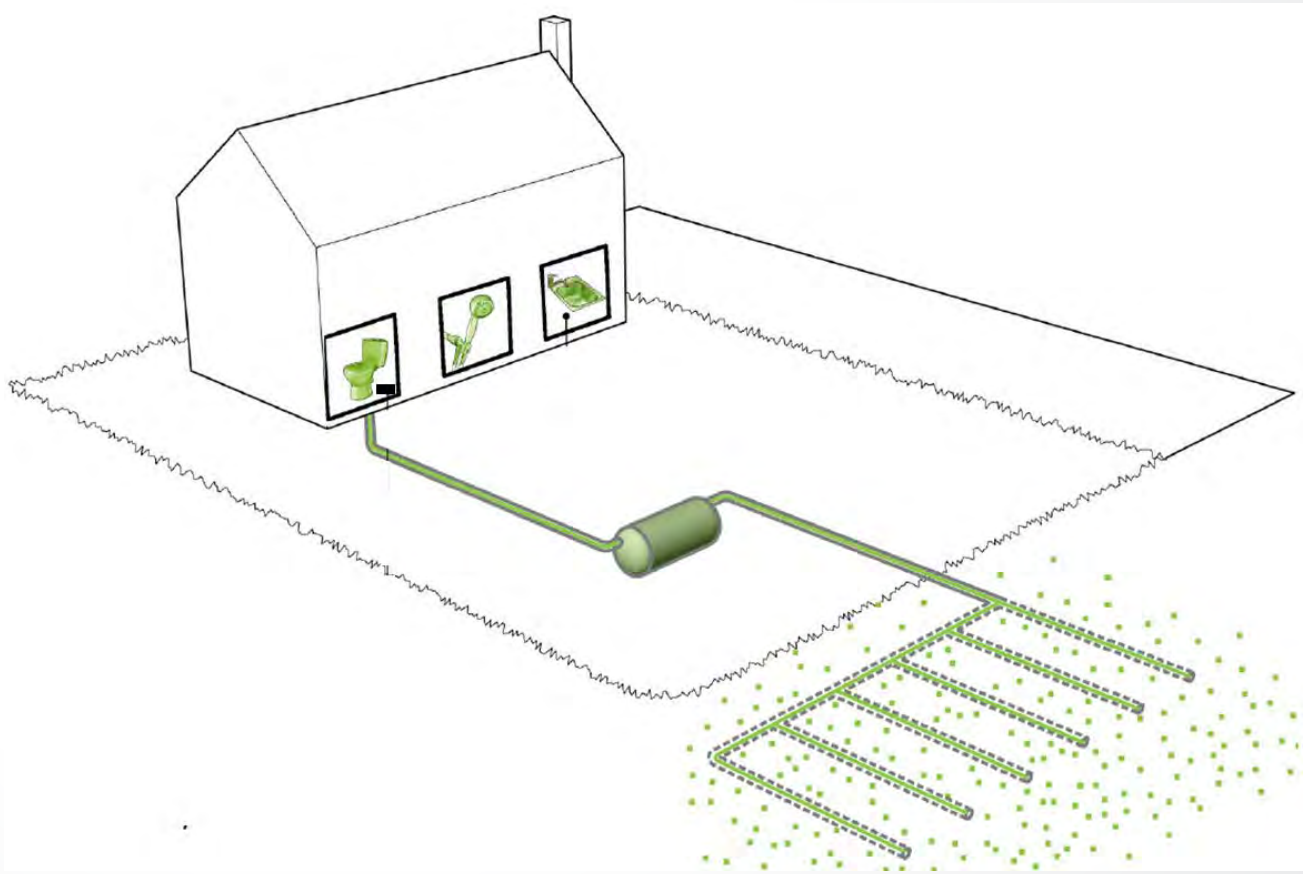
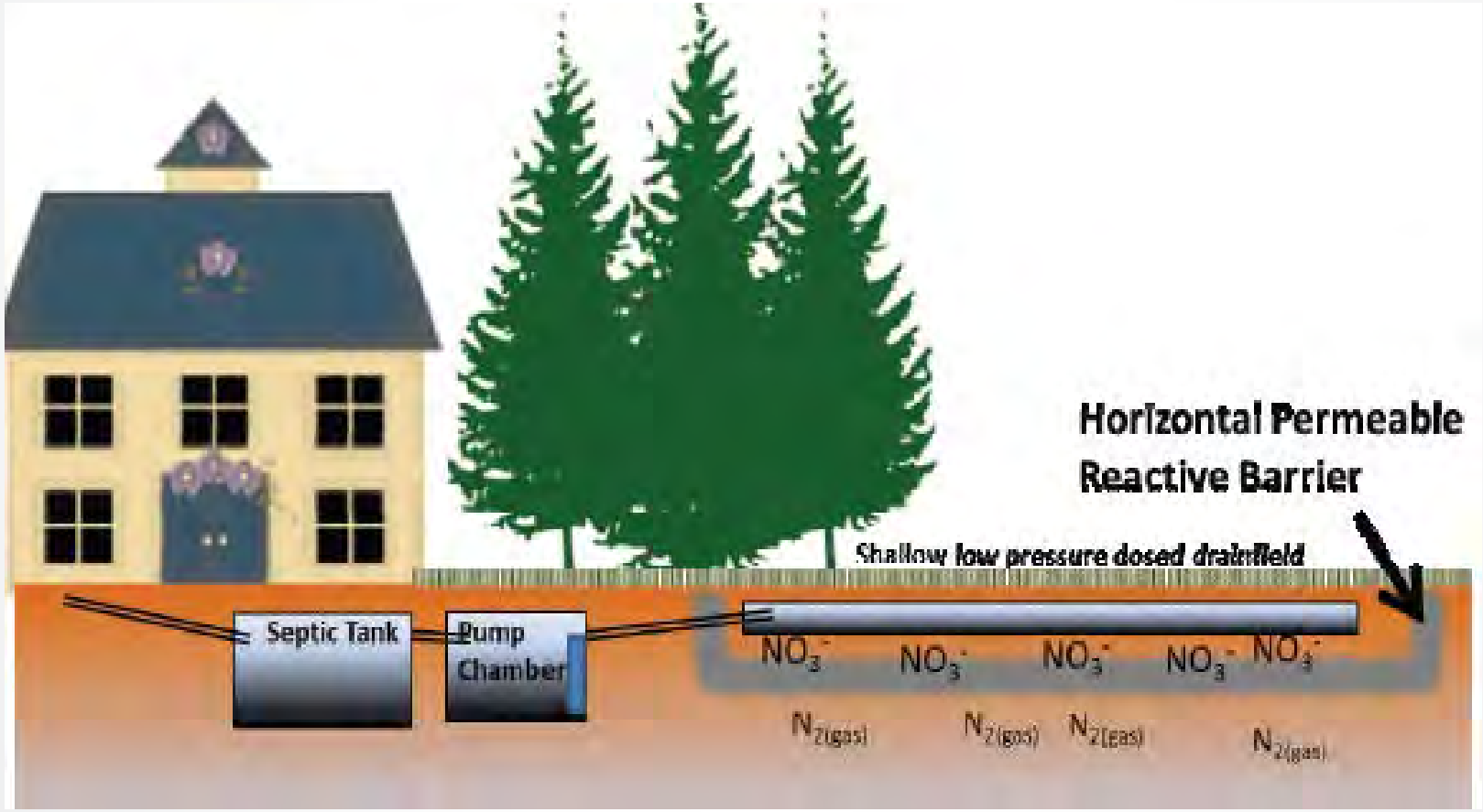
What are alternative leach fields and why are they important?

