Solutions to Nitrogen Pollution: Installation of Nitrogen Reducing Septic Systems

Layer Cake Demonstration Project
Buzzards Bay Watershed

April 17, 2018

www.savebuzzardsbay.org

Layer Cake Demonstration Project
Agenda & Speakers

12:00 p.m.	Check-in & Lunch
12:30 p.m.	Project Background: Maureen Thomas, BBC
12:45 p.m.	Technology: George Heufelder, MASSTC
1:15 p.m.	Design and Permitting: Brian Grady, G.A.F. Engineering
1:45 p.m.	Installation: George Heufelder
2:15 p.m.	Homeowners Perspective: Wendy Pires, Wareham
2:30 p.m.	Results & Costs: George Heufelder
3:15 p.m.	Wrap up & Questions
4:30 p.m.	Optional Field Tour in Acushnet - 73 South Main Street

RESTORE AMERICA'S ESTUARIES

Southeast New England Watershed Grant Program

MASSTC
The Massachusetts Alternative Septic System Test Center

buzzards BAY COALITION

BCDHE
Barnstable County Department of Health and Environment
Promote - Protect - Support
90 YEARS OF SERVICE
1926 - 2016

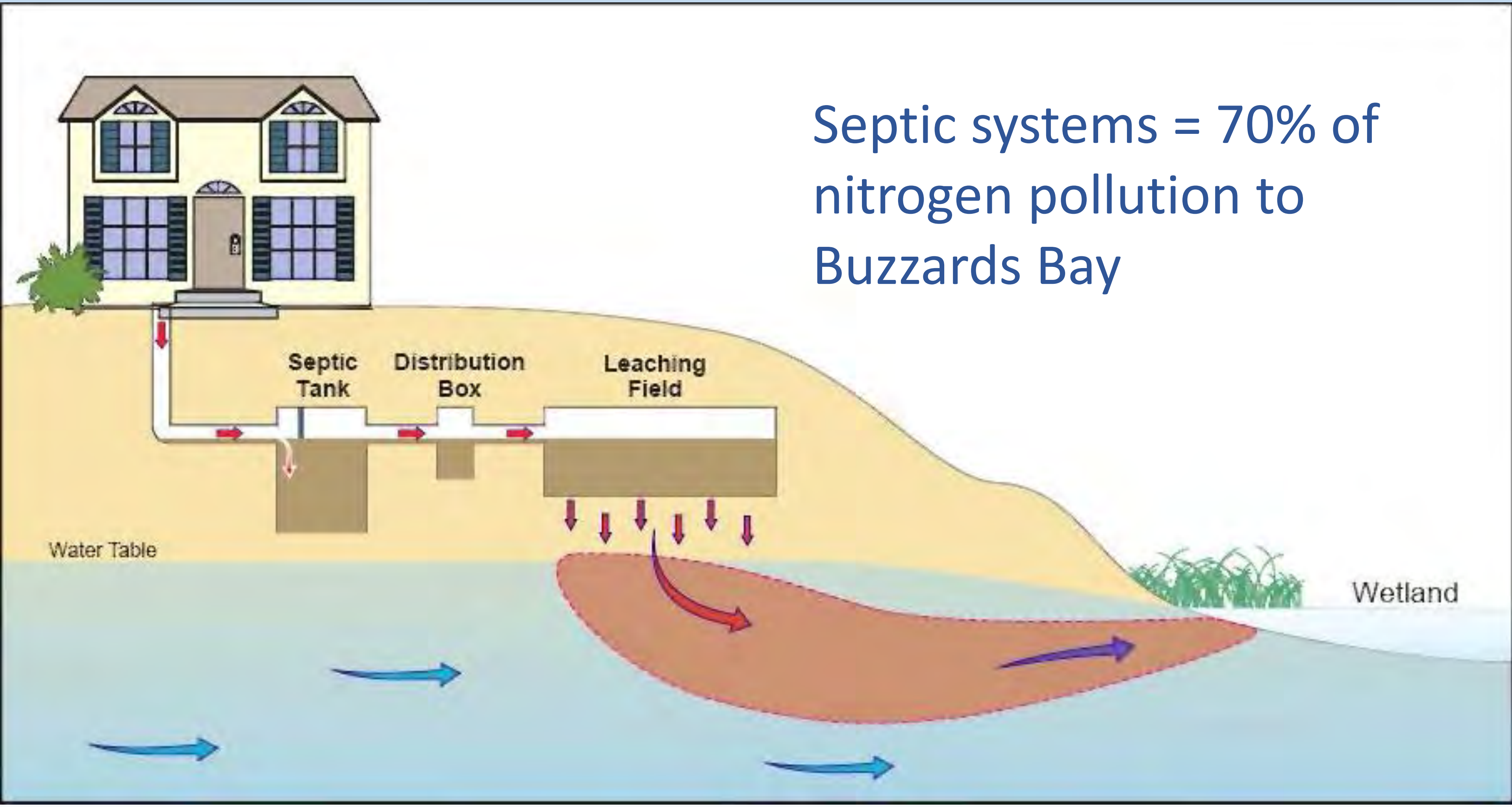
THE UNIVERSITY OF RHODE ISLAND

12 Volunteers

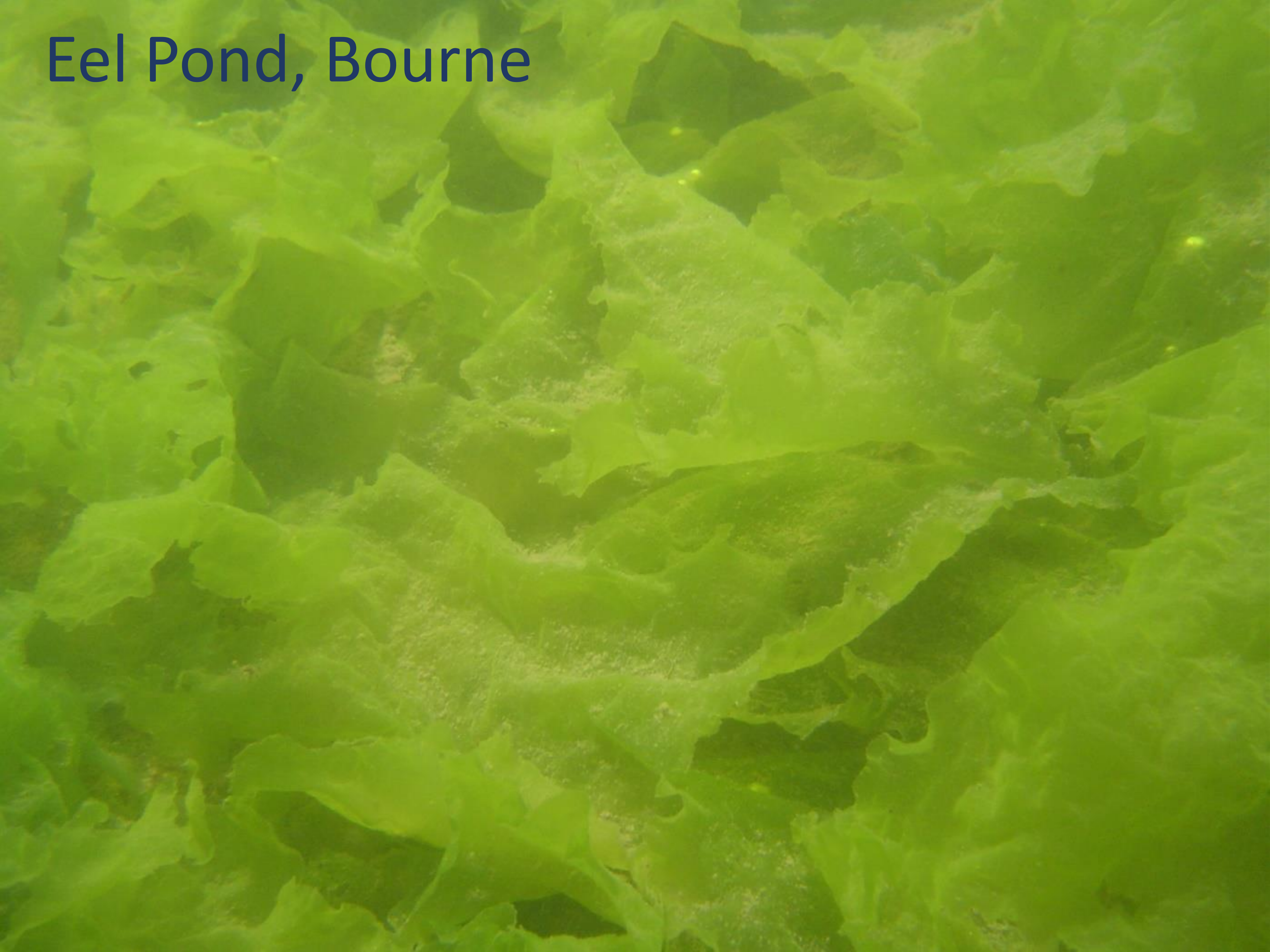
Hazen

Nitrogen Pollution Problem

Septic systems = 70% of nitrogen pollution to Buzzards Bay



Acushnet River


Eel Pond, Bourne

Wild Harbor River, Falmouth

Mark’s Cove, Wareham

Eelgrass

Degraded → *Healthy*

Photo credit: Dr. Joseph Costa & George Hampson

Solutions to Nitrogen Pollution

- Sewering
- Nitrogen reducing septic systems
  - Proprietary I/A systems
  - Non-proprietary I/A systems like the Layer Cake

Layered Soil Treatment Areas (LSTAs) a.k.a. Layer Cakes

- Technology transfer from other parts of country
- TN Removal rates of up to 90% in leachfield
- Passive, non-proprietary system with one pump
- Cost savings
- Simple & easy to maintain
- Sustainable

Selection of Participants

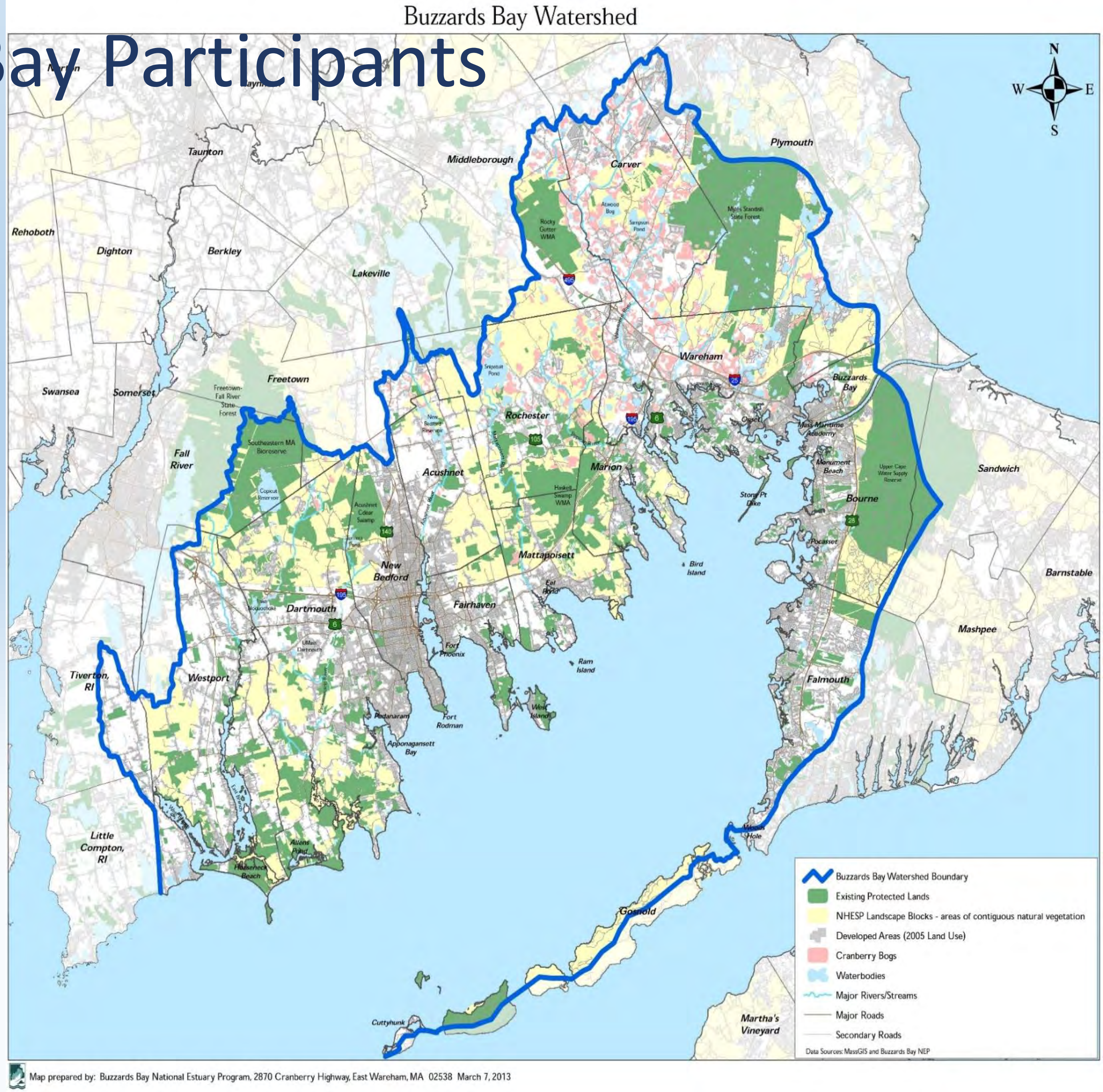
- Single family home?
- # of bedrooms?
- Year round or seasonal?
- Rented?
- How many occupants?
- Type & age of septic system?
- Septic problems?
- Access issues?
- Lot size?
- House coverage?

Demonstration Project Process

- 12 homeowner partners
- $10,000 subsidy
- Homeowner signs contract with BCDHE
- Selection of engineer
- Design of system
- Permitting process
- Selection of installer & installation
- 2 years of BCDHE inspection, maintenance, & monitoring
- I/A system recorded on deed
- Owner responsible after 2 years

Buzzards Bay Participants

- Acushnet
- Dartmouth
- Fairhaven
- Falmouth (2)
- Tisbury
- Wareham (2)
- Westport



Collaborative Effort

- Damann L. Anderson, P.E., a researcher of passive nitrogen removal systems for the State of Florida Onsite Sewage Nitrogen Reduction Study (FOSNRS);
- George Loomis, an onsite septic system specialist and published author from the University of Rhode Island;
- Dr. Will Robertson of the University of Waterloo;
- Jose Amador, a soil scientist at the University of Rhode Island;
- John Eliasson with the Wastewater Management Section of Washington State Department of Health's Division of Environmental Public Health
- More recently, researchers at Stony Brook University, NY

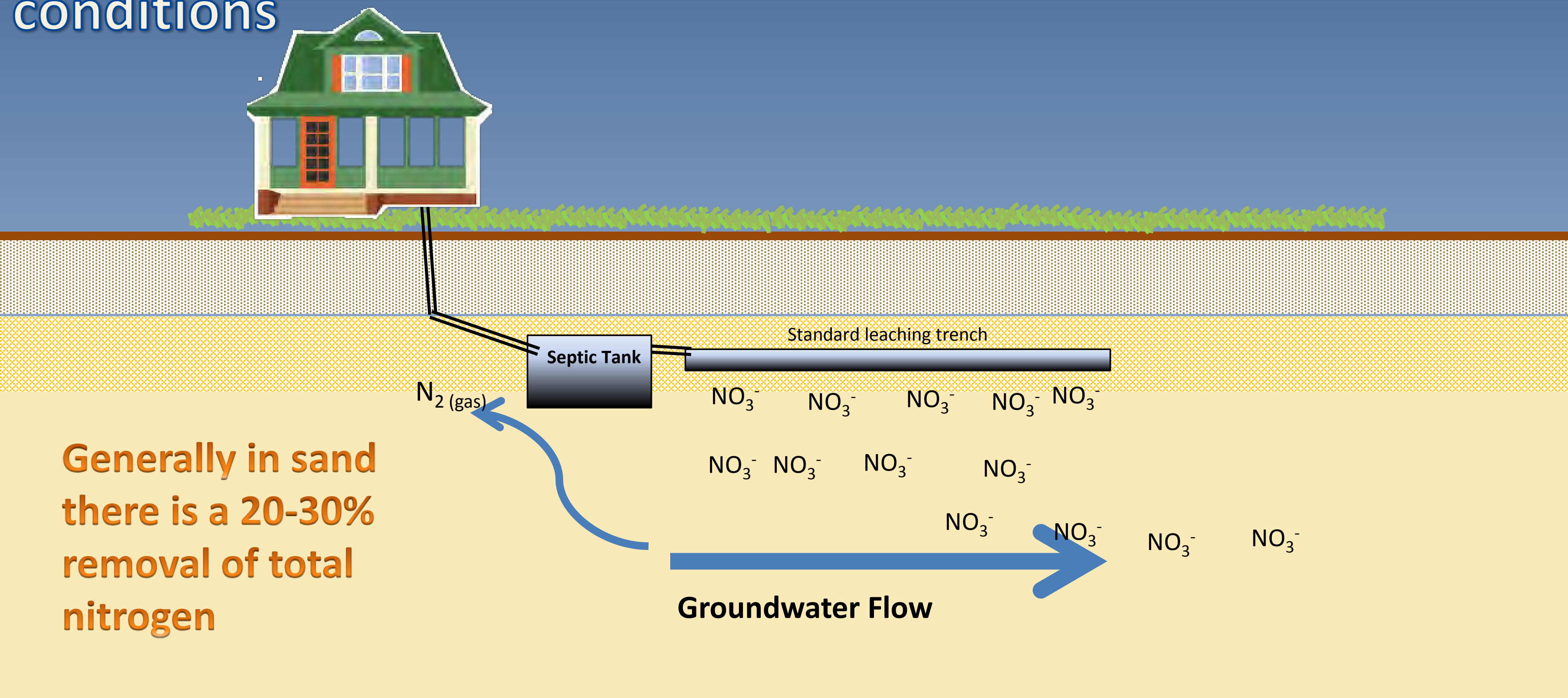
To examine all elements of successful non-proprietary onsite denitrification projects and determine how to adjust the design features to work in our particular climatological and geological setting.

To determine whether the principles used in these projects will allow a design that is economical and feasible to install in Barnstable County.

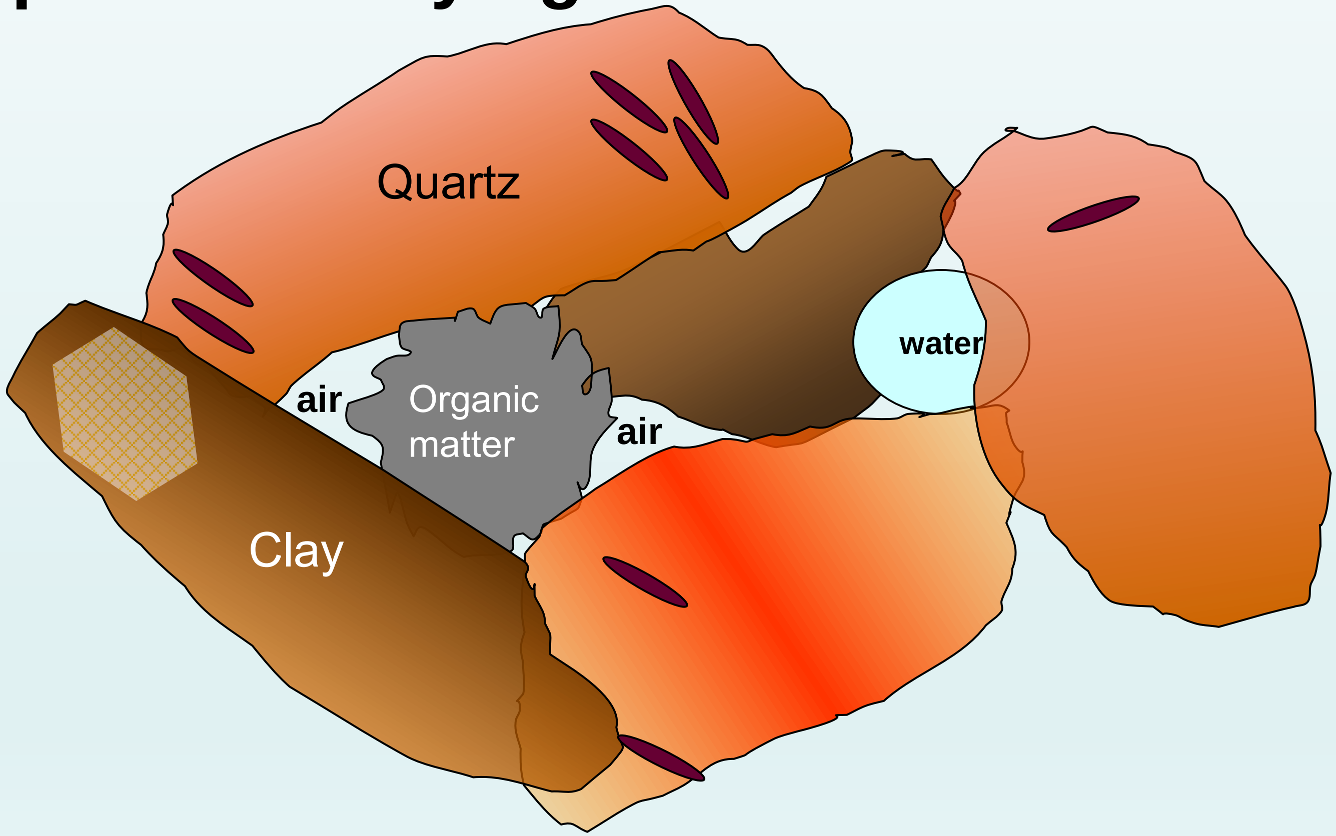
MASSTC

A closer look at nitrogen removal in the standard soil absorption system

When a soil absorption system is placed in the C Horizon and that horizon is predominantly sand, nitrification occurs within the first six inches of percolation but there is **limited** denitrification due to a carbon limitation and lack of anoxic conditions

