How Septic-Related Phosphorus Loading Impacts Your Lake and What Can Be Done About It?

Stephen J. Souza, Ph.D.

Clean Waters Consulting, LLC
Ringoes, NJ 08551
SJSouza.CWC@gmail.com

CWC

Thanks For Having Me!

HABs and The Nutrient Connection

Phosphorus (P) and Nitrogen (N) are key nutrients driving aquatic productivity and HABs.

More P and N = More cyanobacteria = HAB

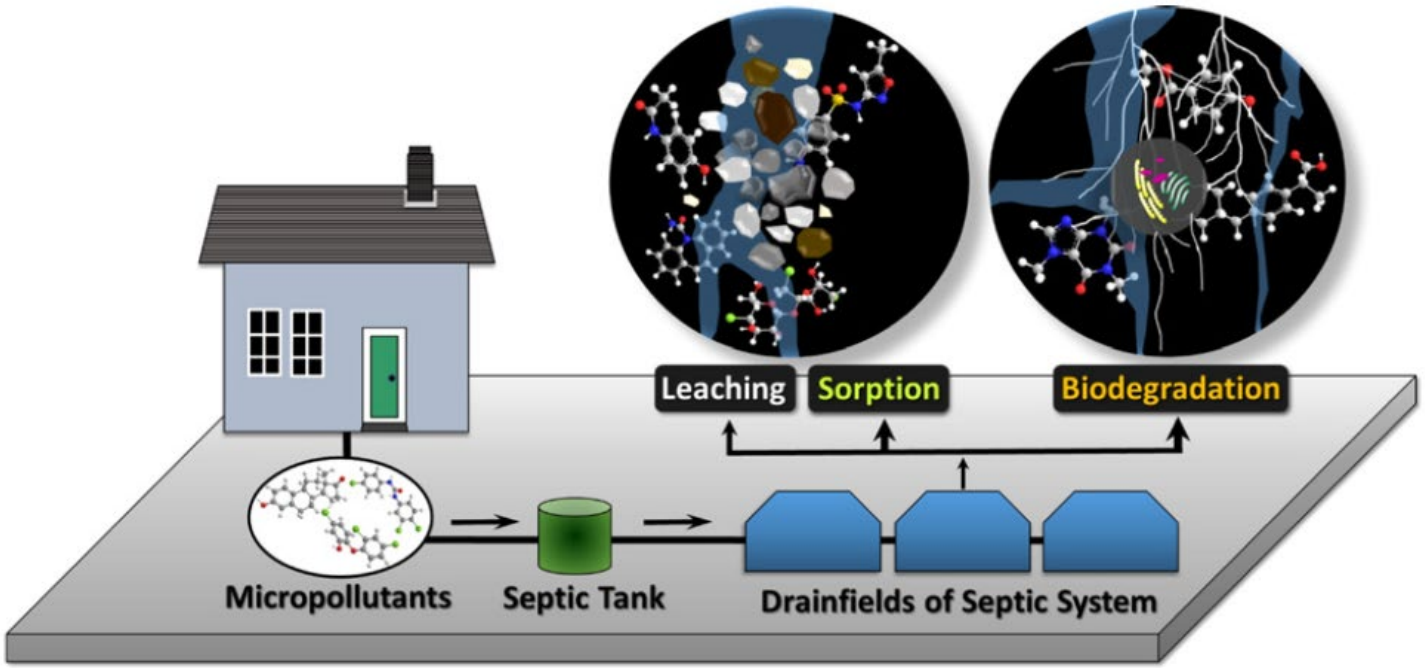
Controlling HABs requires decreasing N and P inputs.