- Increased nutrients entering local water bodies
- Woodchip based layer-cake design
- Helps mitigate nitrogen inputs to water bodies (low-lying areas)
- Affordable alternative





Barnstable County Department of Health and Environment


Travel times
• 0-5 years
• 5-10 years
• 10-40 years
Low lying, near-shore locations are the most appealing

Goals for local decision-makers

- Well-constrained N budgets: magnitude and uncertainty in N interception
- Ancillary benefits and consequences
- Inform decision-making about trade-offs
- Improve PRB siting

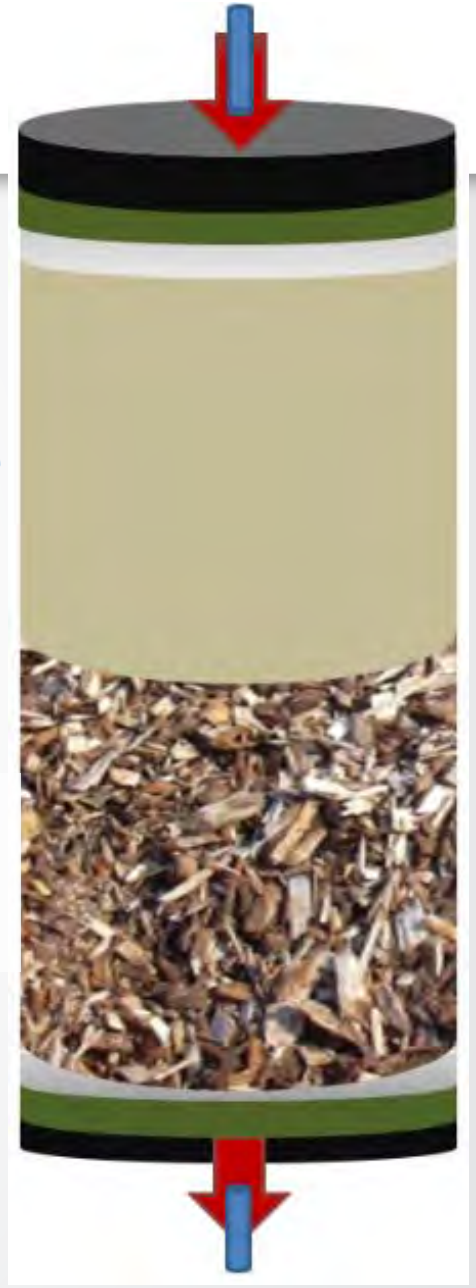
Research questions:

1) What is the fate of N?

2) Is N removal sensitive to flooding with seawater?

Approach:

- Lab-scale leach fields: 12 sawdust-based columns
- Trace N transformations & seawater impacts:
    - N removal (dissolved ions, gases)
    - Nitrification/denitrification (via ^{15}N)
    - Co-benefits (CH_4 & CO_2 production, P removal)