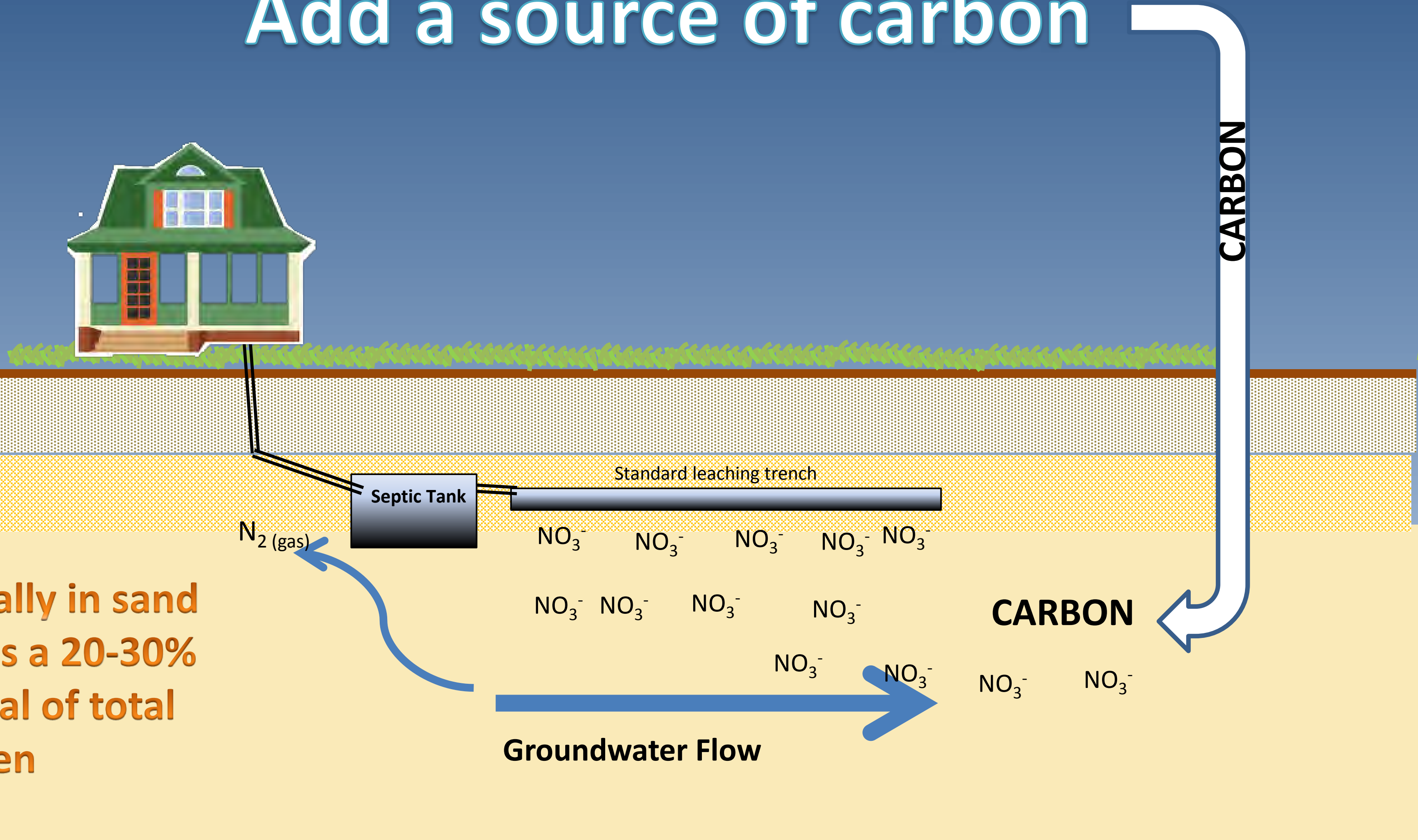


The prevailing theory is that the limited nitrogen removal in soil occurs when nitrified effluent encounters anoxic micro-zones in the soil where there is sufficient carbon to support denitrifying bacteria.



But what if we could….

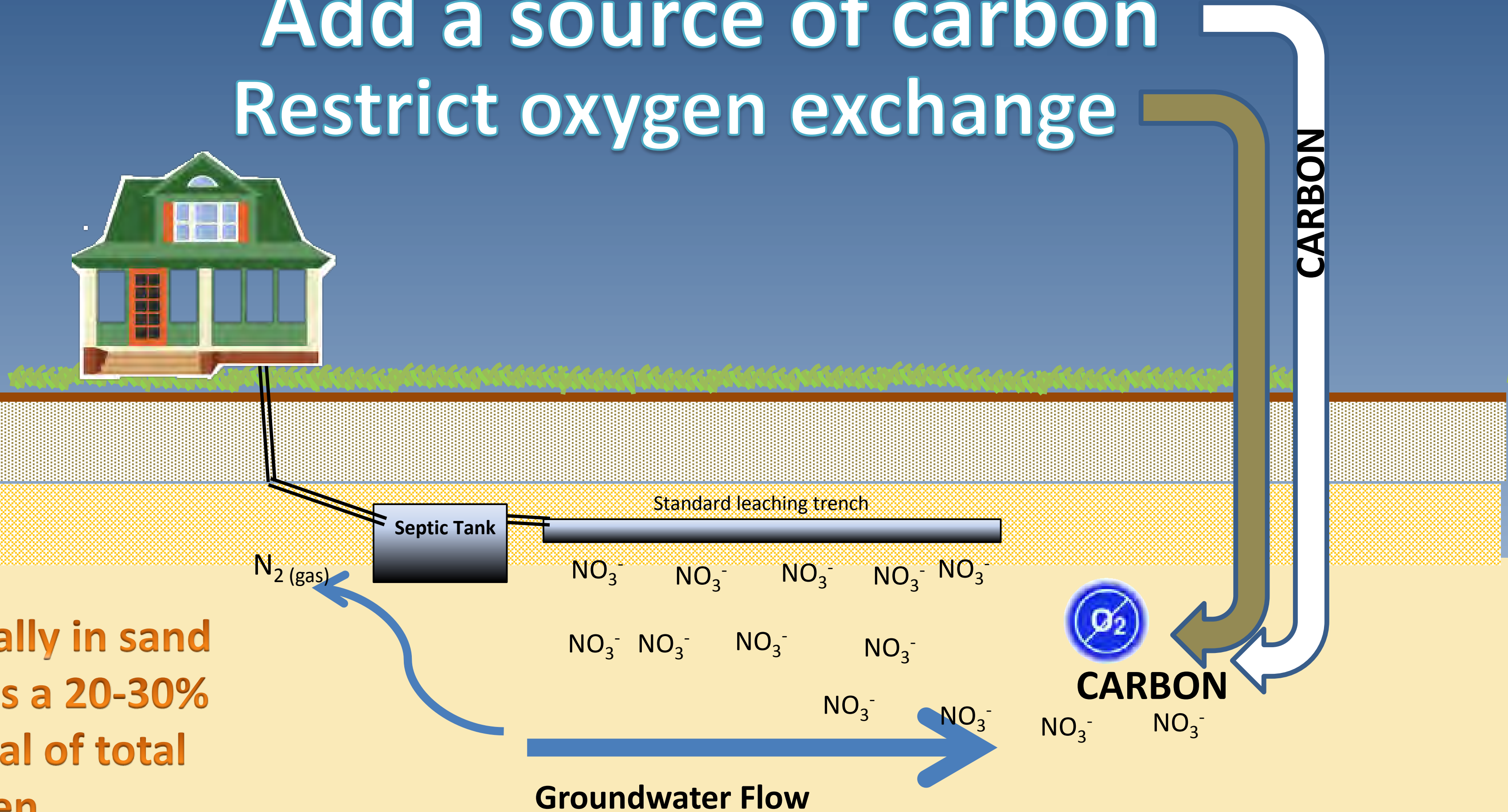
Add a source of carbon



Generally in sand there is a 20-30% removal of total nitrogen

But what if we could....

Add a source of carbon
Restrict oxygen exchange



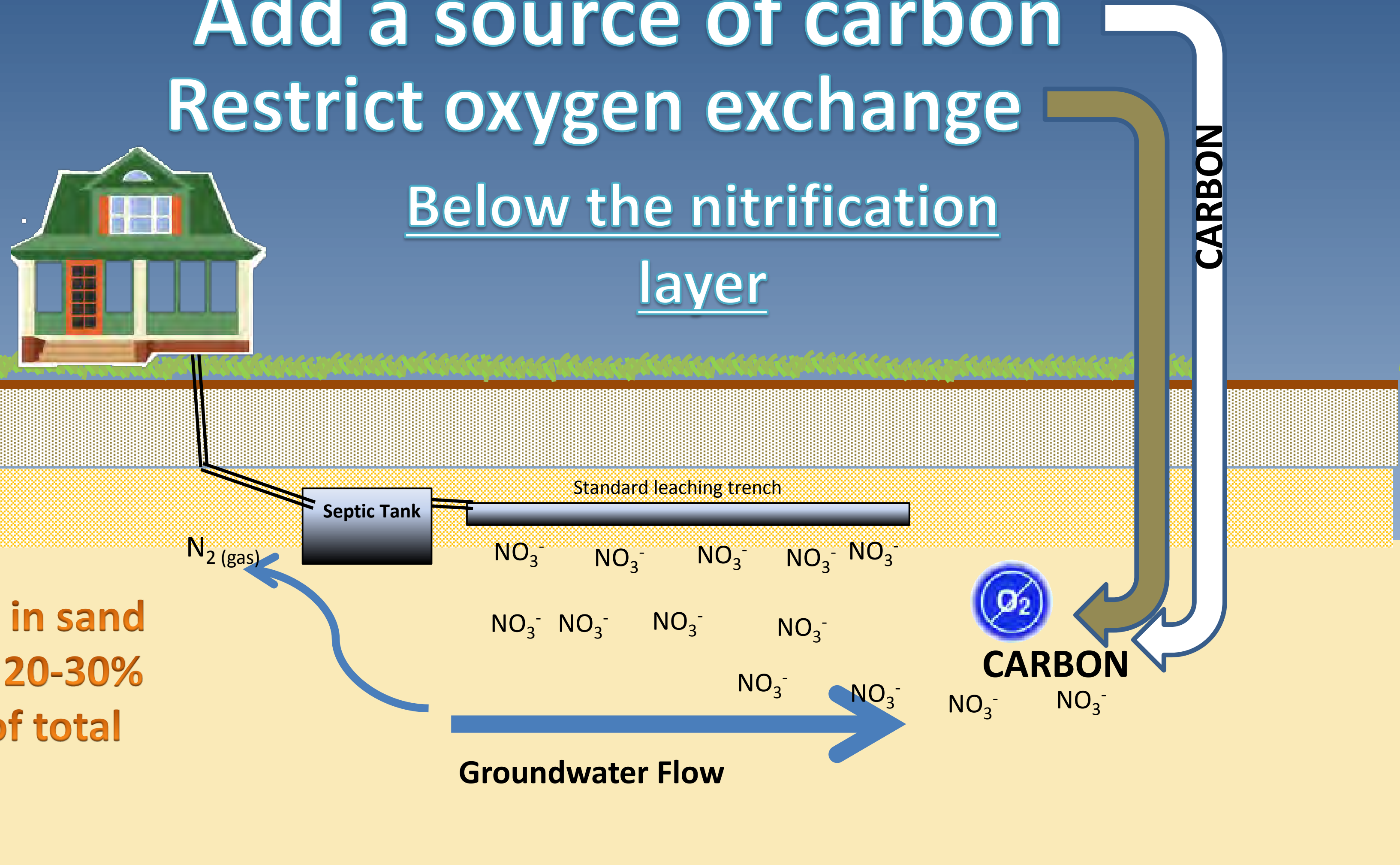
Generally in sand there is a 20-30% removal of total nitrogen

But what if we could….

Add a source of carbon

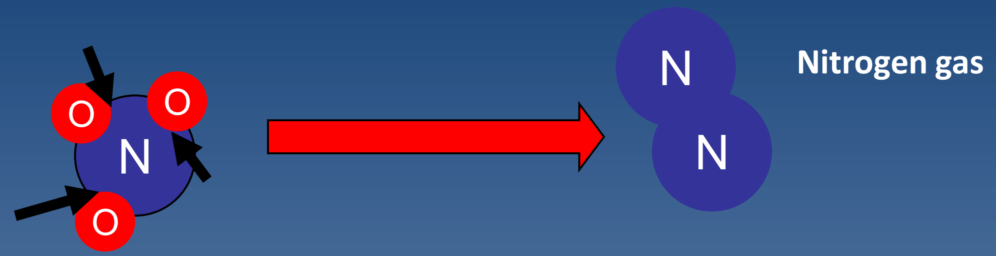
Restrict oxygen exchange

Below the nitrification layer

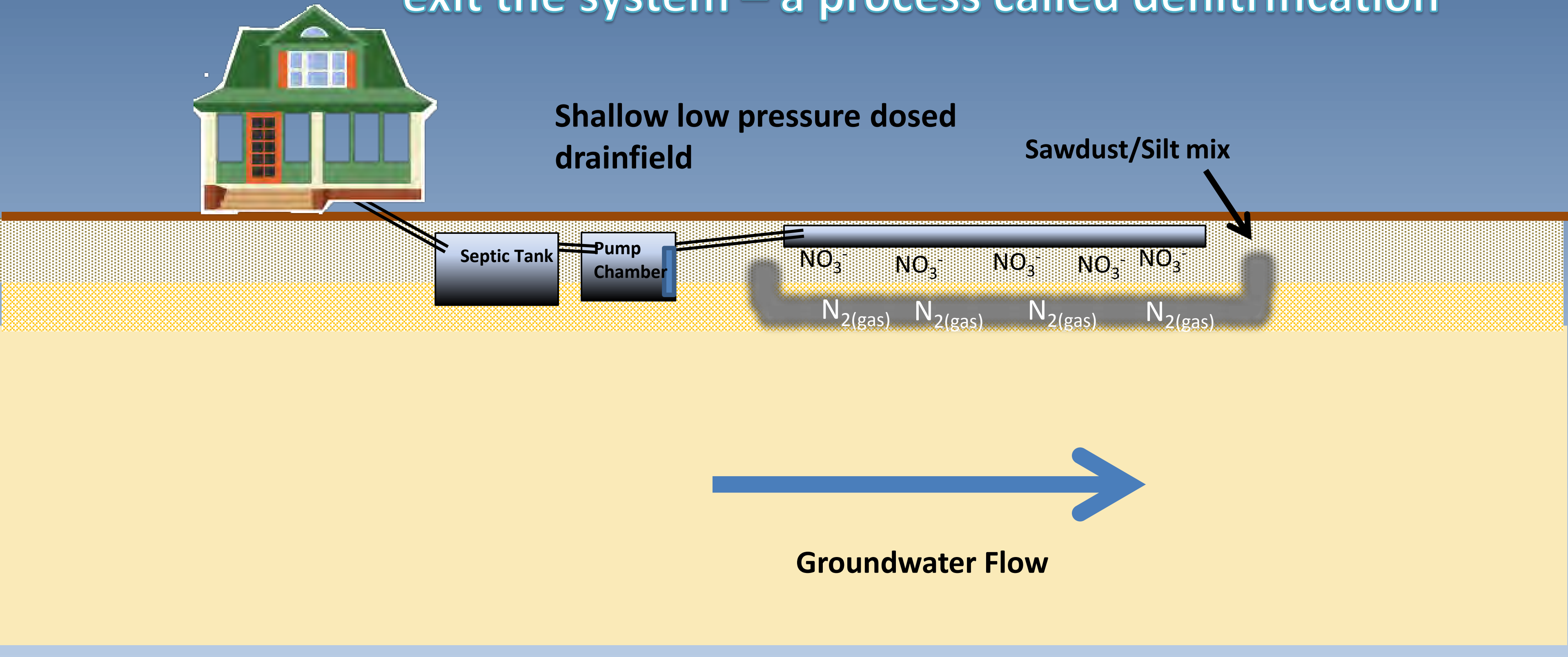


Generally in sand there is a 20-30% removal of total nitrogen

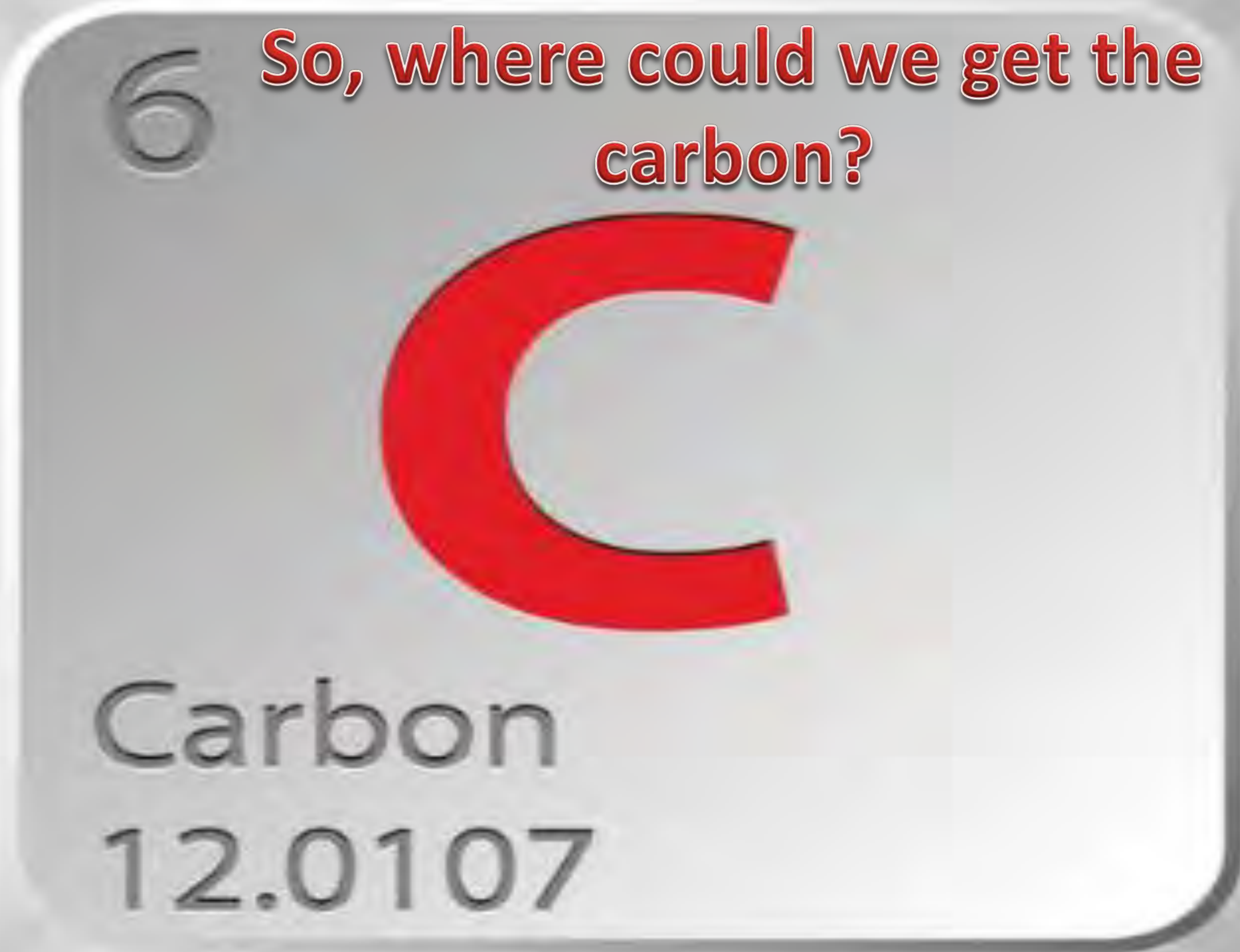
Then we could…



Reduce the nitrate to nitrogen gas and allow it to exit the system – a process called denitrification



So, where could we get the carbon?



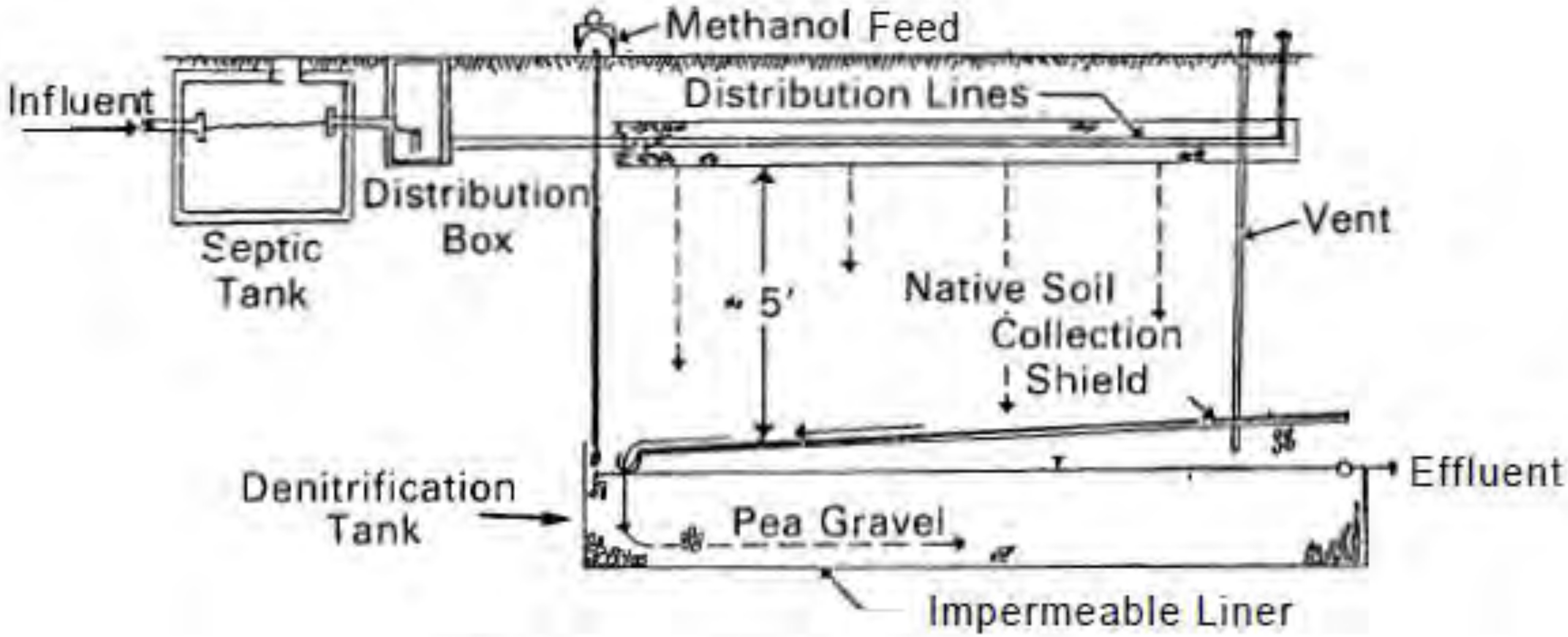
A Blast from the Past

1980

EPA features a profile system that interrupts nitrified percolate and supplies carbon for denitrification

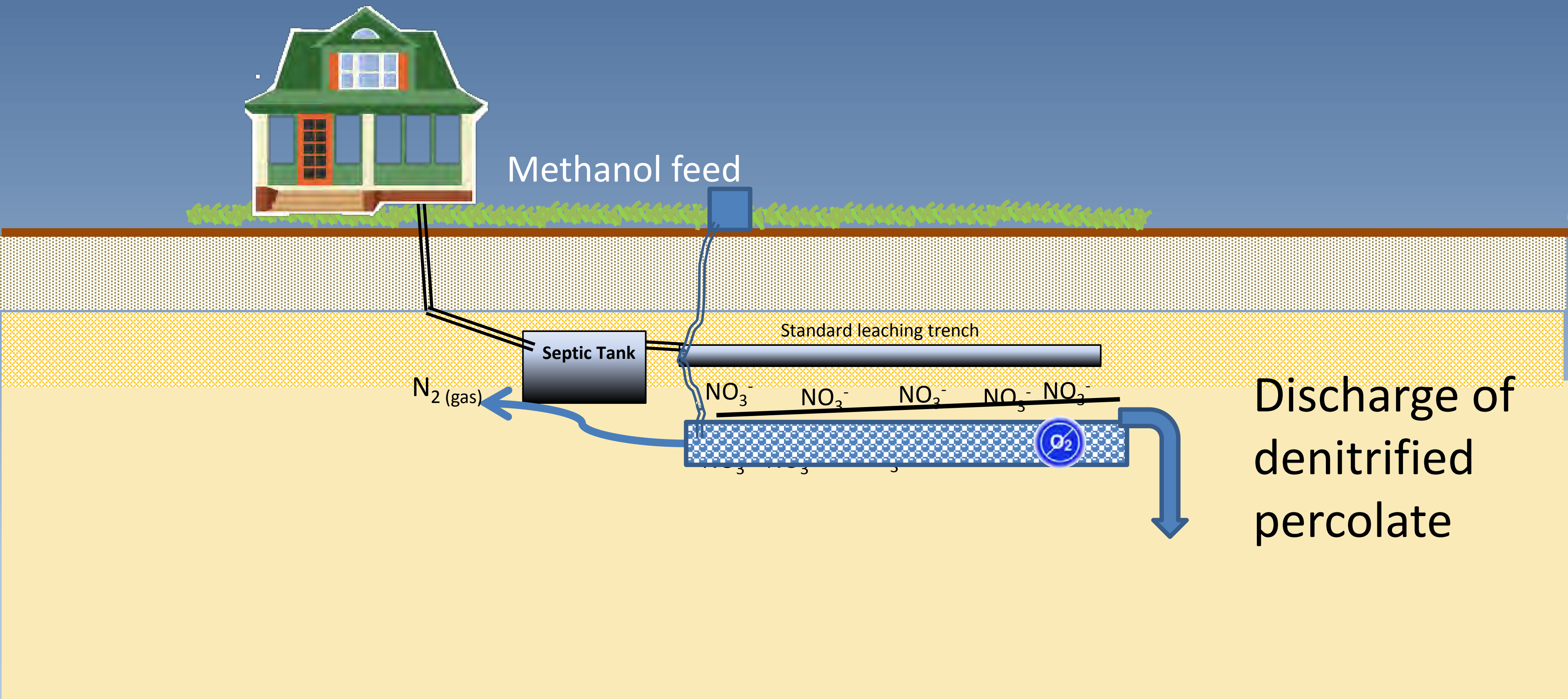
Source:

EPA 1980 ONSITE WASTEWATER TREATMENT AND DISPOSAL DESIGN MANUAL



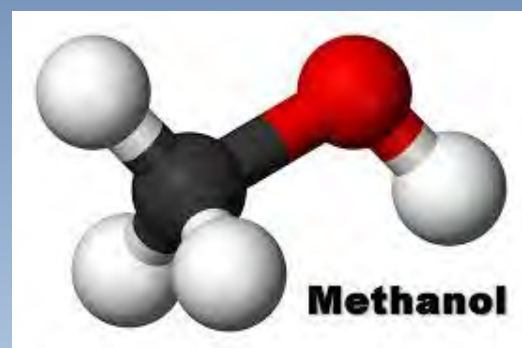
Nitrification-Denitrification in Soil

In essence they created a bathtub full of gravel 5 ft. beneath a standard SAS through which the nitrified effluent had to pass and introduced a carbon source (methanol) in order to denitrify the percolate,



Why five feet ?
Why methanol?

+



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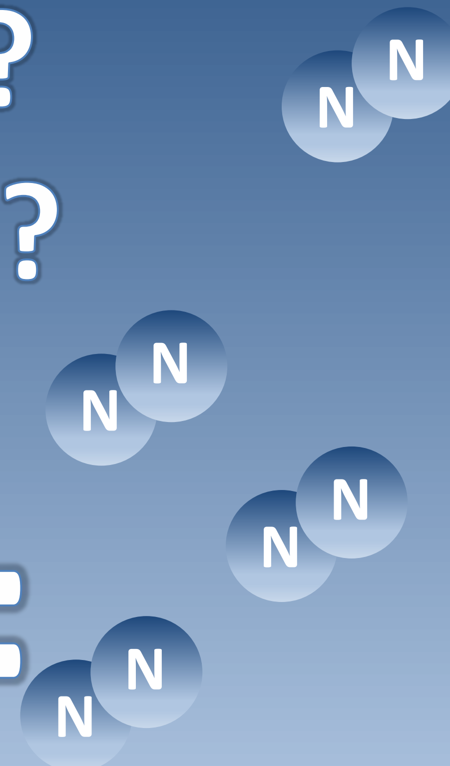

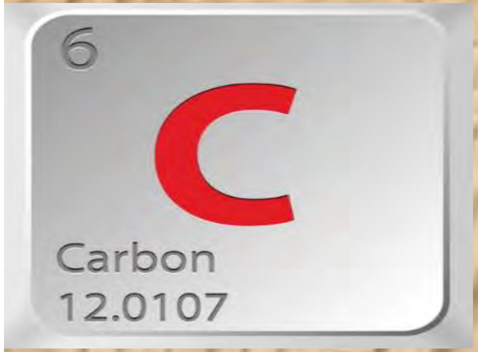

Another Source

(Right under our nose)

Wood in various forms represents a slow release form of carbon for use by the bacteria involved in *denitrification*




This is not new !

NITREX™

Permeable Reactive Barriers (PRB)

1995

Woodchip barriers widely used in agricultural settings

Denitrification Activity, Wood Loss, and N2O Emissions over 9 Years from a Wood Chip Bioreactor

Long-Term Performance of In Situ Reactive Barriers for Nitrate Remediation

by W.D. Robertson[a], D.W. Blowes[a], C.J. Ptacek[a], and J.A. Cherry[a]

Comparing Carbon Substrates for Denitrification of Subsurface Drainage Water

Article in Journal of Environmental Quality · May 2006

Journal of Environmental Quality — SPECIAL SECTION

MOVING DENITRIFYING BIOREACTORS BEYOND PROOF OF CONCEPT

Temperature and Substrate Control Woodchip Bioreactor Performance in Reducing Tile Nitrate Loads in East-Central Illinois

Mark B. David,* Lowell E. Gentry, Richard A. Cooke, and Stephanie M. Herbstritt

A Brief Data Summary of Experiments Performed at
Massachusetts **A**lternative **S**eptic **S**ystem **T**est **C**enter

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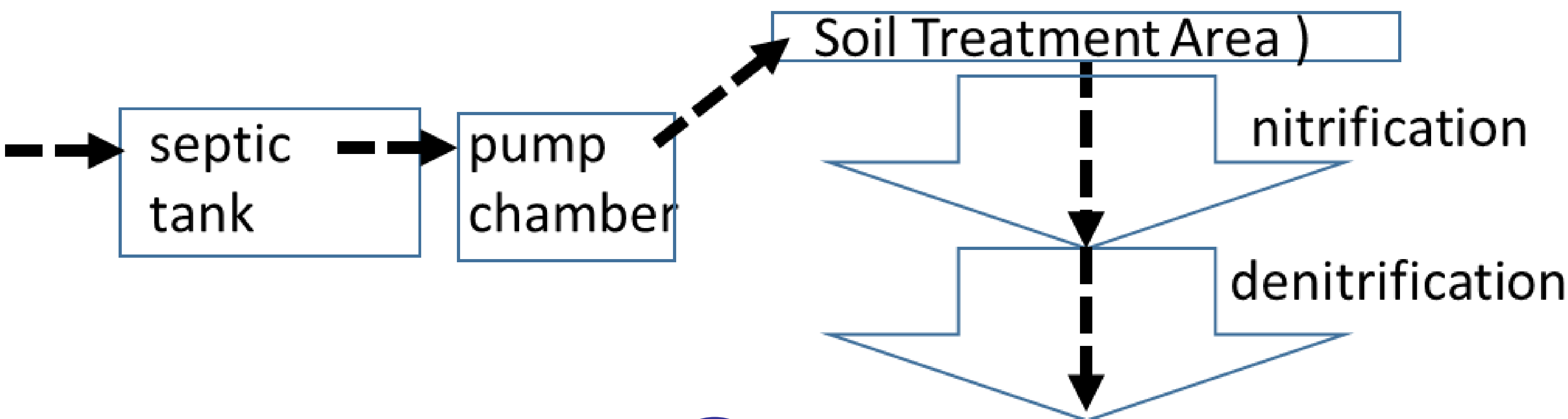
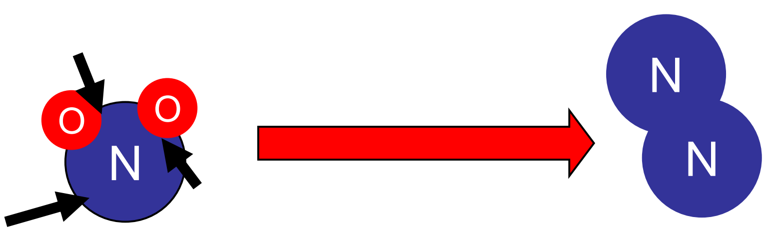
Experiments with three different designs

Design 1 of Three Basic Designs

1



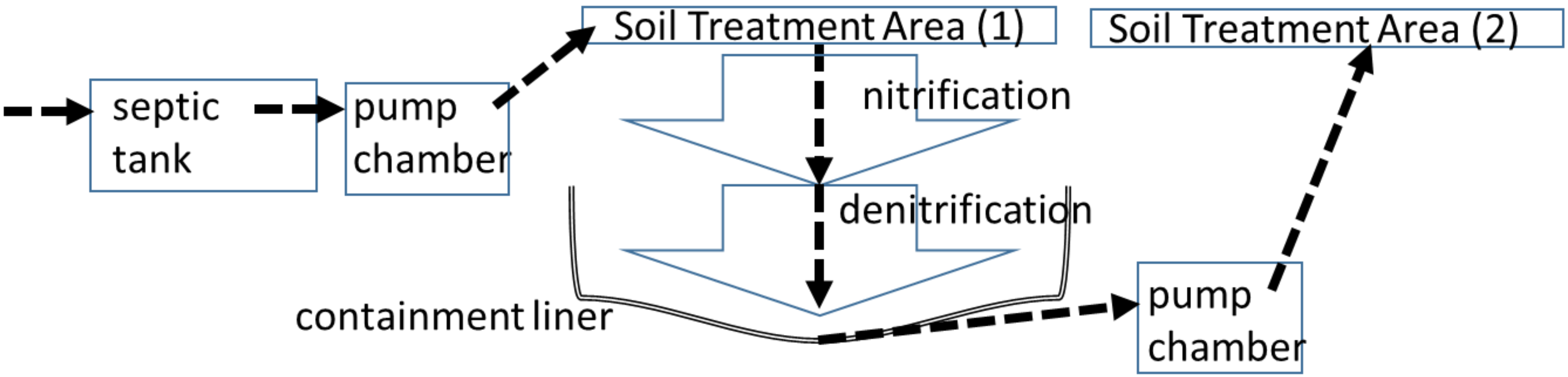


Denitrification is facilitated by a layer of sand mixed with sawdust placed below the nitrification layer

Design 2 of Three Basic Designs

2

The containment liner provided a saturated area that held water and occluded oxygen



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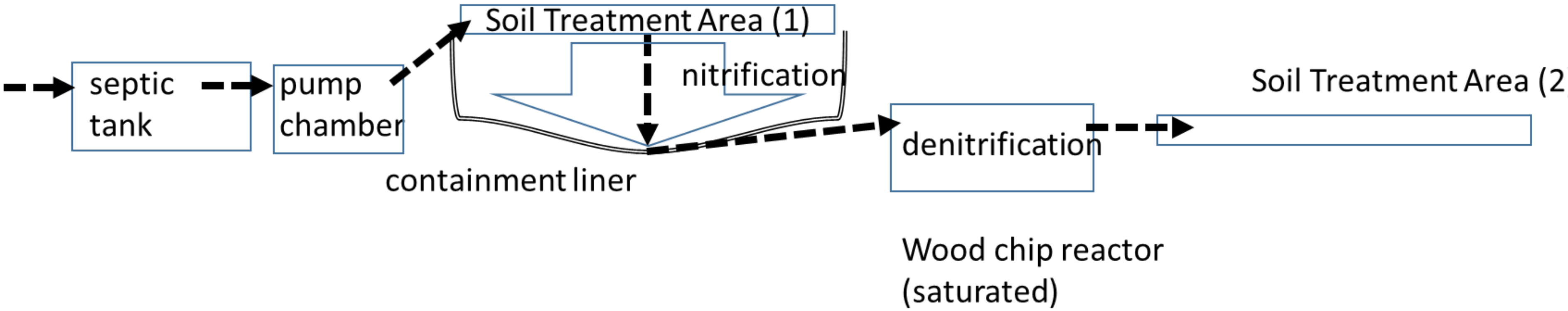
Design 3 of Three Basic Designs

3

The container provided a saturated area that held water and occluded oxygen



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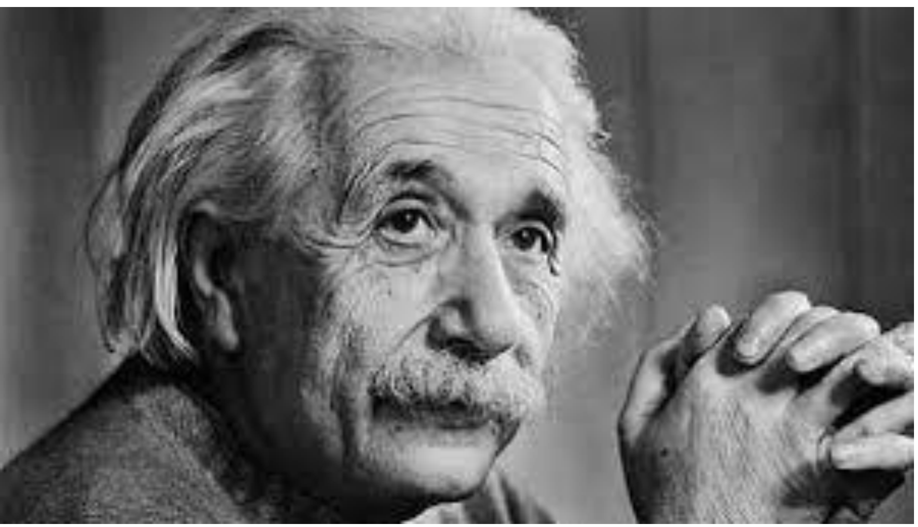
Design 2 & 3 require an additional disposal site so……

"Everything should be made as simple as possible, but not simpler"

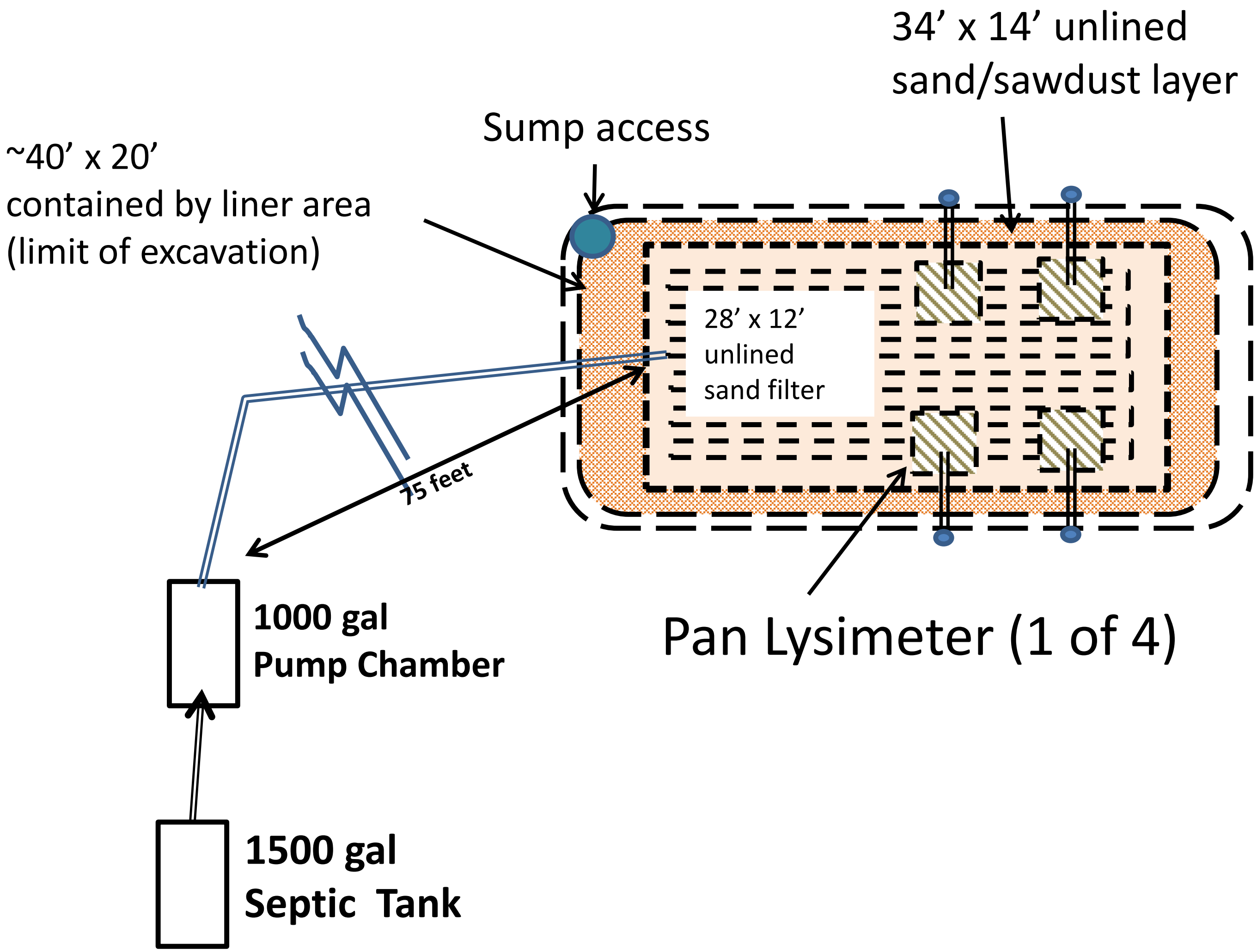


Design 1
Keeping it Simple

DISPERSAL
NITRIFICATION
DENITRIFICATION
DISPOSAL

Design 1

Simple layered system (no liner)