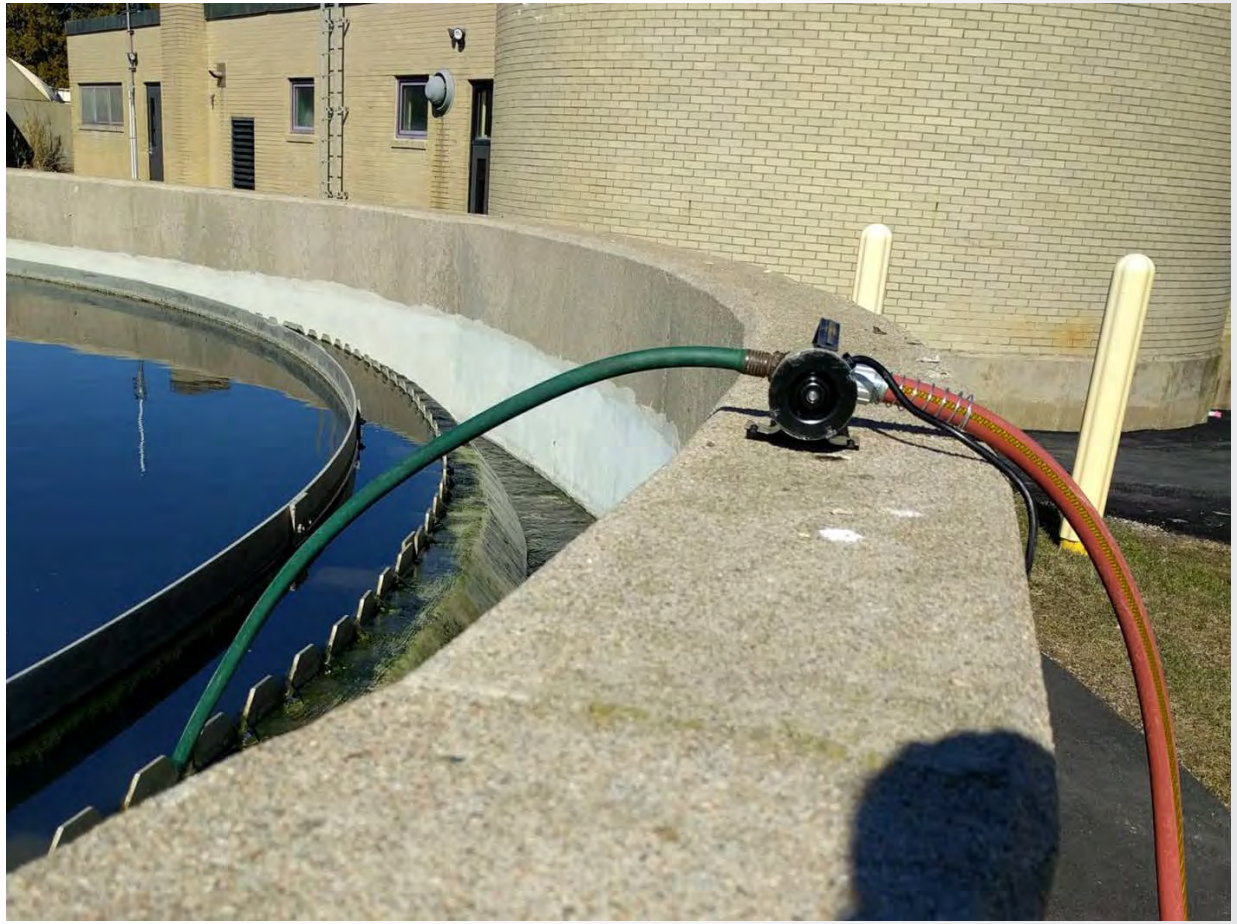


Monitoring

- YSI meter (pH, temp, DO, cond, sal)
- Tank, PLI, column water samples
- Bi-weekly flow tests

Maintenance