Design 1

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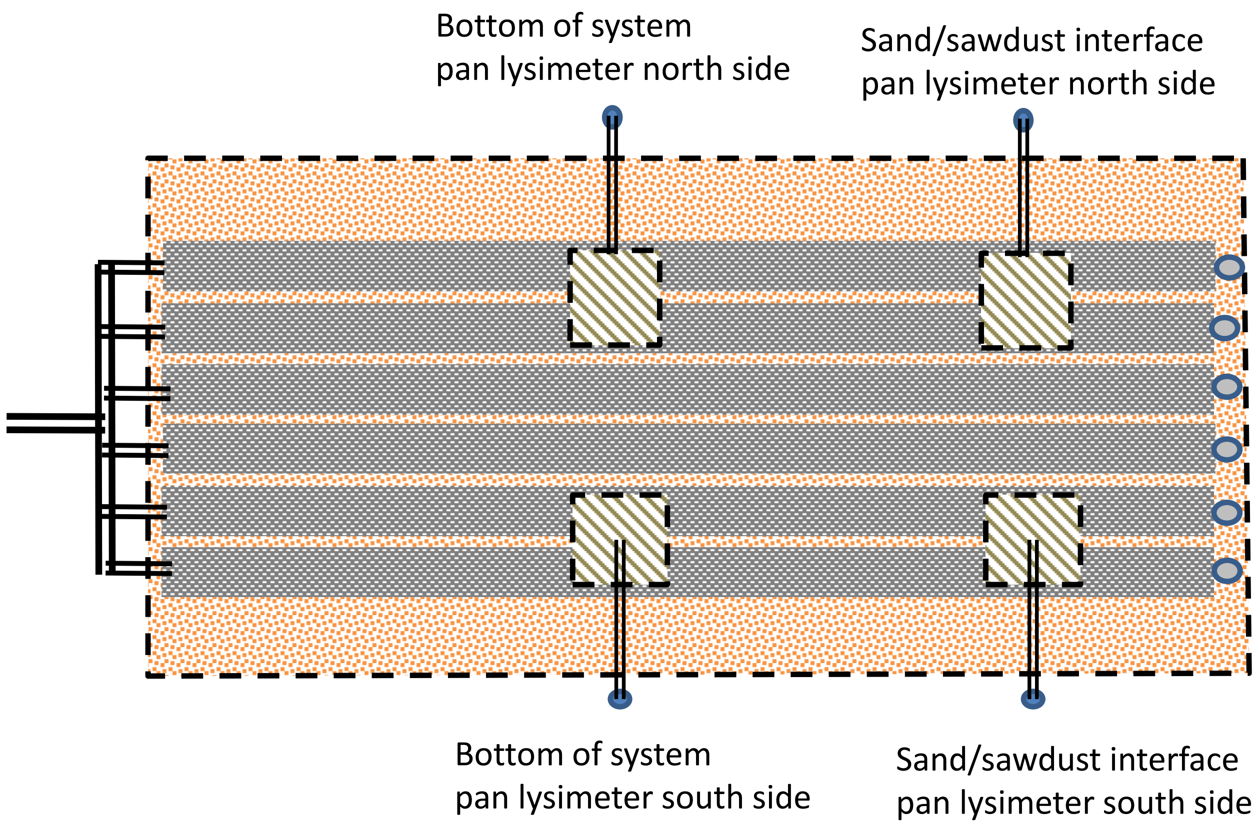

Design 1

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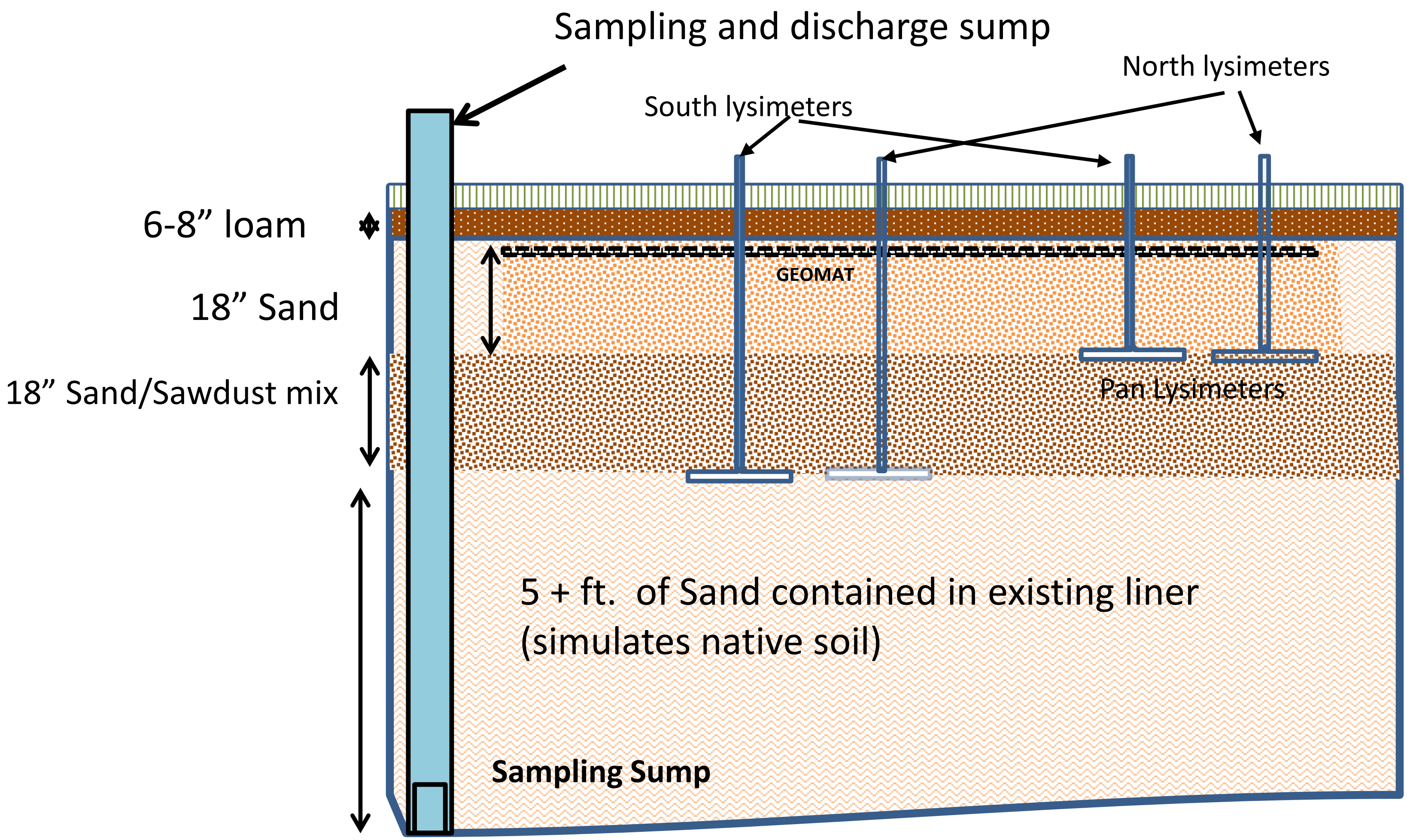
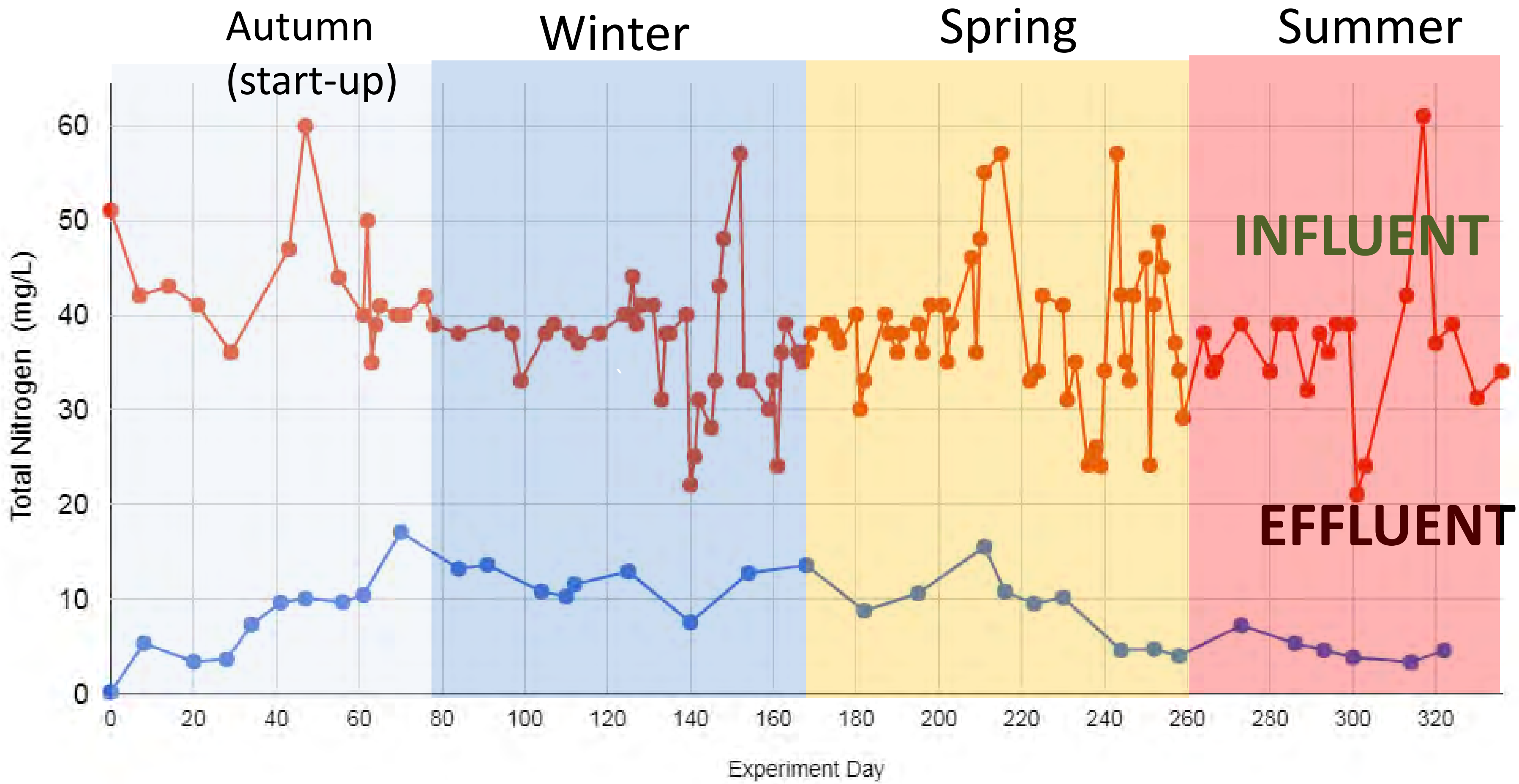


Design 1

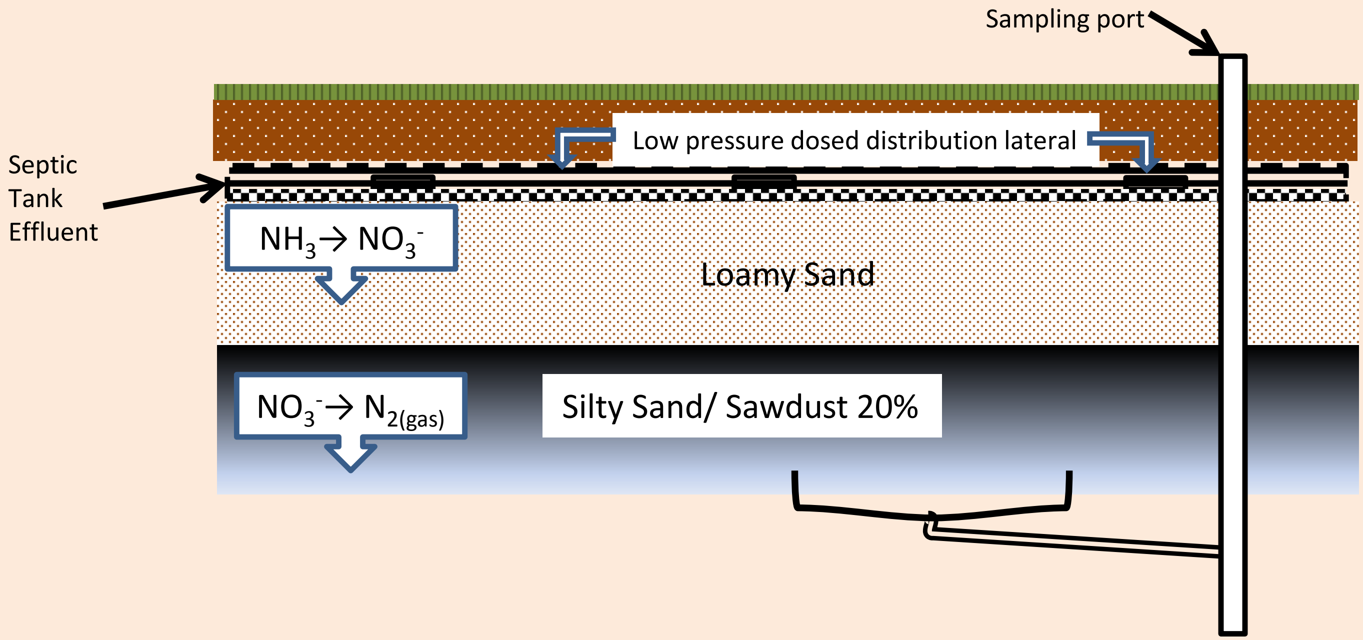
Simple layered system (no liner)



Average TN since Sept 2016 – May 2017 – 9.9 mg/L
Average TN since June 6, 2017 – 4.7 mg/L day 325

Design 1

Simple layered system (no liner)
Slightly modified



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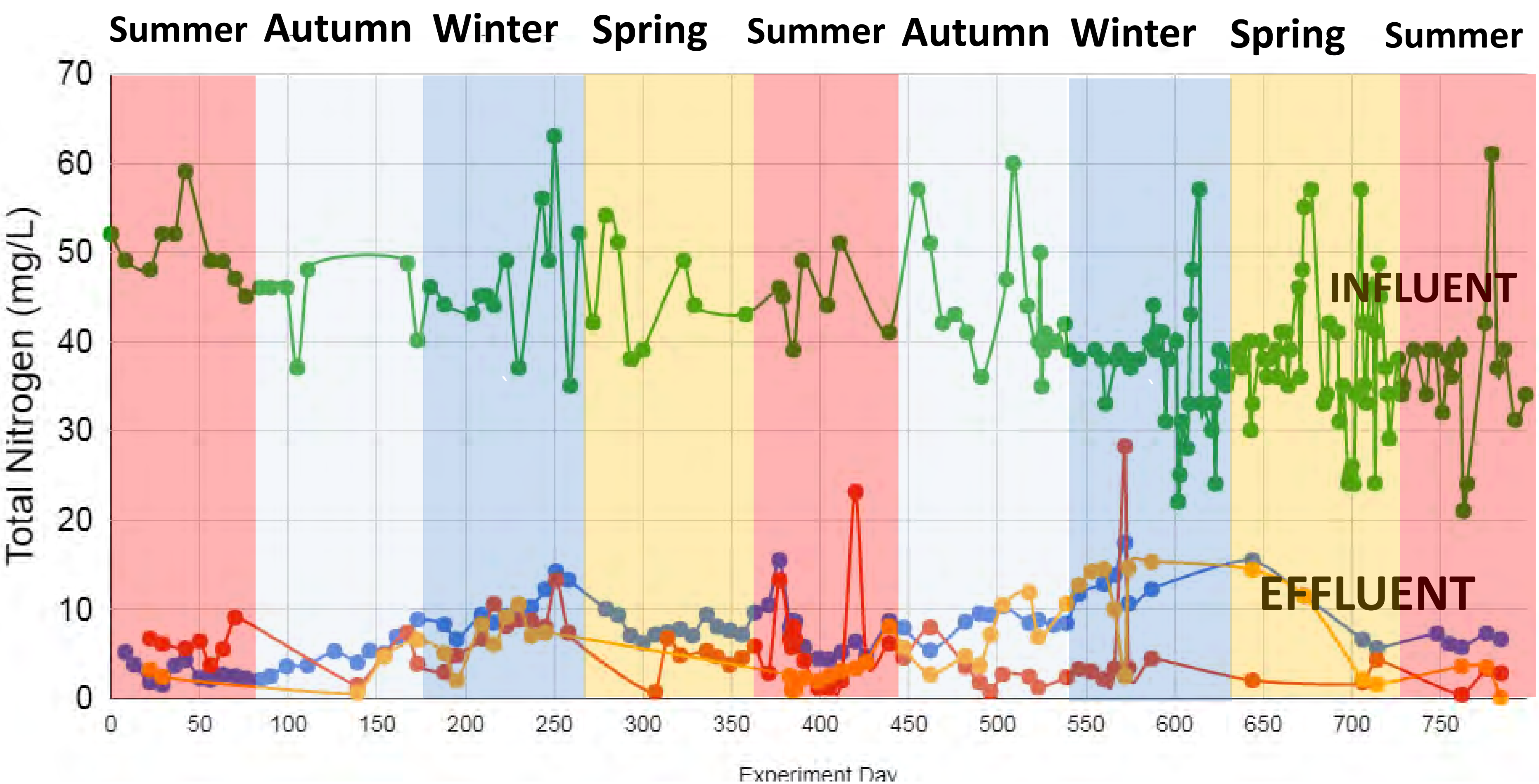
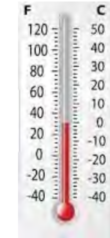
Design 1

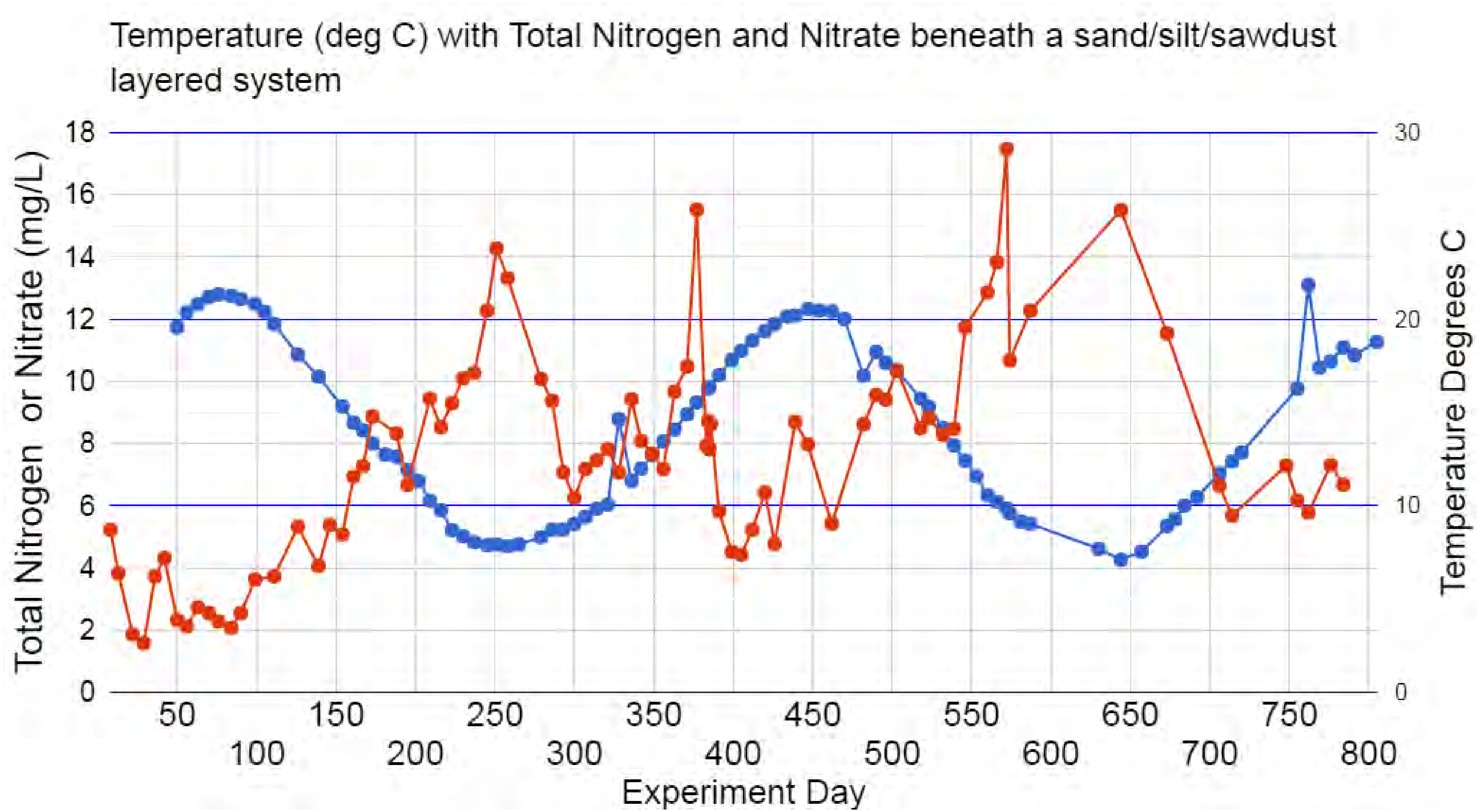
Simple layered system (no liner)



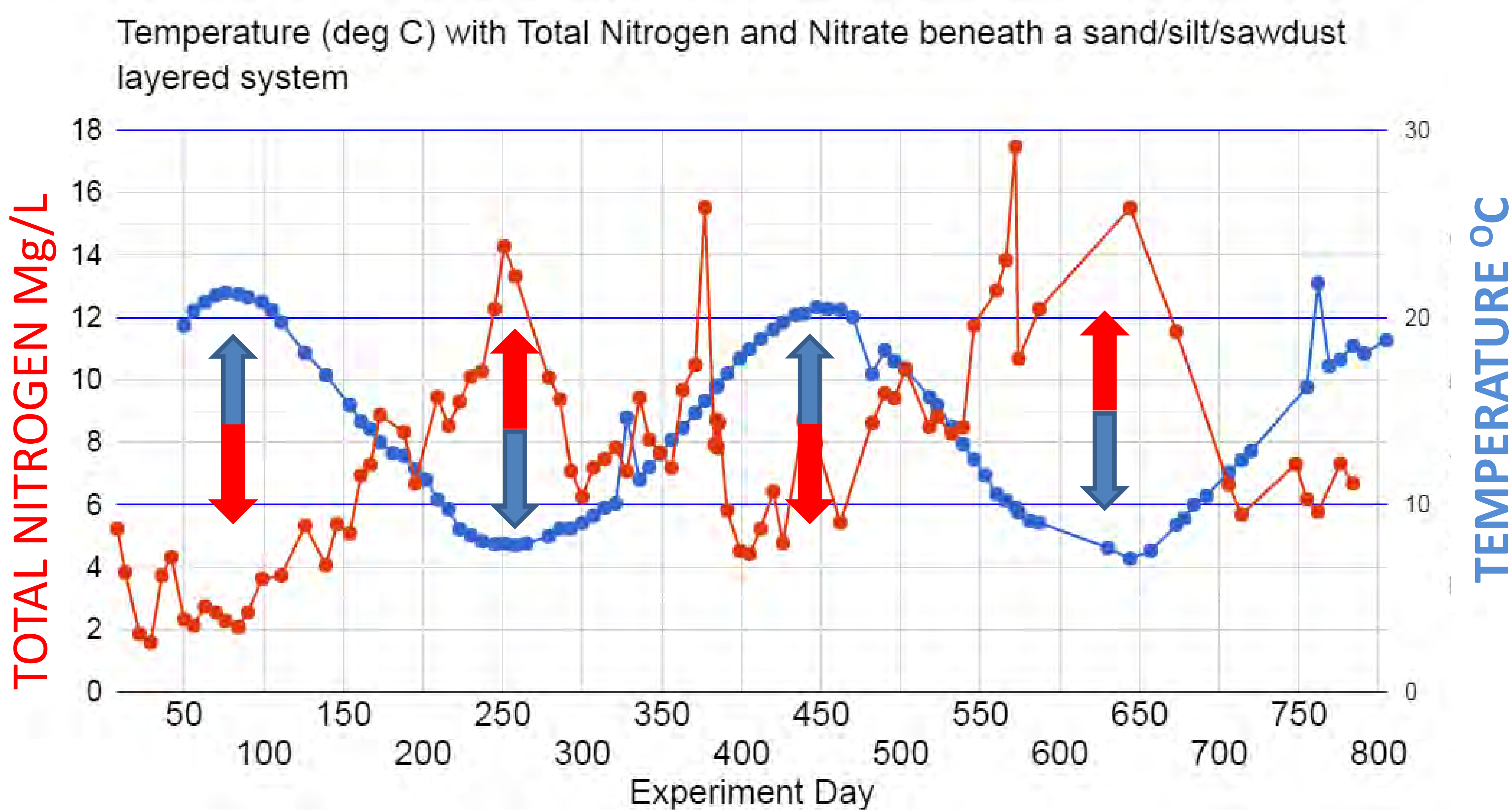
Average TN below system 7.6 mg/L (6.9 – 8.3 mg/L TN, p=.05)

The effect of temperature





The effect of temperature

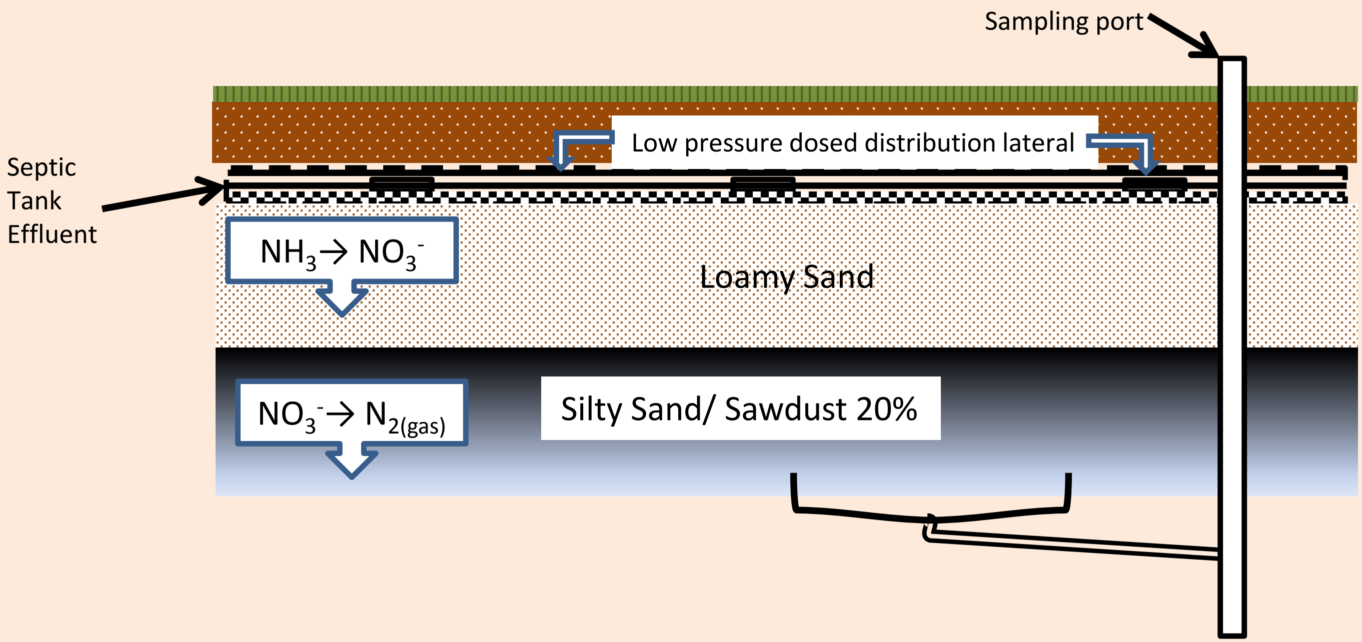


As temperature decreases, TN increases

So practically what does it look like? How is it constructed?

Design 1

Simple layered system (no liner)



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Full-scale layered system

Design 1

Simple layered system (no liner)

Design 1

Simple layered system (no liner)

Design 1

Simple layered system (no liner)

Field area levelled and made ready for distribution piping

Low-pressure distribution piping placed

Design 1

Simple layered system (no liner)

Final grade over soil treatment area

Grass planted over soil treatment area

Design 1

Simple layered system (no liner)

Example 2
Still
Design 1

Design 1

Simple layered system (no liner)

Design 1

Simple layered system (no liner)

Full-scale layered system (2)

Design 1

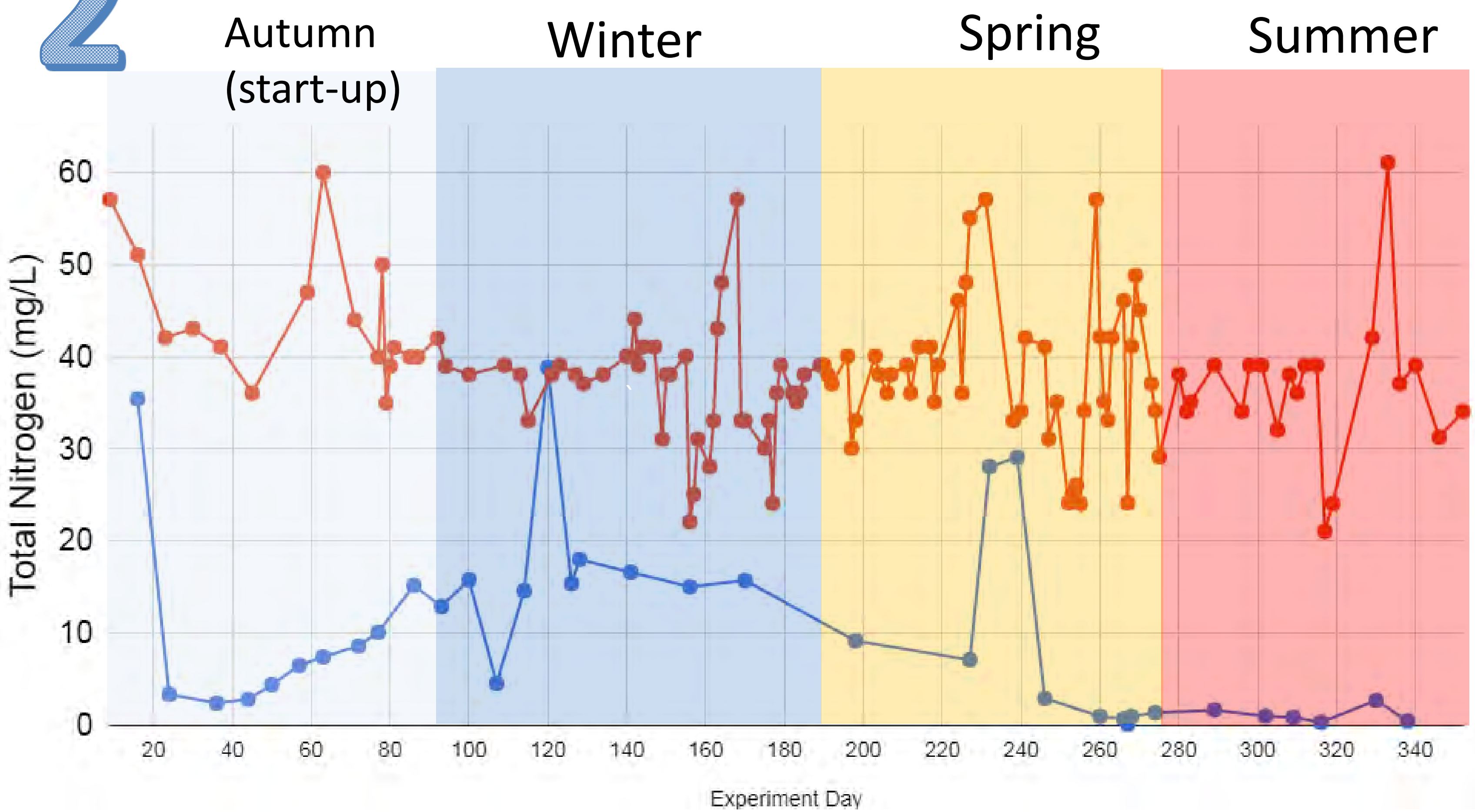
Simple layered system (no liner)

Design 1

Simple layered system (no liner)

Design 2

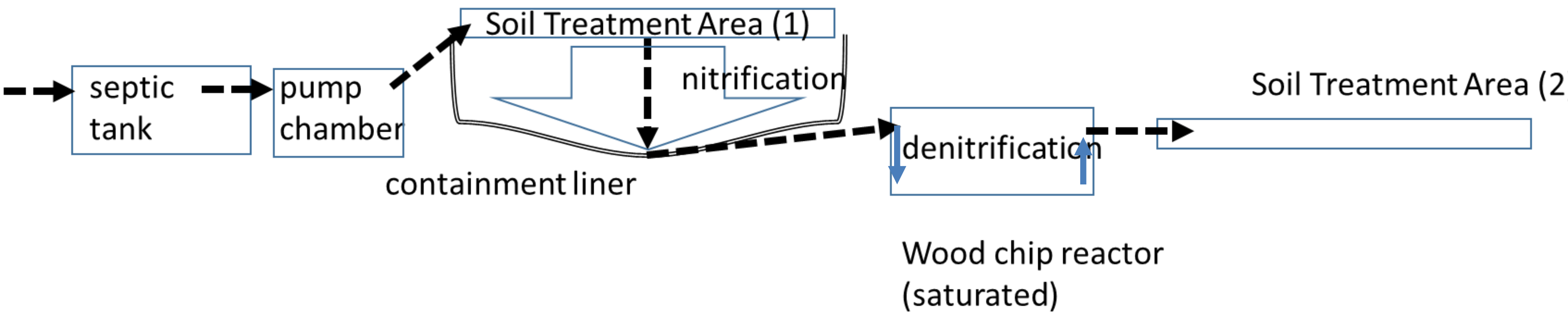
The containment liner provided a saturated area that held water and occluded oxygen



Design 3

Three Basic Designs

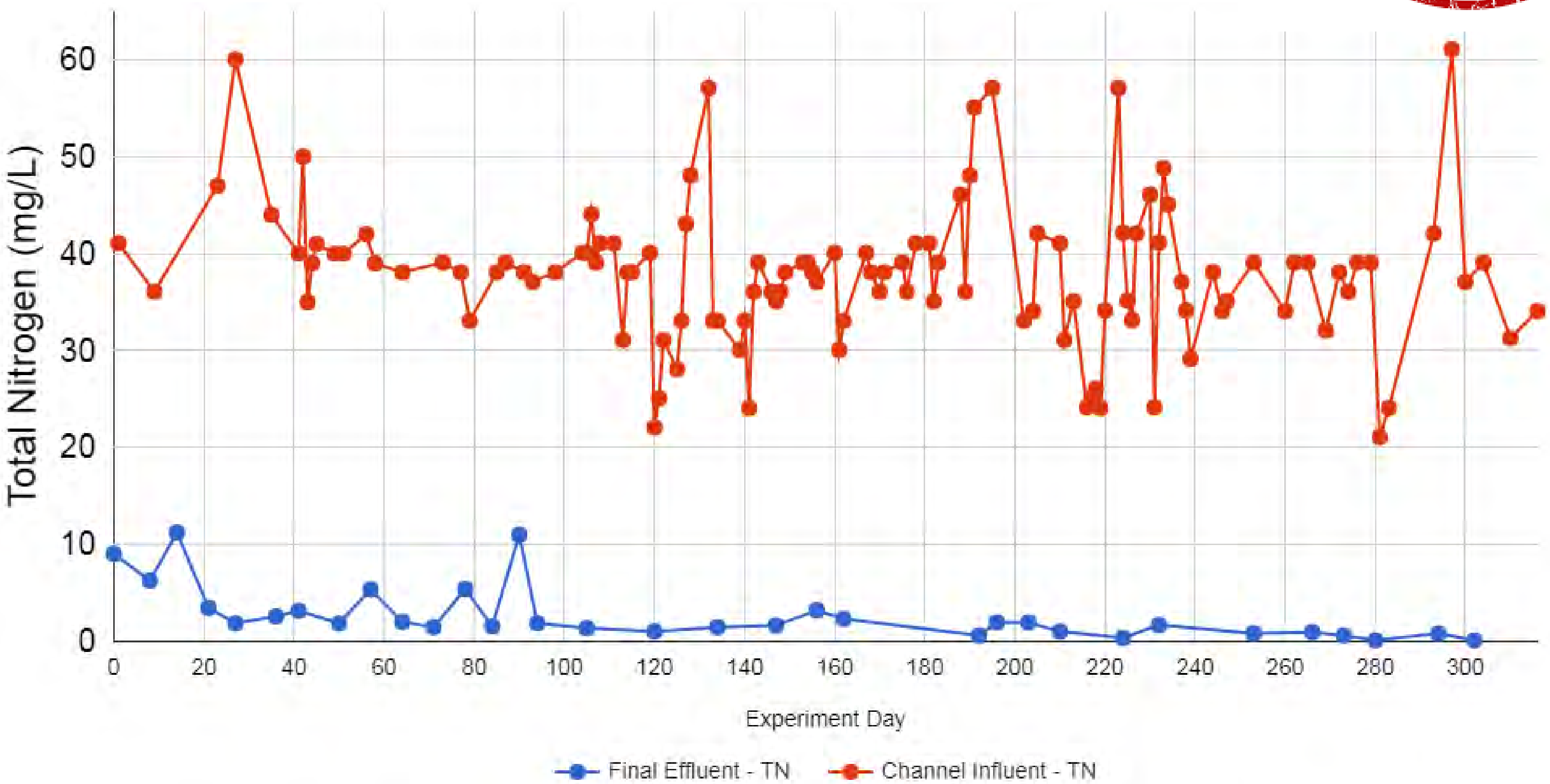
The container provided a saturated area that held water and occluded oxygen




Underdrain to woodchip bioreactor

Design 3

The container provided a saturated area that held water and occluded oxygen



Conclusions

Design 1

- Easiest to install
- Overall 75%+ removal
- Uncertain media life

Design 2

- Liner required
- Overall 75%+ removal
- Final disposal required
- More certain media life

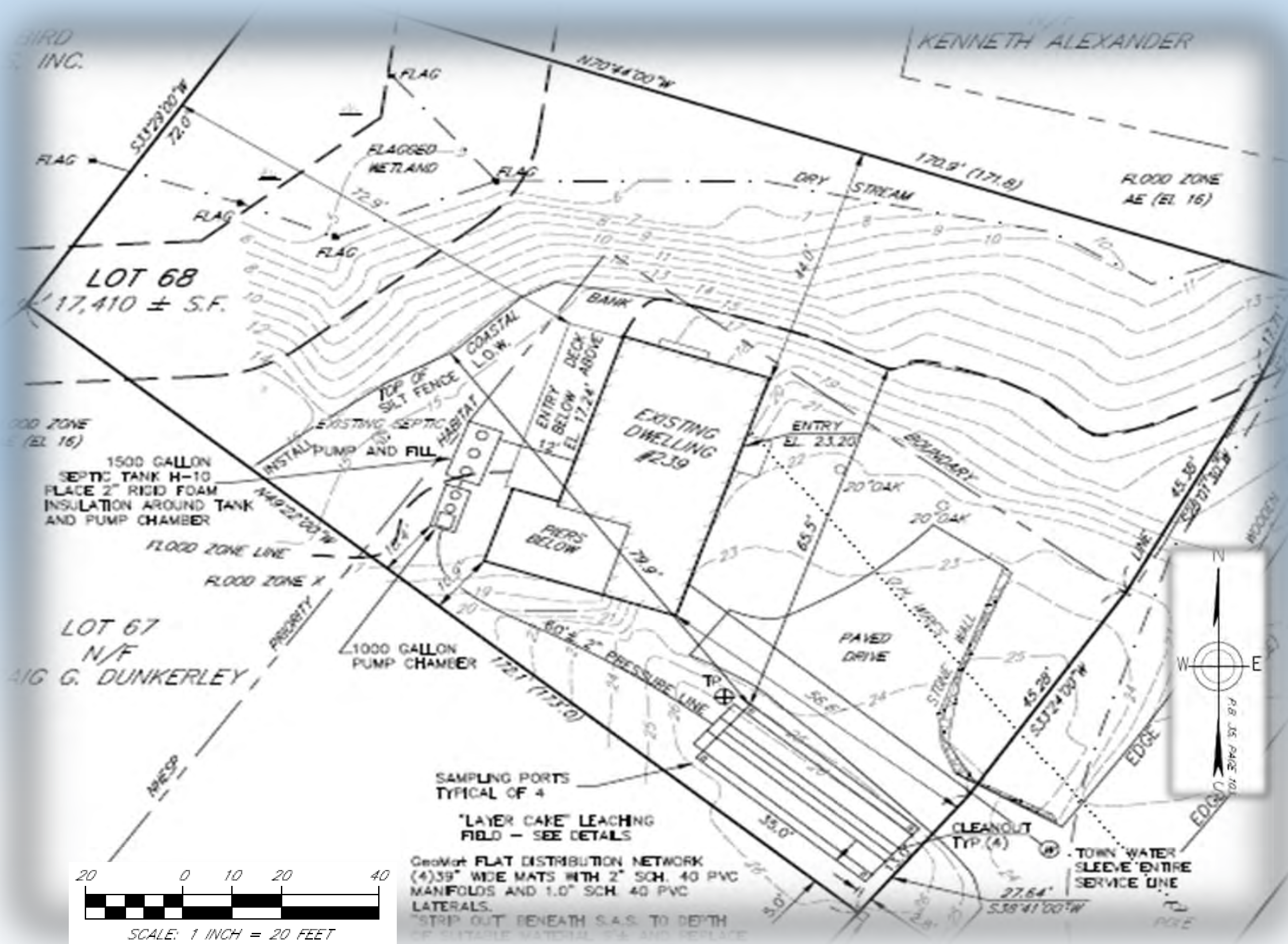
Design 3

- Overall 85-90% removal
- Final disposal required
- More certain media life
- Easy access for media replacement

Questions?