- Tri-weekly tank refill
- Tank cleaning monthly
- Tubing maintenance

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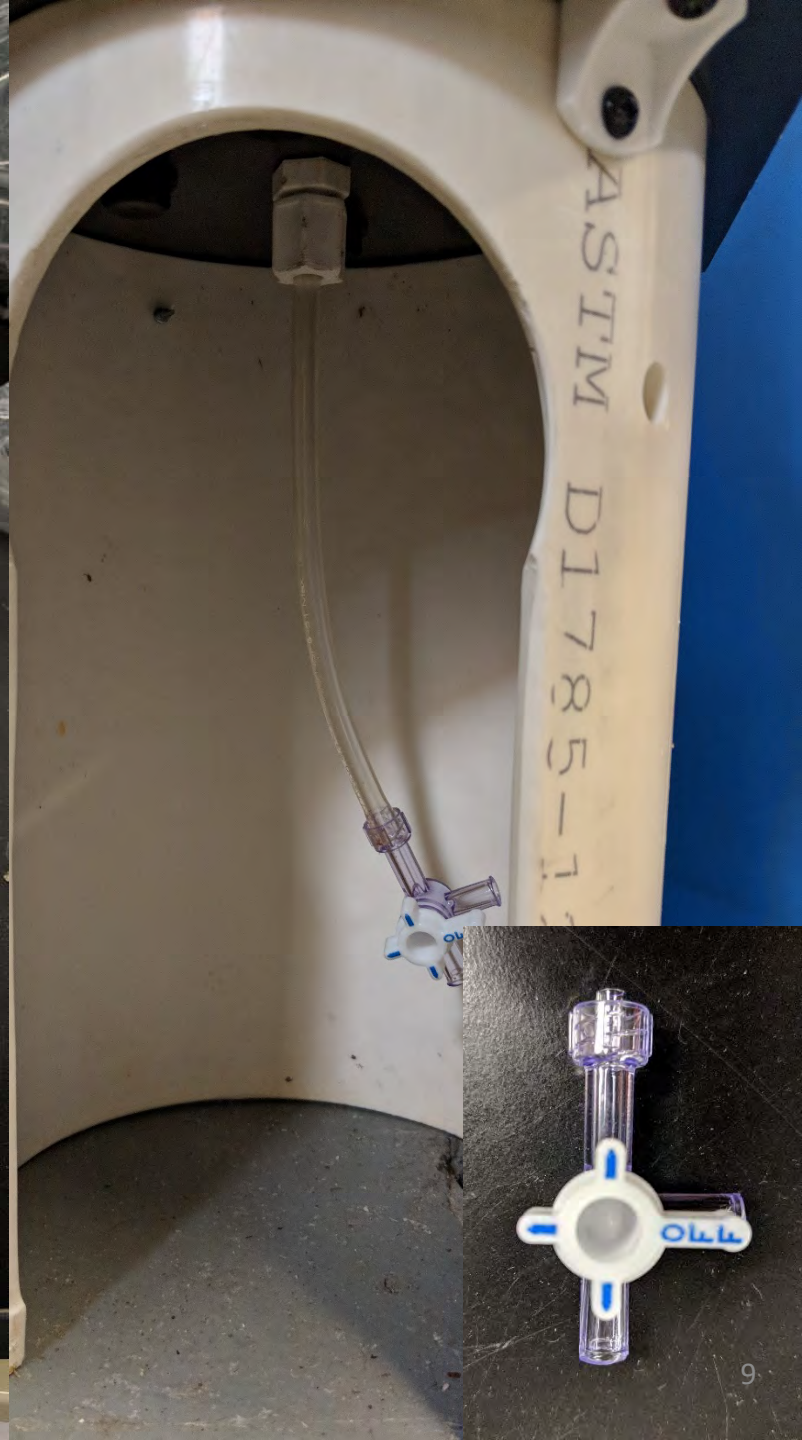

ASTM D1785-1

Storm Event Simulation

- Additions of 8 (L)
- Filtered Seawater : col 1,4,6,11
- DI Water : col 5,7,9,10
- Control : col 2,3,8,12

Tracer Event

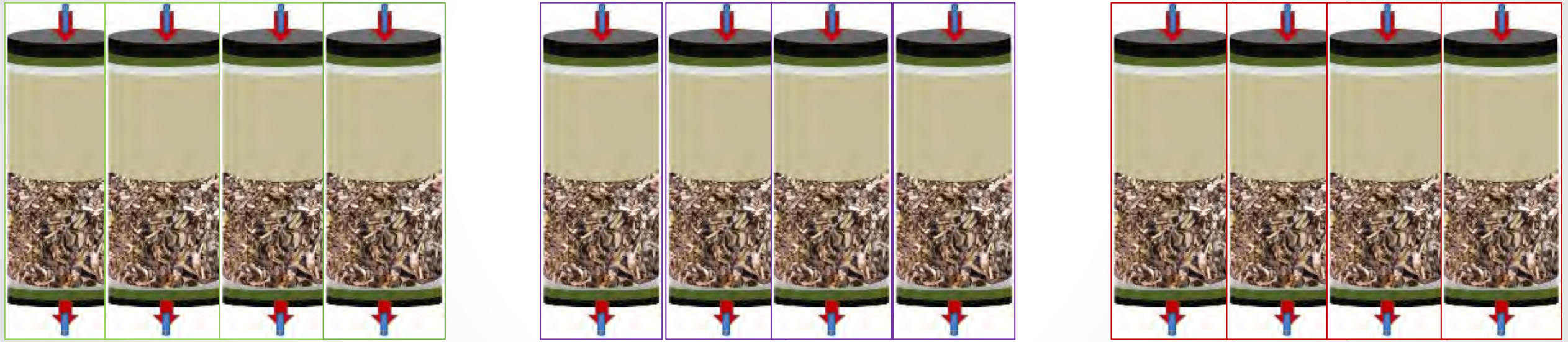
- 12 sampling events
- 1.5 mg of N15 per column
- Dissolved and headspace (gas)
- DOC, Nitrates, Nitrites, Ammonia, Phosphorus (water)