George Heufelder M.S., R.S.
Barnstable County Department of Health and Environment
Massachusetts Alternative Septic System Test Center
MASSTC.org email gheufelder@barnstablecounty.org

Design & Permitting



Site Suitability Considerations

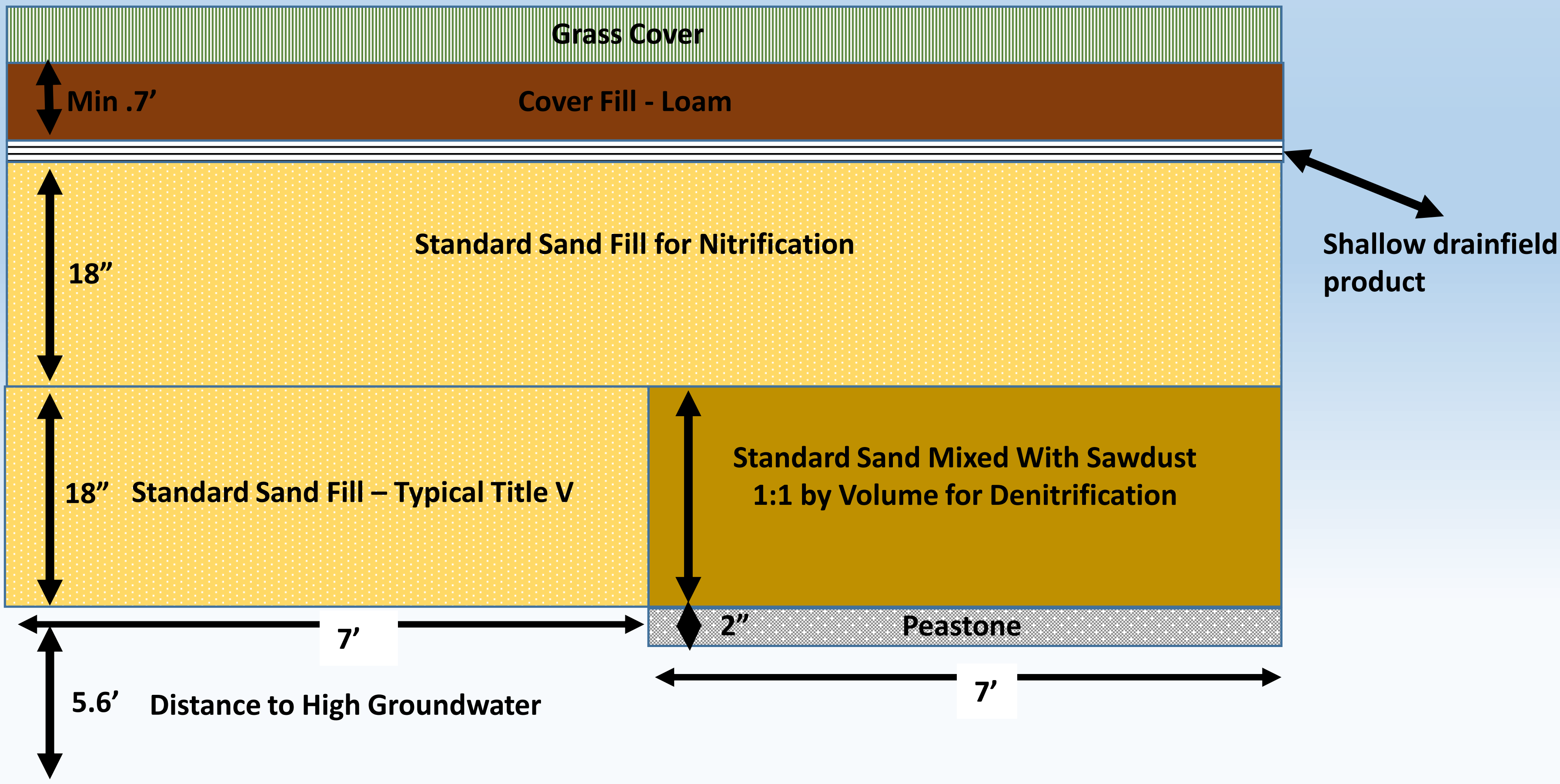
- Soils
- Groundwater elevation
- Lot size
- House coverage

- ~150 SF of leach area/bedroom plus the septic tank and pump chamber area

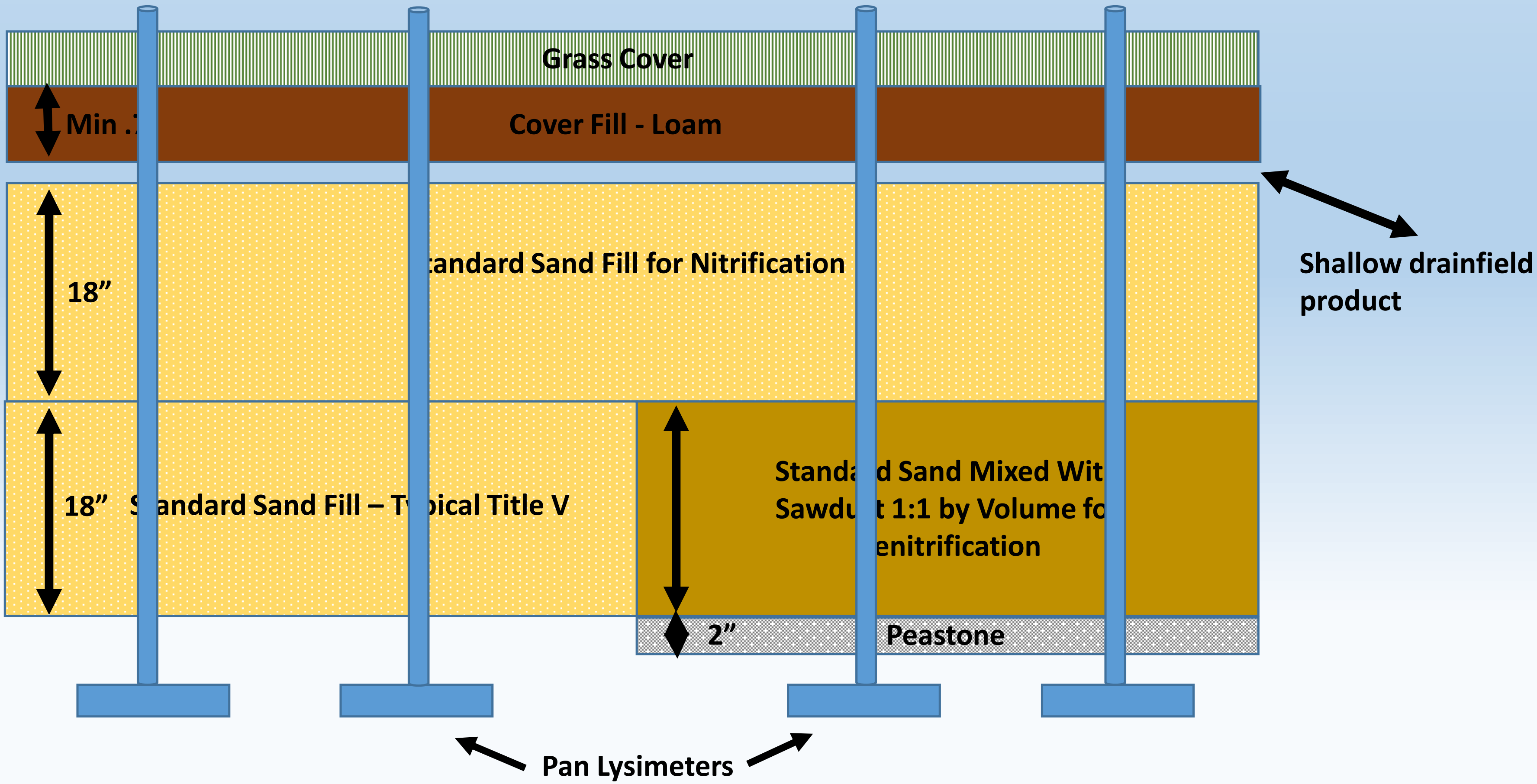
Conventional vs. Layer Cake Design

- Shallow leach field – 4 feet vs. 5 feet
- Less over dig – 12 inches vs. 5 feet
- Depth to groundwater relief with GeoMat
- Monitoring & pan lysimeters
- Pump chamber for 1 pump & electrical panel for low pressure timed dosing

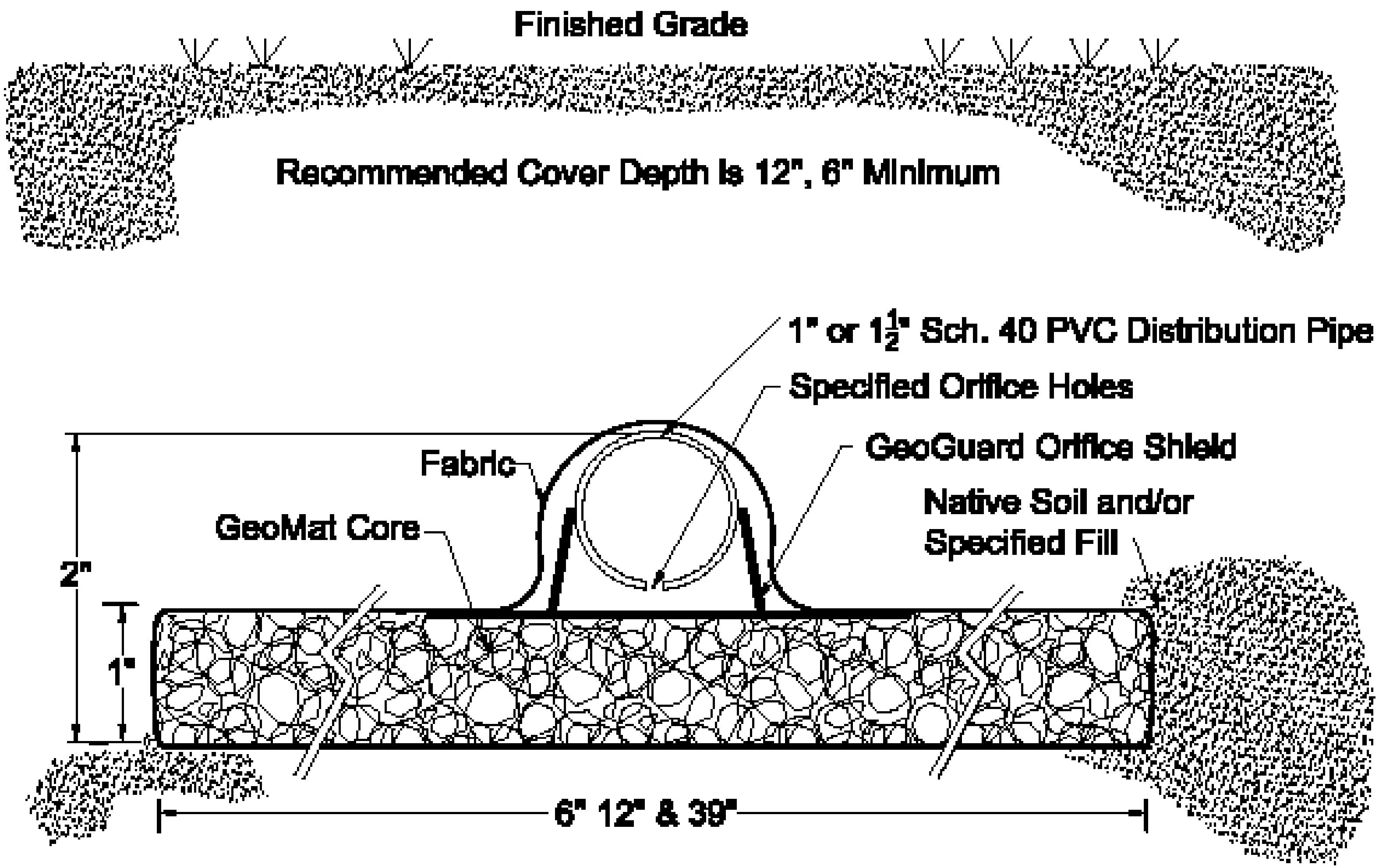
Cross Section



Pan Lysimeter Locations



GeoMat Cross Section

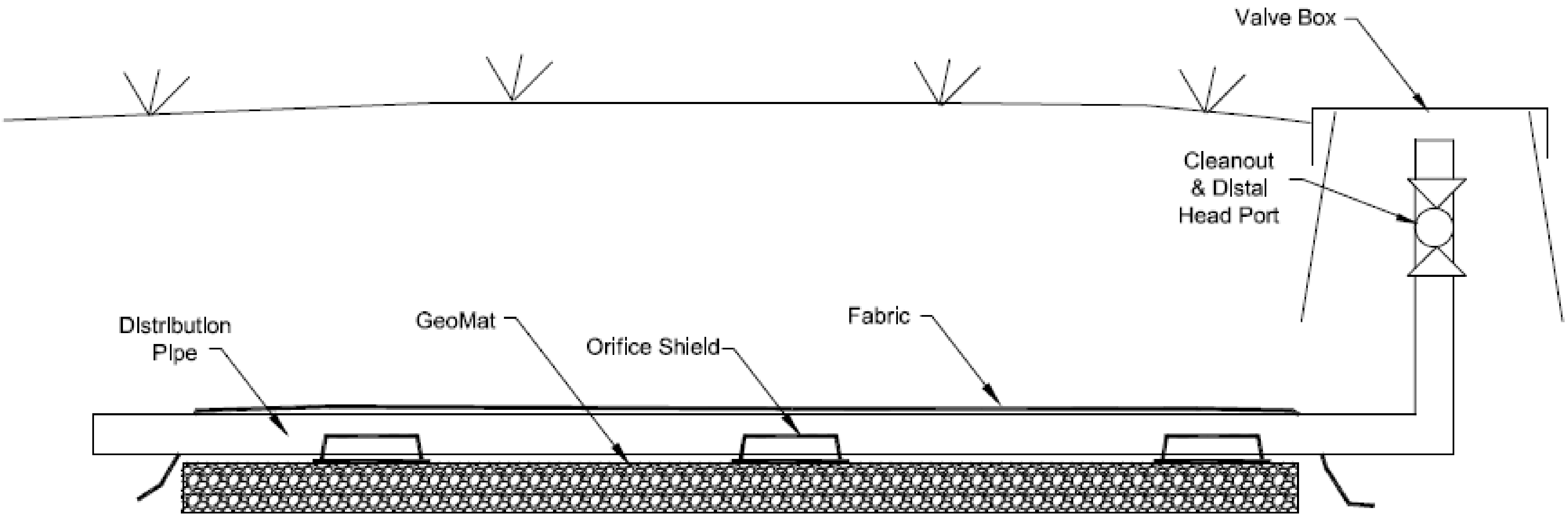


GEOMAT LEACHING SYSTEM
Cross Section
- Not to Scale -

NOTE: Lateral spacing as required

GEOMAT LEACHING SYSTEM Cross Section Geomatrix Systems, LLC., Old Saybrook, CT	
SCALE None	REV. A
DATE 7/2/2011	ACAD No.
DRAWN BY: ERP	SHEET 1 OF 1

GeoMat Longitudinal Cross Section



Massachusetts

September 2017

Patents: www.geomatrixsystems.com –
GeoMat is a trademark of Geomatrix Systems, LLC

GeoMat™ Leaching Systems

Design Manual for
Pressure and Gravity Applications

GEOMATRIX

Pipe & Pump Calculator

Windows 2000/XP/Vista Version 1.0

Software for calculating pressure distribution requirements for Geomatrix Products

Geomatrix Systems, LLC 888-764-5247 www.geomatrixsystems.com

GeoMat System Parameters

File Edit Tools Project Help

GeoMat System Parameters

Orifice Size	3/16	inches
Residual Head at Last Orifice	4.0	feet
Orifice Spacing	4.0	feet
Number of Laterals (all zones)	2	
Perforated Lateral Length	40	feet
Non-Perforated Lateral Length	0	feet
Lateral Pipe Class/Schedule	40	
Lateral Line Size	1.00	inches
Distributing Valve Model	None	
Manifold Length	10	feet
Manifold Pipe Class/Schedule	40	
Manifold Line Size	2.00	inches
Lift to Manifold	5	feet
Transport Length	100	feet
Transport Pipe Class/Schedule	40	inches
Transport Line Size	2.00	inches
Discharge Assembly Size	2.00	inches
Flow Meter	None	feet
'Add-on' Friction Losses	0	

Calculation

Minimum Flow Rate per Orifice	0.87	gpm
Number of Orifices per Zone	22	
Total Flow Rate per Zone	19.6	gpm
Number of Laterals per Zone	2	
% Flow Differential 1st and Last Orifice	8.5	%

Static Heads

Lift to Manifold	5	feet
Residual Head at Last Orifice	4.0	feet

Frictional Head Losses

Head Loss in Perforated Laterals	0.9	feet
Head Loss in Non-Perforated Laterals	0.0	feet
Head Loss through Distributing Valve	0.0	feet
Head Loss in Manifold	0.0	feet
Head Loss in Transport Pipe	0.7	feet
Head Loss through Discharge	0.8	feet
Head Loss through Flow Meter	0.0	feet
'Add-on' Friction Losses	0.0	feet

Size Pump For

Design Flow Rate	19.6	gpm
Total Dynamic Head	11.4	feet

The flow rate required of the pump to satisfy the input design parameters.

Calculate

DEP I/A Technology Approvals for GeoMat

- *Remedial Use Approval* – for upgrade or replacement of existing failed or nonconforming systems

- *General Use Approval* – for addition to a fully compliant Title 5 system or being built in compliance with new construction requirements

https://www.mass.gov/guides/title-5-innovativealternative-technology-approval-letters

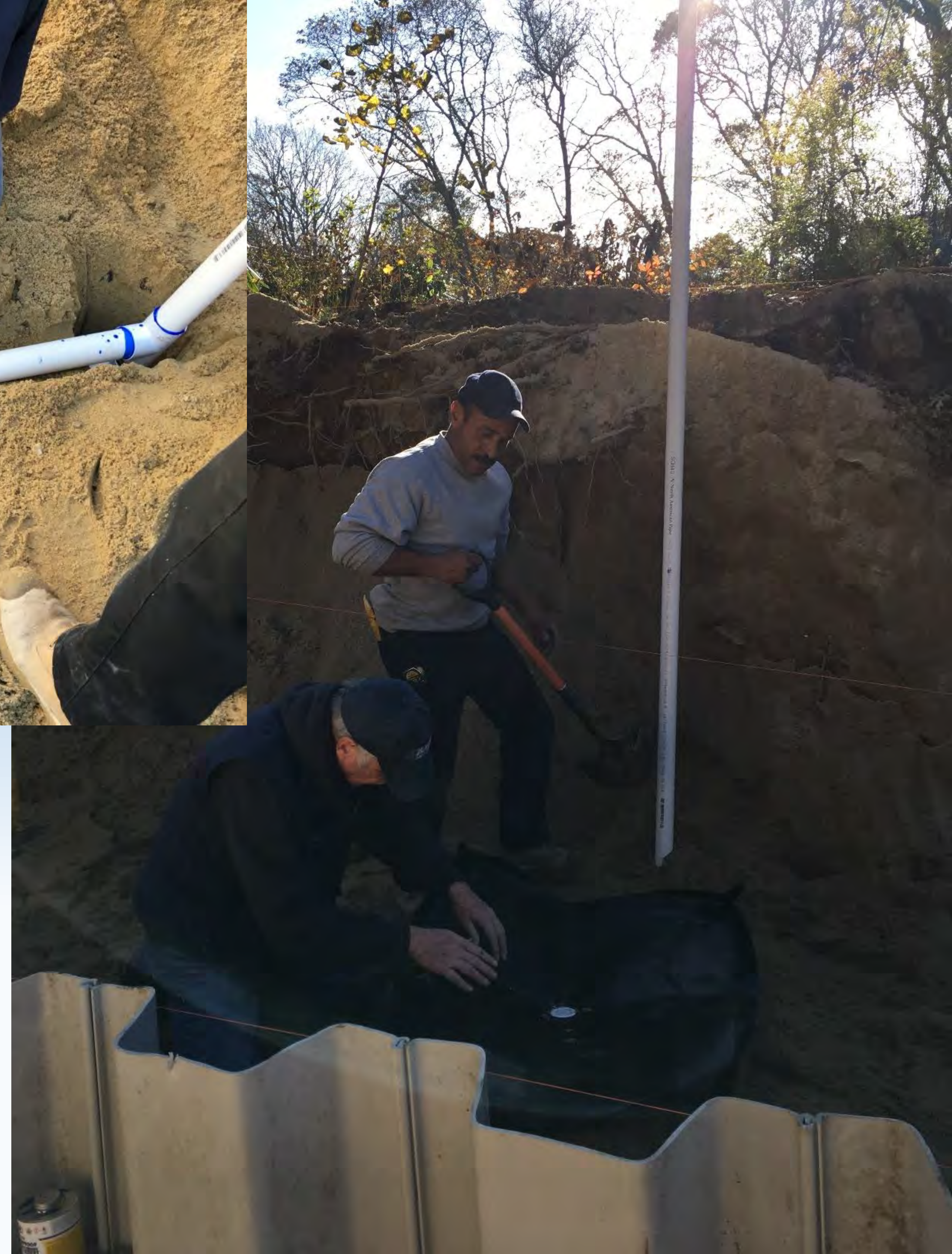
Permits

- Board of Health
- Conservation if needed
- MassDEP pilot approval
- ~3 months altogether
- Some towns grant fee waivers to support innovative technology

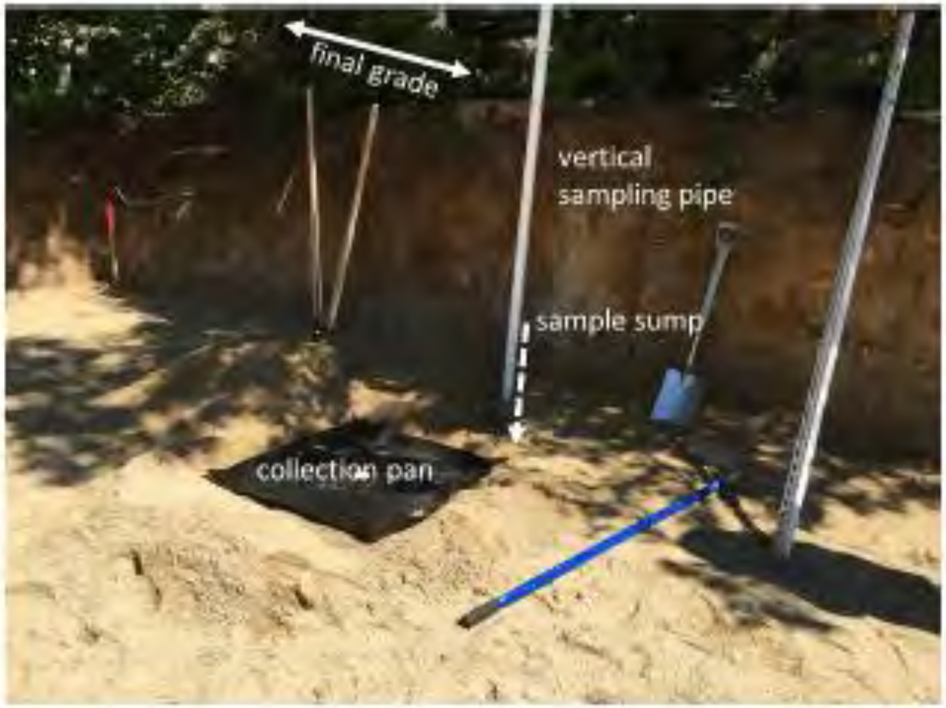
Mixing sand & sawdust

Installation





Installation of pan lysimeters by BCDHE



Source: BCDHE & MASSTC Fact Sheet: Construction Summary for Layered Soil Treatment Area (LSTA) to be installed under the Demonstration Project – A primer for board of health members, septic system designers and installers

Peastone Layer

Compaction of sand-sawdust 50-50% mix

Setting up laterals


Connecting laterals into GeoMat

Laying out the field

Shallow distribution


HYUNDAI

Pump chamber

Ball valve

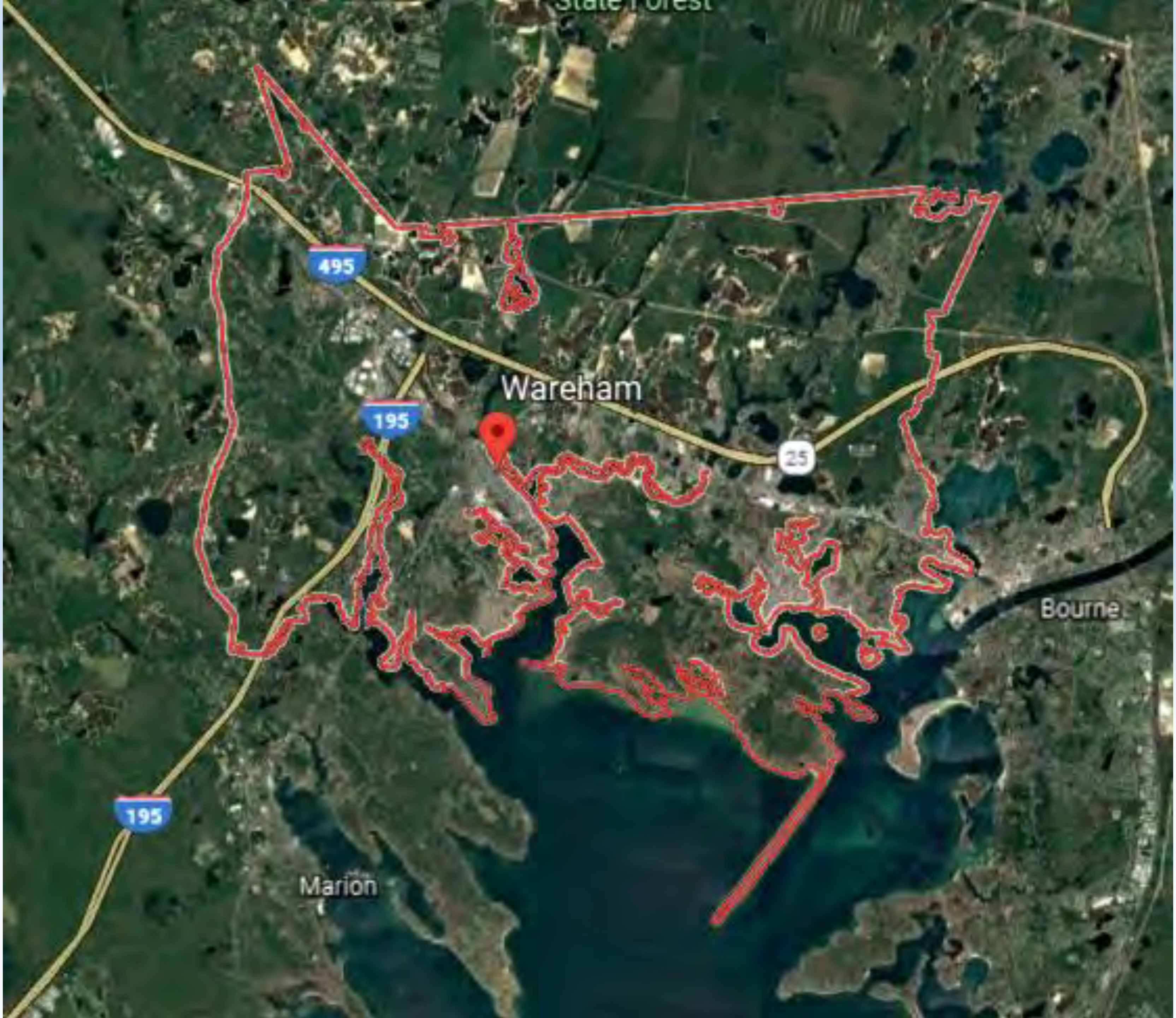

CH-40 10 NATIONAL N/O 2" SCH-40 PLUMB-RITE
STM D-1785 NSF pw-G DWV ASTM D-2665 NSF dwv E NY 11:09 04-11-15

Homeowner Perspective from Wareham

2013 Board of Health Water Quality Protection Regs.

Established WQ Protection Zone within 500 feet of any surface water

- New Construction – 150-foot setback for new leachfields & N-reducing system with TN annual average < or =19 mg/L
- Existing & Expanded Systems – increase in flow & failed systems, including cesspools, requires N-reducing system with TN annual average < or =19 mg/L

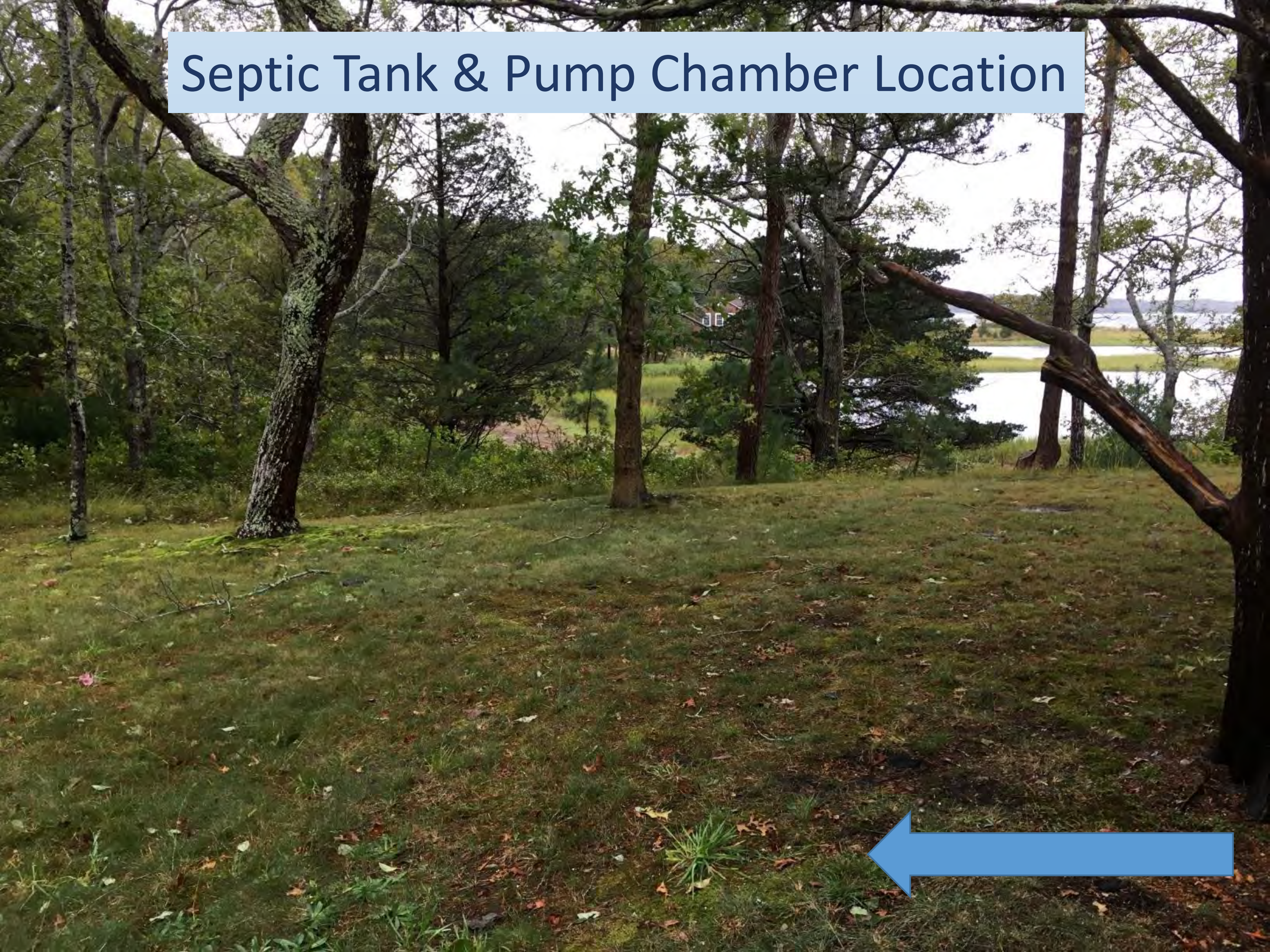

495
Wareham
195
25
Bourne
195
Marion

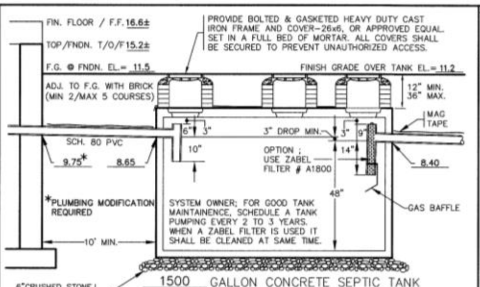
TOWN OF WAREHAM ★ MASSACHUSETTS
NEPINNAE KEKIT
·1739·

Existing Cesspool

Layer Cake Leachfield Location

Septic Tank & Pump Chamber Location





1500 GALLON CONCRETE SEPTIC TANK

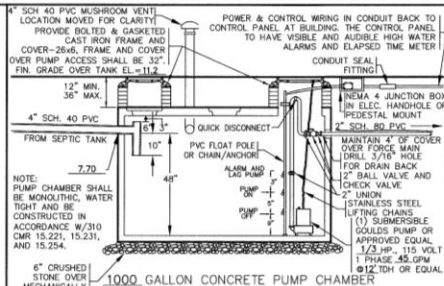
LENGTH 10' 6" WIDTH 5' 4" DEPTH 5' 8"

TANK SHALL BE INSTALLED ON A LEVEL STABLE BASE

NOTE: SEPTIC TANK SHALL BE MONOLITHIC, WATER TIGHT.

SEPTIC TANK PROFILE

N.T.S./H-20 LOADING REQUIRED



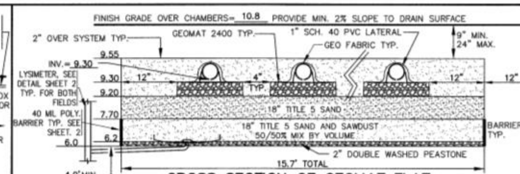
1000 GALLON CONCRETE PUMP CHAMBER

LENGTH 8' 6" WIDTH 4' 10" DEPTH 5' 4"

TANK SHALL BE INSTALLED ON A LEVEL STABLE BASE

PUMP CHAMBER PROFILE

N.T.S.



CROSS SECTION OF GEOMAT FLAT LAYERED SOIL TREATMENT AREA

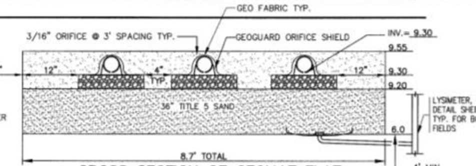
GEOMAT 2400 BY GEOMATRIX SYSTEMS, LLC / N.T.S.

6 NUMBER OF LATERALS

15.7' TOTAL WIDTH

36' TOTAL LENGTH

NOTES:
1) TITLE 5 SAND/SAWDUST MIXTURE TO BE SPECIFIED AND APPROVED BY BARNSTABLE COUNTY HEALTH DEPARTMENT AND/OR MASSACHUSETTS ALTERNATIVE SEPTIC SYSTEM TEST CENTER.
2) INSTALL "GEOMAT FLAT" IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
3) USE CLEAN GRANULAR TITLE 5 SAND IN ACCORDANCE WITH 310 CMR 15.255(3)
4) REMOVE AND REPLACE EXISTING SOIL DOWN TO SUITABLE MATERIAL FOR THE FOOTPRINT OF BOTH FIELDS.



CROSS SECTION OF GEOMAT FLAT CONVENTIONAL LAYOUT

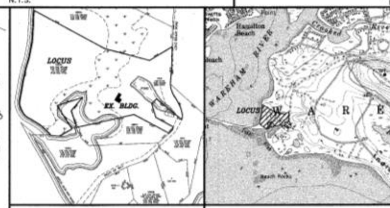
GEOMAT 2400 BY GEOMATRIX SYSTEMS, LLC / N.T.S.

3 NUMBER OF LATERALS

8.7' TOTAL WIDTH

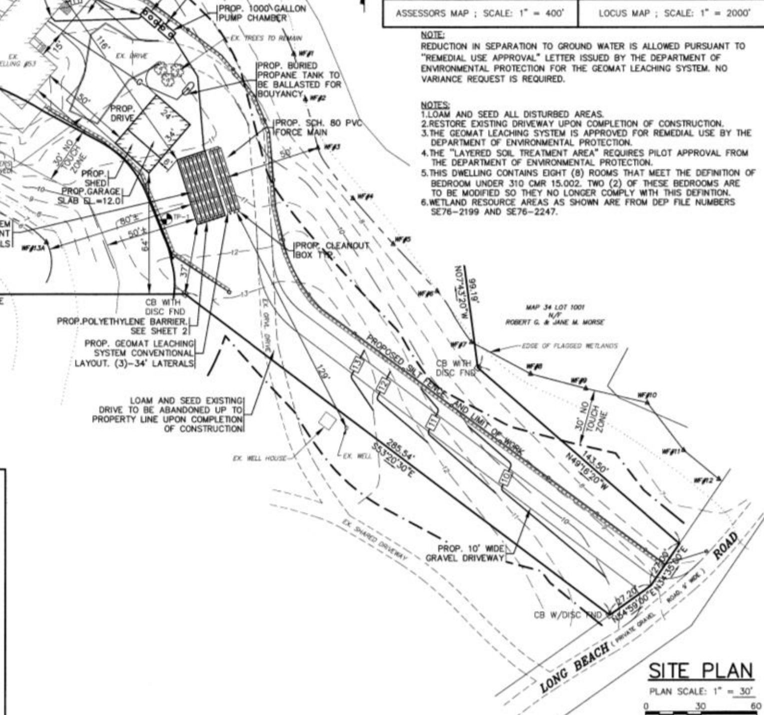
36' TOTAL LENGTH

NOTES:
1) INSTALL "GEOMAT FLAT" IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2) USE CLEAN GRANULAR TITLE 5 SAND IN ACCORDANCE WITH 310 CMR 15.255(3)
3) REMOVE AND REPLACE EXISTING SOIL DOWN TO SUITABLE MATERIAL FOR THE FOOTPRINT OF BOTH FIELDS.



ASSESSORS MAP ; SCALE: 1" = 400'

LOCUS MAP ; SCALE: 1" = 2000'

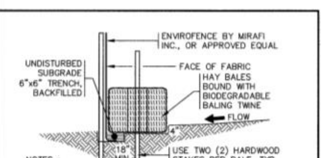


SITE PLAN

PLAN SCALE: 1" = 30'

NOTE:
REDUCTION IN SEPARATION TO GROUND WATER IS ALLOWED PURSUANT TO "REMEDIAL USE APPROVAL" LETTER ISSUED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION FOR THE GEOMAT LEACHING SYSTEM. NO VARIANCE REQUEST IS REQUIRED.

NOTES:
1. LOAM AND SEED ALL DISTURBED AREAS.
2. RESTORE EXISTING DRIVEWAY UPON COMPLETION OF CONSTRUCTION.
3. THE GEOMAT LEACHING SYSTEM IS APPROVED FOR REMEDIAL USE BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION.
4. THE "LAYERED SOIL TREATMENT AREA" REQUIRES PILOT APPROVAL FROM THE DEPARTMENT OF ENVIRONMENTAL PROTECTION.
5. THIS DWELLING CONTAINS EIGHT (8) ROOMS THAT MEET THE DEFINITION OF BEDROOM UNDER 310 CMR 15.002. TWO (2) OF THESE BEDROOMS ARE TO BE MODIFIED SO THEY NO LONGER COMPLY WITH THIS DEFINTION.
6. WETLAND RESOURCE AREAS AS SHOWN ARE FROM DEP FILE NUMBERS SE76-2199 AND SE76-2247.



NOTES ;
1. EROSION CONTROL MEASURES SHALL BE MAINTAINED UNTIL VEGETATIVE COVER HAS BEEN FIRMLY ESTABLISHED.
2. EROSION CONTROL MEASURES SHALL MEET PERFORMANCE STANDARDS OF THE USDA SOIL CONSERVATION SERVICE, AND ANY APPLICABLE STATE/LOCAL CONSERVATION AUTHORITY.

SILTATION BARRIER DETAIL

N.T.S.

GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL SYSTEM COMPONENTS AND CONSTRUCTION METHODS SHALL BE IN ACCORDANCE WITH 310 CMR (TITLE 5) AND ANY APPLICABLE LOCAL RULES.
2. ANY CHANGES TO THIS PLAN MUST BE APPROVED BY THE ENGINEER & BOARD OF HEALTH.
3. USE 4" SCH. 40 PVC PIPE W/WATER TIGHT JOINTS UNLESS OTHERWISE NOTED.
4. SLOPE ALL SOLID PIPE AT 1.0% MINIMUM.
5. THIS SYSTEM IS NOT DESIGNED FOR A GARBAGE DISPOSAL.
6. THE BOARD OF HEALTH & ENGINEER SHALL BE NOTIFIED PRIOR TO BACKFILLING WHEN THE SYSTEM IS NEARLY COMPLETE & READY FOR INSPECTION. SYSTEM IS NOT TO BE BACKFILLED WITHOUT FIRST OBTAINING APPROVAL FROM BOARD OF HEALTH AND DESIGN ENGINEER.
7. ELEVATIONS BASED ON NAVD-88
8. CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION & REPORT ANY DISCREPANCIES TO THE DESIGN ENGINEER. ALL UNDERGROUND UTILITIES SHOWN OR NOT SHOWN WERE COMPILED ACCORDING TO AVAILABLE RECORD PLANS AND IN PART FROM DIGSAFE DELINEATIONS AND ARE APPROXIMATE ONLY. ACTUAL LOCATIONS MUST BE DETERMINED IN THE FIELD. BEFORE EXCAVATING, BLASTING, INSTALLING, BACK FILLING, GRADING, PAVING OR REPAIRING, ALL UTILITY COMPANIES, PUBLIC AND PRIVATE MUST BE CONTACTED INCLUDING THOSE IN CONTROL OF UTILITIES NOT SHOWN ON THIS PLAN. SEE MGL CHAPTER 370, ACTS OF 1963. CONTRACTORS MUST CALL DIG-SAFE. G.A.F. ENGINEERING, INC. ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN.
9. NON-SHRINK GROUT TO BE USED AT ALL POINTS WHERE PIPES ENTER OR LEAVE ALL CONCRETE STRUCTURES IN ORDER TO PROVIDE WATER TIGHT SEALS.
10. ALL TANKS SHALL BE WATERTIGHT THROUGH MANUFACTURERS SPECIFICATIONS OR APPLICATION OF ASPHALT OR SYNTHETIC POLYMER SEALER.
11. ALL SEPTIC SYSTEM COMPONENTS SHALL WITHSTAND H-10 LOADING UNLESS LOCATED UNDER PAVEMENT, DRIVES OR TRAVELED WAYS IN WHICH CASE THEY SHALL WITHSTAND H-20 LOADING.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PAYING ALL APPLICABLE FEES AND OBTAINING ALL PERMITS, INCLUDING A TRENCH PERMIT PURSUANT TO 320 CMR 14.00 AS APPLICABLE.
13. WHERE REQUIRED, CONTRACTOR SHALL REMOVE ALL LOAM, SUBSOIL AND UNSUITABLE MATERIAL IN AREA BENEATH AND FOR 5 FT. ON ALL SIDES OF LEACHING FACILITY. REPLACE ALL UNSUITABLE MATERIAL WITH CLEAN COARSE SAND FREE FROM CLAY, FINES OR OTHER UNSUITABLE MATERIAL IN ACCORDANCE WITH 310 CMR 15.255(3).
14. CONTRACTOR SHALL NOTIFY DESIGN ENGINEER OF ANY DISCREPANCIES FOUND IN SITE CONDITIONS FROM THOSE SHOWN PRIOR TO CONTINUATION OF WORK.
15. ALL SYSTEM COMPONENTS SHALL BE MARKED WITH MAGNETIC MARKING TAPE OR A COMPARABLE MEANS IN ORDER TO LOCATE THEM ONCE BURIED.
16. ALL SOIL ABSORPTION SYSTEMS SHALL HAVE A MINIMUM OF ONE (1) INSPECTION PORT CONSISTING OF A PERFORATED FOUR(4) INCH PIPE PLACED VERTICALLY DOWN INTO THE STONE TO THE NATURALLY OCCURRING SOIL OR SAND FILL BELOW THE STONE. THE PIPE SHALL BE CAPPED WITH A SCREW TYPE CAP AND ACCESSIBLE TO WITHIN THREE(3) INCHES OF FINISH GRADE.
17. WHERE AN EXISTING CESSPOOL IS TO BE ABANDONED IN PLACE, IT SHALL BE PUMPED COMPLETELY DRY, COLLAPSED IN PLACE AND BACKFILLED WITH CLEAN GRANDULAR SAND IN ACCORDANCE WITH 310 CMR 15.255(3).
18. WHERE AN EXISTING SEPTIC TANK IS TO BE REMOVED FROM THE SITE, IT SHALL BE PUMPED COMPLETELY DRY PRIOR TO REMOVAL. WHERE AN EXISITNG LEACHING AREA IS TO BE REMOVED, ALL STRUCTURES, INCLUDING DISTRIBUTION BOX, ANY PIPE, CRUSHED STONE AND ALL CONTAMINATED SOIL SHALL BE REMOVED. BACKFILL WITH CLEAN GRANDULAR SAND IN ACCORDANCE WITH 310 CMR 15.255(3). ALL MATERIALS SHALL BE DISPOSED OF IN ACCORDANCE WITH ALL LOCAL, STATE AND FEDERAL REGULATIONS.
19. PROPOSED PROJECT IS LOCATED WITHIN:
    ASSESSORS MAP # 34 LOT # 1007-B
    ZONING DISTRICT R-60
    BUILDING SETBACKS F: 20 ft. S: 10 ft. R: 10 ft.
    FEMA FLOOD ZONE VE ELEVATION 18
    AS SHOWN ON COMMUNITY PANEL # 25023C0577J
20. OWNER OF RECORD: ANTHONY & WENDY PIRES
    ADDRESS: 236 S. COLLEGE STREET
    CARLISLE, PA 17013