wastewater labeled with $^{15}N\text{-}NO_3^-$

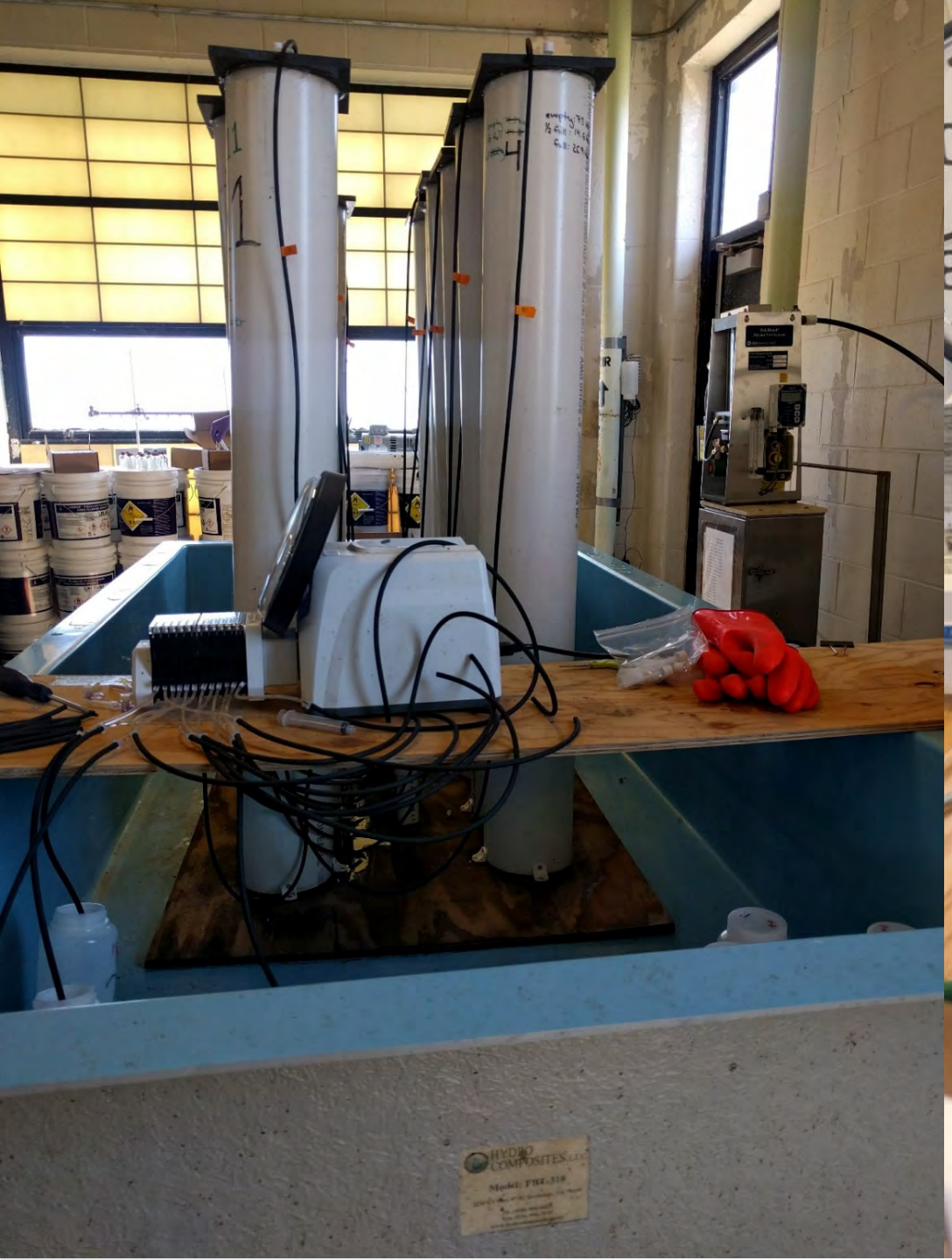
Control

DI water

Seawater pulse