TEST PIT DATA

INSPECTOR: DAVID FLAHERTY DATE: NOV. 1, 2012

SOIL EVALUATOR: KEVIN W. FORGUE CERT. #: SE-782

TEST PIT #: 1	TEST PIT #:	TEST PIT #:	TEST PIT #:
ELEV TOP = 11.2	ELEV TOP =	ELEV TOP =	ELEV TOP =
ELEV WATER = 2.8 MOTTLES @ 110"	ELEV WATER =	ELEV WATER =	ELEV WATER =
PERC RATE = 2 MIN/IN	PERC RATE = MIN/IN	PERC RATE = MIN/IN	PERC RATE = MIN/IN
DEPTH OF PERC=36-54"	DEPTH OF PERC=	DEPTH OF PERC=	DEPTH OF PERC=
TEXTURAL CLASS I	TEXTURAL CLASS	TEXTURAL CLASS	TEXTURAL CLASS

Test Pit 1 log (REMOVE & REPLACE 0–30"):

0–8"	SANDY LOAM 10 YR 2/2
8"–30"	LOAMY SAND 10 YR 5/6
30"–120"	FINE SAND 2.5 Y 6/4 (MOTTLES 110")

DESIGN DATA

NUMBER OF BEDROOMS 6 (ACTUAL BEDROOM COUNT IS 8)
NUMBER OF PERSONS 12
DESIGN FLOW 110 GAL/DAY/BEDROOM
TOTAL DESIGN FLOW 660 GAL/DAY

SEPTIC TANK:
660 GAL. X 200% = 1320 GALS. DESIGN CAPACITY
USE 1500 GALLON SEPTIC TANK. (MIN. SIZE PER REGS)

SYSTEM SIZING CALCULATION:
BOTTOM CAPACITY–EFFECTIVE LEACHING AREA (ELA)
GEOMAT LOADING RATE=1.5GPD/SF
SQ.FT. OF GEOMAT REQUIRED: 660GPD/1.5GPD/SF=440 SF
LENGTH OF GEOMAT FLAT 2400: (440SF)/(2.17LF/SF)=203 LIN. FT.
6 LATERALS @ 34' LENGTH + 1' SAND EACH END=36 FT
535 SF(MIN.)/36 FT LENGTH=14.9' WIDTH–USE 15.7' WIDTH
USE 15.7' WIDTH X 36' LENGTH=544 SF
15.7'–(6 ROWS OF GEOMAT 2400 2' WIDE)– 1FT EACH SIDE=1.7 FT
1.7 FT/5 SPACES BETWEEN LATERALS=4" SPACING
LAYERED SOIL TREATMENT AREA SHALL BE HALF OF CONVENTIONAL LAYOUT FIELD SIZE. USE 3 LATERALS

LEGEND

F.F. = 00.00	FINISHED FLOOR ELEVATION	T/O/F = 00.00	TOP OF FOUNDATION
G.F. = 00.00	GARAGE FLOOR ELEVATION	INV. = 00.00	INVERT ELEVATION
B.F. = 00.00	BASEMENT FLOOR ELEVATION	(00.00)	AS-BUILT ELEVATION
— 100 —	EXISTING CONTOURS	100x0	EXISTING SPOT GRADE
— 110 —	PROPOSED CONTOURS		TEST PIT LOCATION
— G —	GAS LINE		LIMITS OF WETLANDS
— E —	ELECTRIC LINE		SEPTIC TANK
— W —	WATER LINE		LIMITS OF OVERDIG
	4" SOLID SCH.-40 PVC PIPE		DISTRIBUTION BOX

REV.	DATE	BY	APP'D.	DESCRIPTION

APPROVED BY: 2/28/18

WILLIAM F. MADDEN CIVIL NO. 32883 REGISTERED PROFESSIONAL ENGINEER COMMONWEALTH OF MASSACHUSETTS

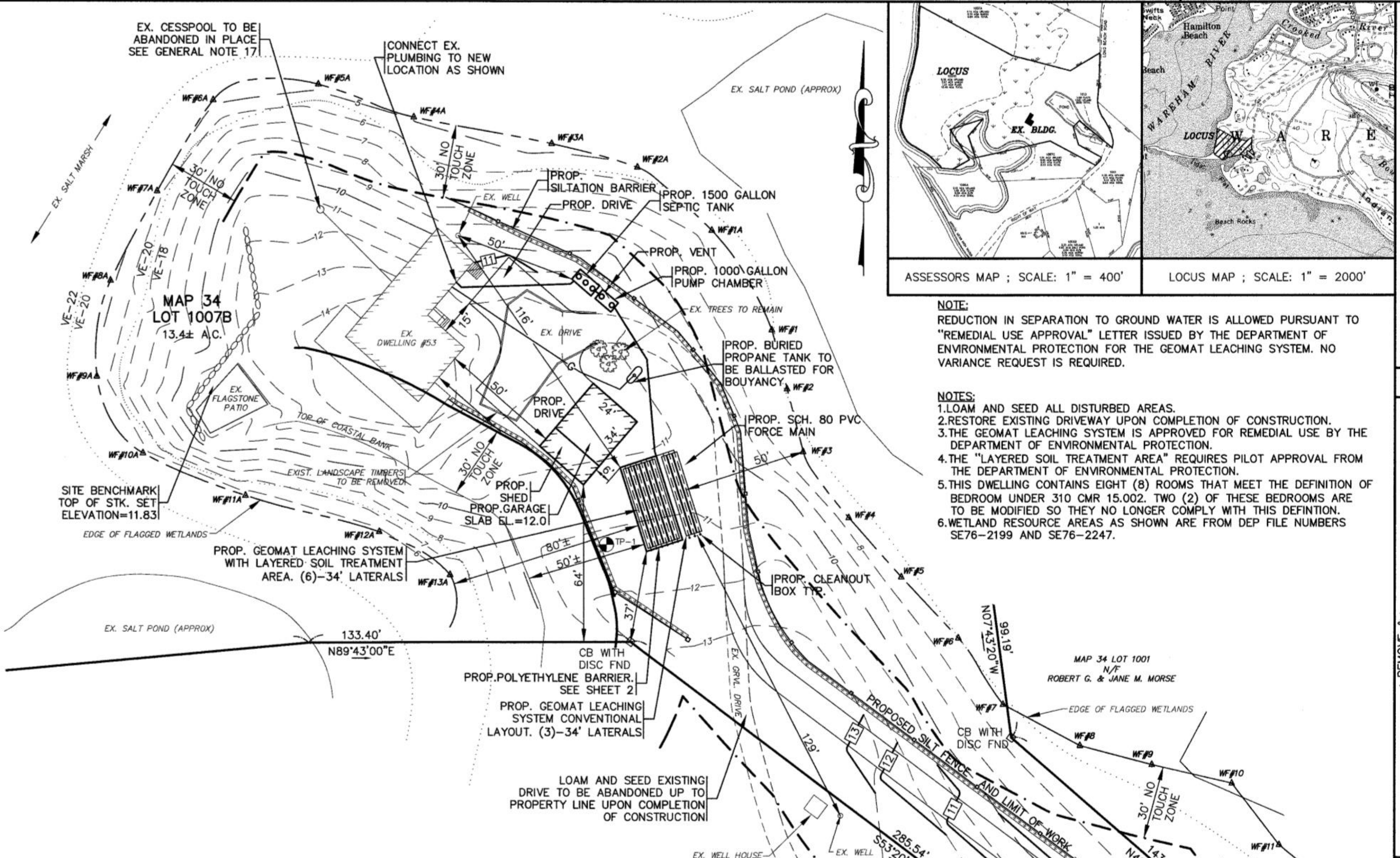
APPROVED BY:

SEWAGE DISPOSAL SYSTEM DESIGN

PREPARED FOR
ANTHONY & WENDY PIRES
MAP 34 / LOT 1007-B
53 LONG BEACH ROAD
WAREHAM, MA

G.A.F. ENGINEERING, INC.
PROFESSIONAL ENGINEERS & LAND SURVEYORS
266 MAIN STREET, WAREHAM, MA 02571
TEL: (508) 295-6600 FAX: (508) 295-6634
E-MAIL: gaf@gaf-eng.com

DWG NO.: SD-1 OF 2	SCALE: AS NOTED	DATE: FEB. 27, 2018
DRN BY: BRG	CHK BY: WFM	JOB No. 17-8998



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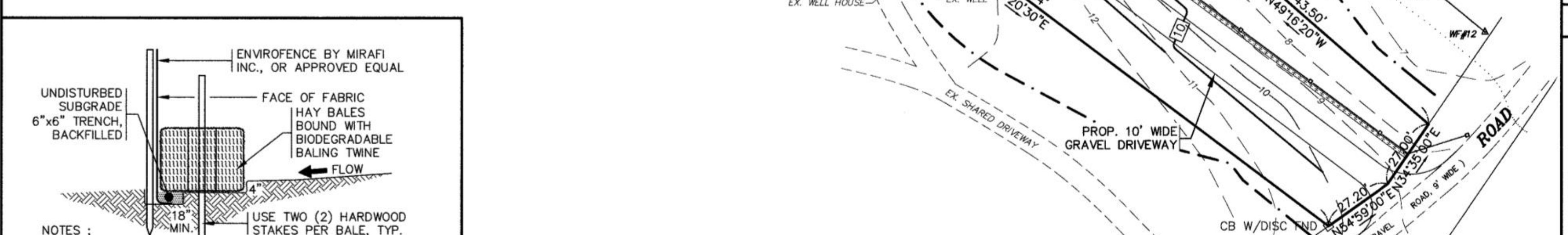

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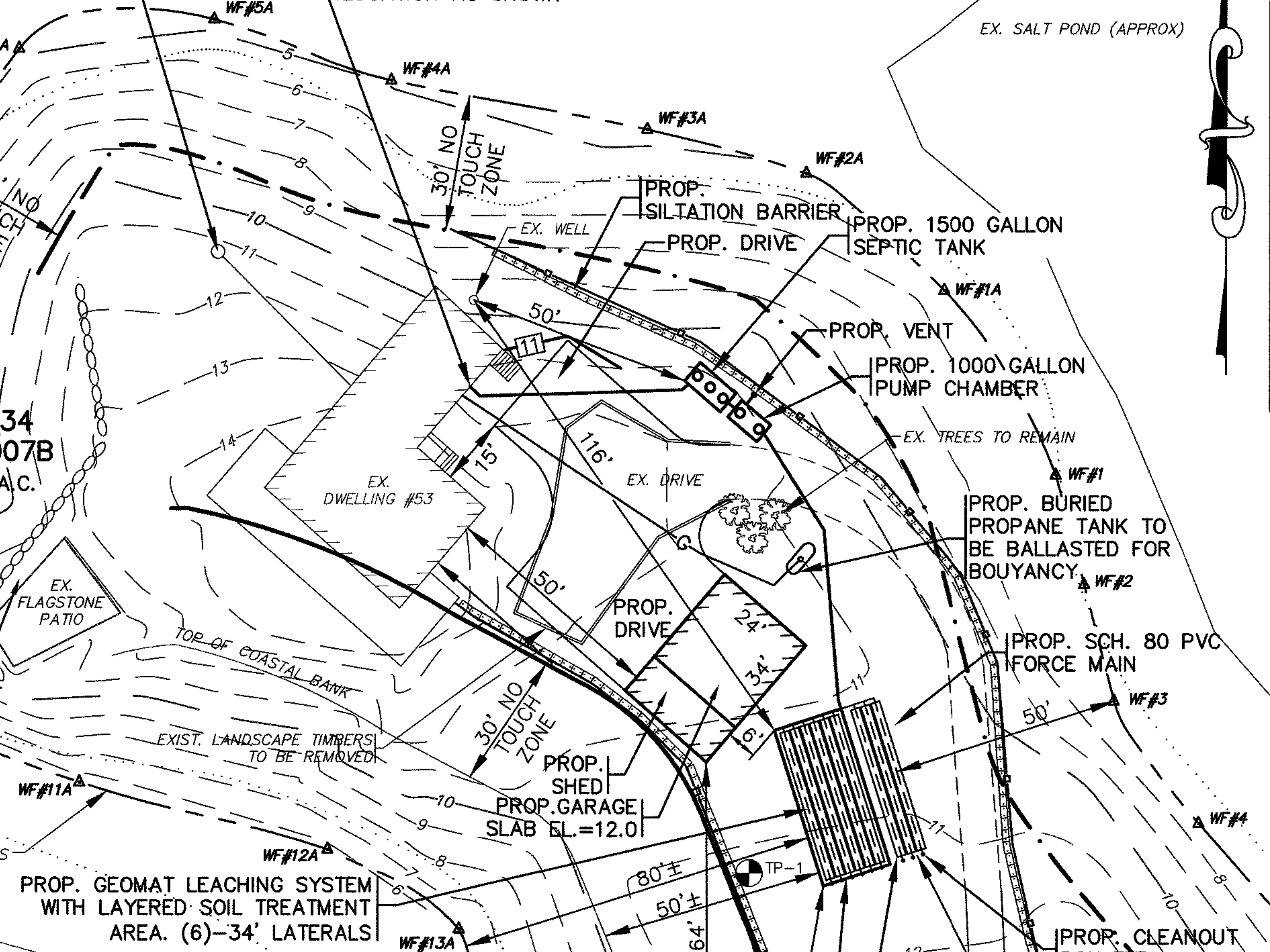
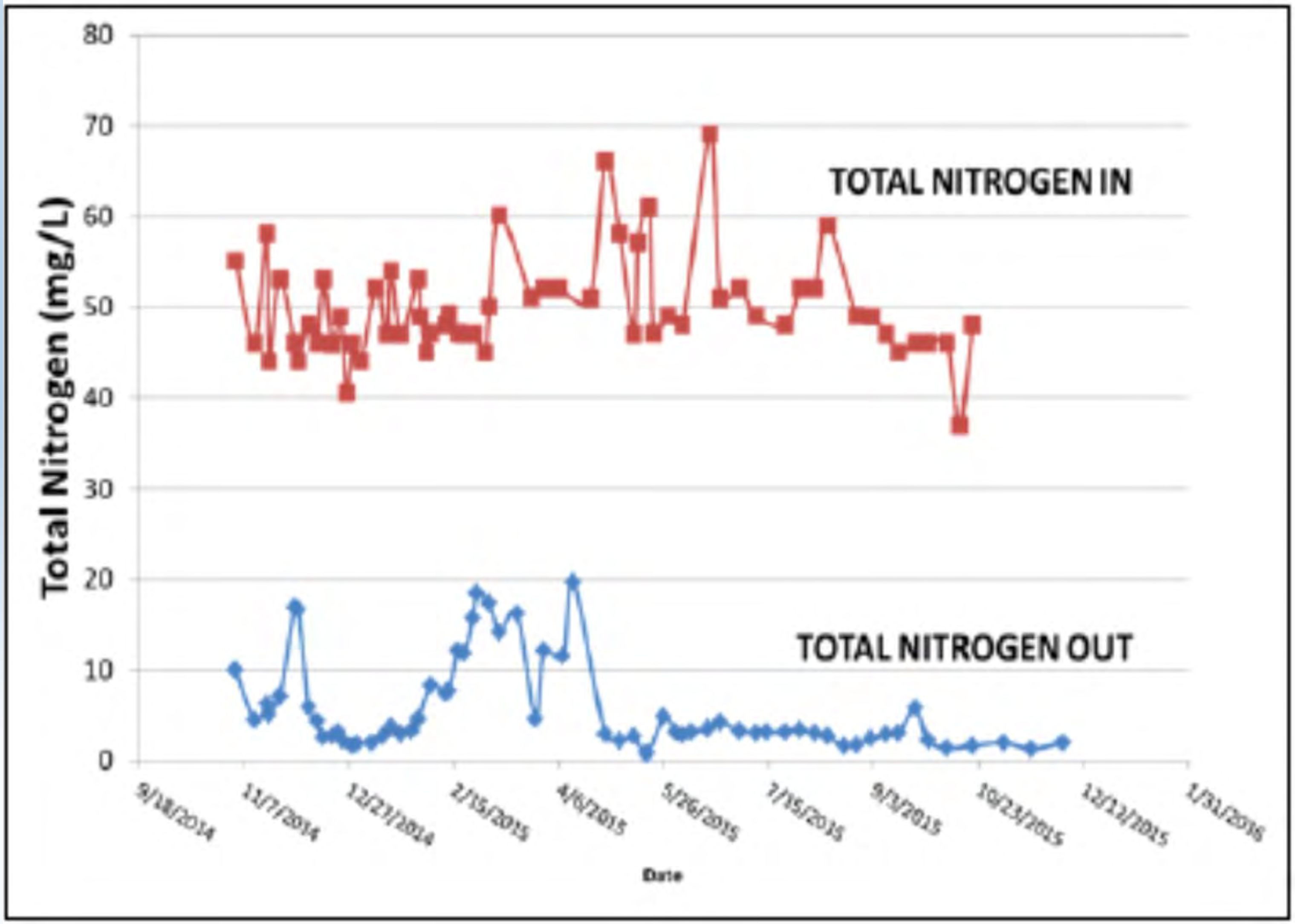


EX. SALT POND (APPROX)
WF#5A
WF#4A
WF#3A
WF#2A
WF#1A
WF#1
WF#2
WF#3
WF#4
WF#11A
WF#12A
WF#13A
30' NO TOUCH ZONE
PROP. SILTATION BARRIER
PROP. 1500 GALLON SEPTIC TANK
EX. WELL
PROP. DRIVE
PROP. VENT
PROP. 1000 GALLON PUMP CHAMBER
EX. TREES TO REMAIN
EX. DWELLING #53
EX. DRIVE
PROP. BURIED PROPANE TANK TO BE BALLASTED FOR BOUYANCY
PROP. DRIVE
PROP. SCH. 80 PVC FORCE MAIN
EX. FLAGSTONE PATIO
TOP OF COASTAL BANK
30' NO TOUCH ZONE
EXIST. LANDSCAPE TIMBERS TO BE REMOVED
PROP. SHED
PROP.GARAGE SLAB EL.=12.0
TP-1
PROP. GEOMAT LEACHING SYSTEM WITH LAYERED SOIL TREATMENT AREA. (6)-34' LATERALS
PROP. CLEANOUT
50'
116'
15'
24'
34'
6'
80'±
50'±
64'
34
07B
A.C.

Results - MASSTC



Layer Cake Costs

- Design & permitting costs - ~$2,500 – $5,200
- Installation cost - ~$20,000 - $41,000
- Installation cost comparison conventional vs. layer cake system - $2,500 difference ($18,000 - $20,500)

Resources

- Layer Cake Fact Sheets
- MA GeoMat Design Manual
- DEP GeoMat Approvals (General & Remedial)
- Towns throughout the watershed where layer cakes are being installed (Acushnet, Dartmouth, Fairhaven, Falmouth, Vineyard Haven, Wareham, Westport)
- Project Team, including volunteer homeowners
- Forthcoming BBC Brochure


Questions?