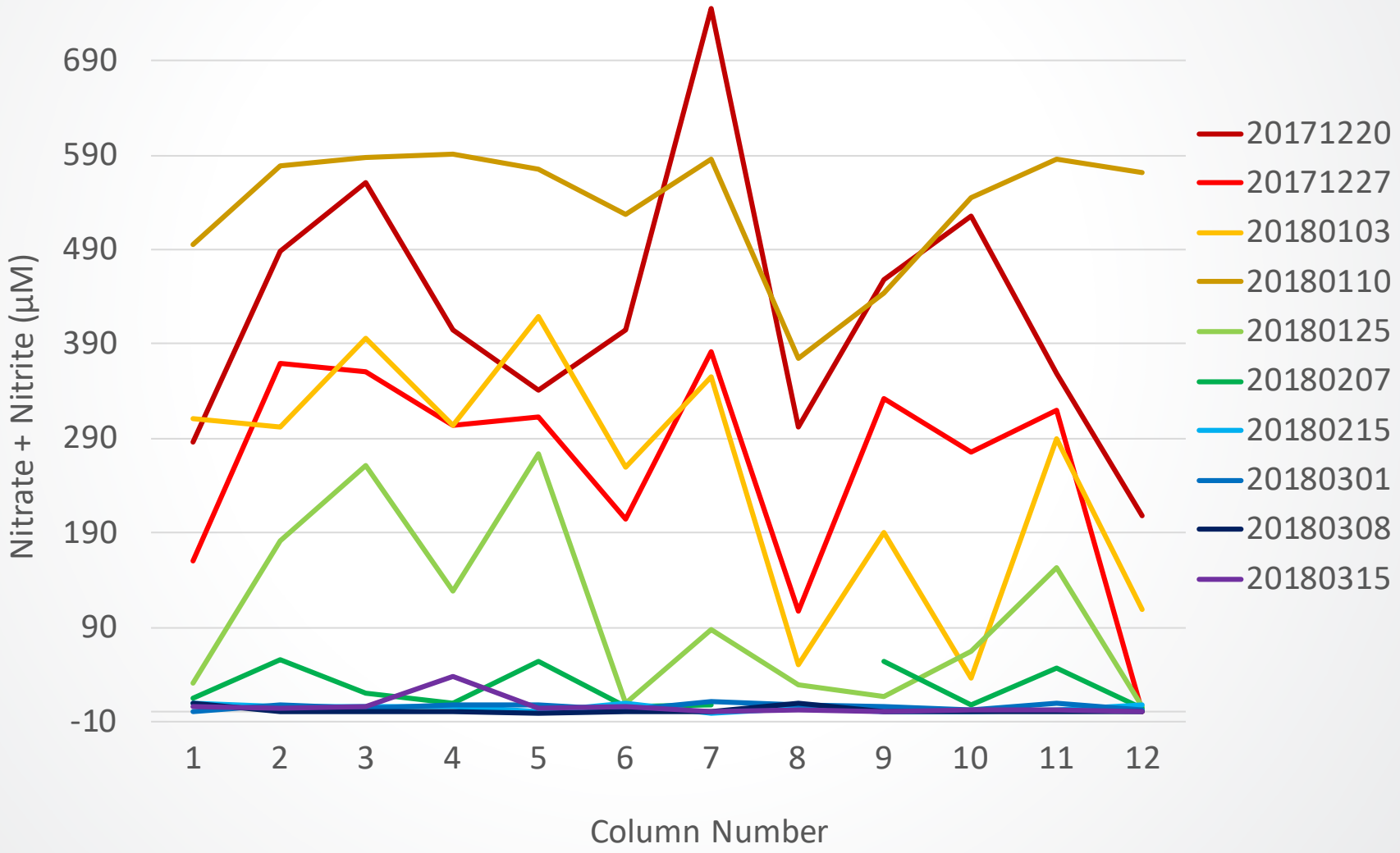
End-products labeled with ^{15}N provide quantitative estimates of biogeochemical process rates

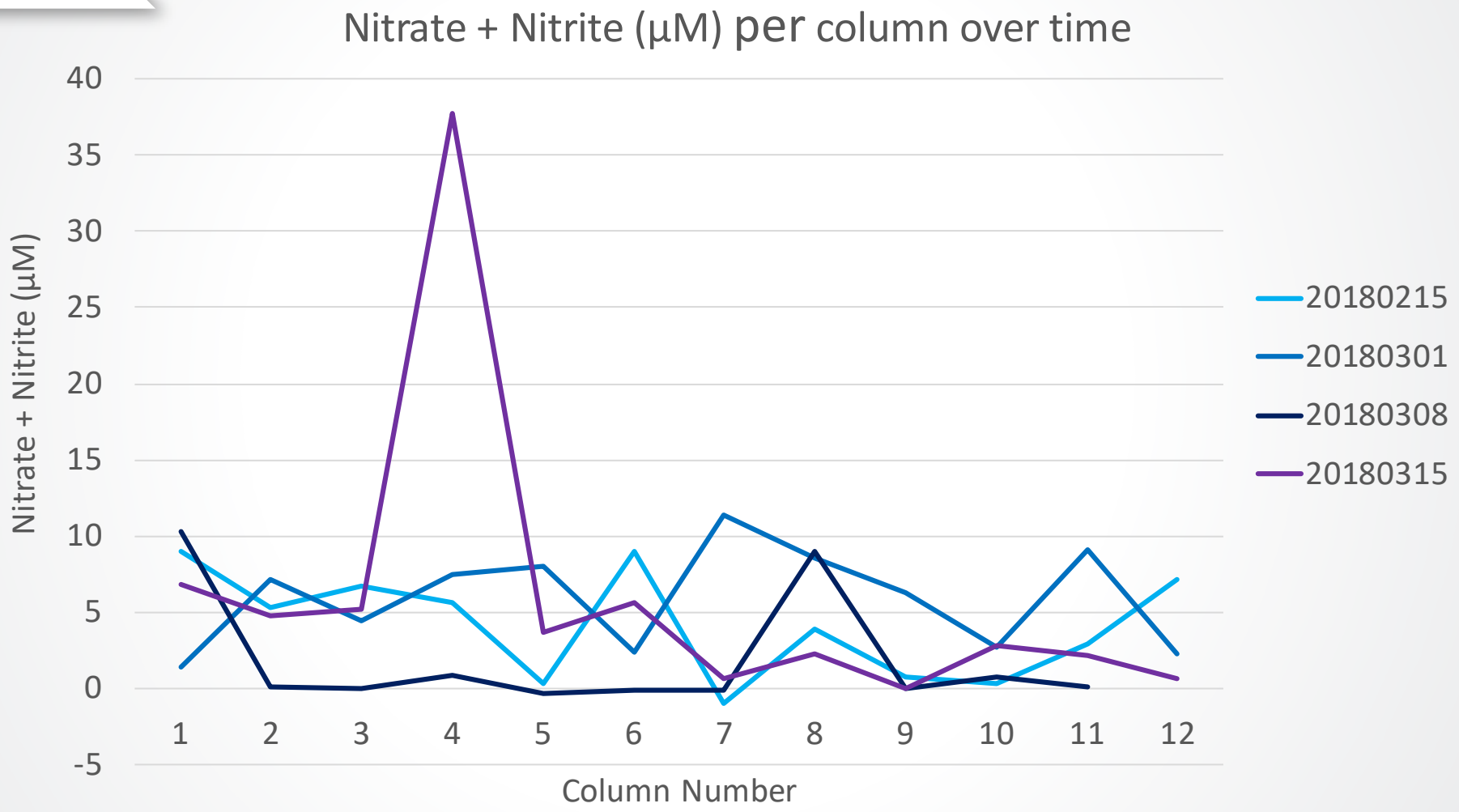

HYDRO COMPOSITES


SKILCRAFT
QUARTZ


BD IM1


IM1
BD


Nitrate + Nitrite (µM) per Column over time
690
590
490
390
290
190
90
-10
Nitrate + Nitrite (µM)
1
2
3
4
5
6
7
8
9
10
11
12
Column Number
20171220
20171227
20180103
20180110
20180125
20180207
20180215
20180301
20180308
20180315


Nitrate + Nitrite (µM) per column over time
Nitrate + Nitrite (µM)
40
35
30
25
20
15
10
5
0
-5
1
2
3
4
5
6
7
8
9
10
11
12
Column Number
20180215
20180301
20180308
20180315

Preliminary Conclusions

- We saw significant reductions in N after an initial lag period, probably due to a gradual microbial community establishment
- We are waiting on the results from subsequent tests to fully determine the fate of N
- The seawater addition did not appear to greatly impact the N removal efficiency of the columns