Requires ID, quantification and prioritization of sources

Common Sources of N & P

- Internal (In-lake)
  - Sediment release and recycling
  - Decomposition of organic material (algae, weeds, fish, etc.)
- External (watershed)
  - Stormwater runoff (direct and indirect)
  - Septic systems
  - Point sources
  - Atmospheric
  - Waterfowl

Basic Operation of a Septic System



Source: Yang, et. Al. 2016. Septic Systems as Hot Spots of Pollutants in the Environment. Sci. Total Environment, 566-557(2016) 1535-1544

Septic Systems and Lake Communities

- In New York 22% of homes rely on septic systems… but in rural and suburban areas can be as great as 80%.
- A "properly functioning" septic system adequately removes bacteria and protects human health.
- Phosphorus removal occurs mostly within leach field.
- Nitrogen removal occurs in septic tank and within leach field.
- Due to development history of most lake communities existing septic systems often antiquated and undersized and are often improperly maintained.

Phosphorus In Domestic Wastewater

Median concentration of TP in domestic wastewater entering a septic tank is 19 mg/L (Lowe et al., 2007).

As per University of Florida, TP concentration leaving tank **only** 20-30% lower.

Most of inital TP reduction due to settling of sludge and associated **particulate phosphorus.**

Dissolved phosphorus is present in leachate that is transferred to septic field.

Dissolved phosphorus removal in septic field result of combination of phosphates binding to soils and assimilation of phosphorus by bacteria.

Septic Systems and Lake Communities

- As per USEPA… any septic system within 300' of a lake, stream or wetland is a source of N & P loading.
- Typical daily phosphorus load for **properly functioning** septic system is 0.114 kg-P/capita/yr.
- Thus, a typical home (3.5 individuals / dwelling) generates at least 0.4 kg/yr. (~ 0.9 lbs/yr.)… most of which is bioavailable.
- May not sound like a lot but that's enough to generate almost 1,000 lbs. of algae!
- Even greater for undersized / compromised systems.

How Bad Can It Be?

- Nitrogen (nitrate) not readily removed by soil… decrease result of aerobic and anaerobic bacterial processes (most of which occurs in septic tank).
- Although phosphorus is adsorbed by soil, older leach fields and compromised leach fields have lower (or little) P removal capability.
- Also, other contaminants (pharmaceuticals, PFos/PFas/PFoa) can easily pass through leach field.
- My studies show that septic system loading is typically responsible for between 30% to 50% of a lake's annual N&P loads.

Septic Systems and Lake Communities

- Septic performance and nutrient removal capability a function of design and age of system… especially the size and condition of the leach field.
- Leach field performance compromised by natural conditions… high water table, shallow depth to bedrock, sub-optimal soils, and steeper slopes.
- Leach field performance also compromised by increased development… intensity of land use increases impervious cover = more runoff and less recharge.

What The Research Says

- In "raw, untreated" septic effluent soluble phosphorus 1-14 mg/L (70-85% SRP), soluble nitrogen 8-63 mg/L (70-85% NH_4 and NO_3 great enough to impact fish)[1].
- Septic systems in older developed communities present a WQ threat due to age, design and lack of maintenace[2].
- Septic systems significant source of nutrients facilitating algae blooms and ecosystem impairments[3].

1. P. Withers, et al. 2011. Quantifying the Impact of Septic Tank Systems on Eutrophication Risk in Rural Headwaters. Environment International 37(3):644-53.
2. P. Withers, et al. 2014. Do septic tanks pose a hidden threat to water quality? Frontiers in Ecology and the Environment 12(2):123-130.
3. B. LaPointe. 2015. Evidence of sewage-driven eutrophication and harmful algal blooms in Florida's Indian River Lagoon. Harmful Algae, Vol 43:82-102.

OK! But What Can We Do??

Practicing Preventative Maintenance

Maintenance is Critical!

Septic Failures

- Most septic "failures" due to inability of leach field to manage effluent. Function of:
  - Natural conditions that limit infiltration
  - Age / Outdated design
  - Excessive hydraulic loading
  - Inappropriate waste loading
  - Lack of system maintenance
  - Physical damage and impact

Well within our own control

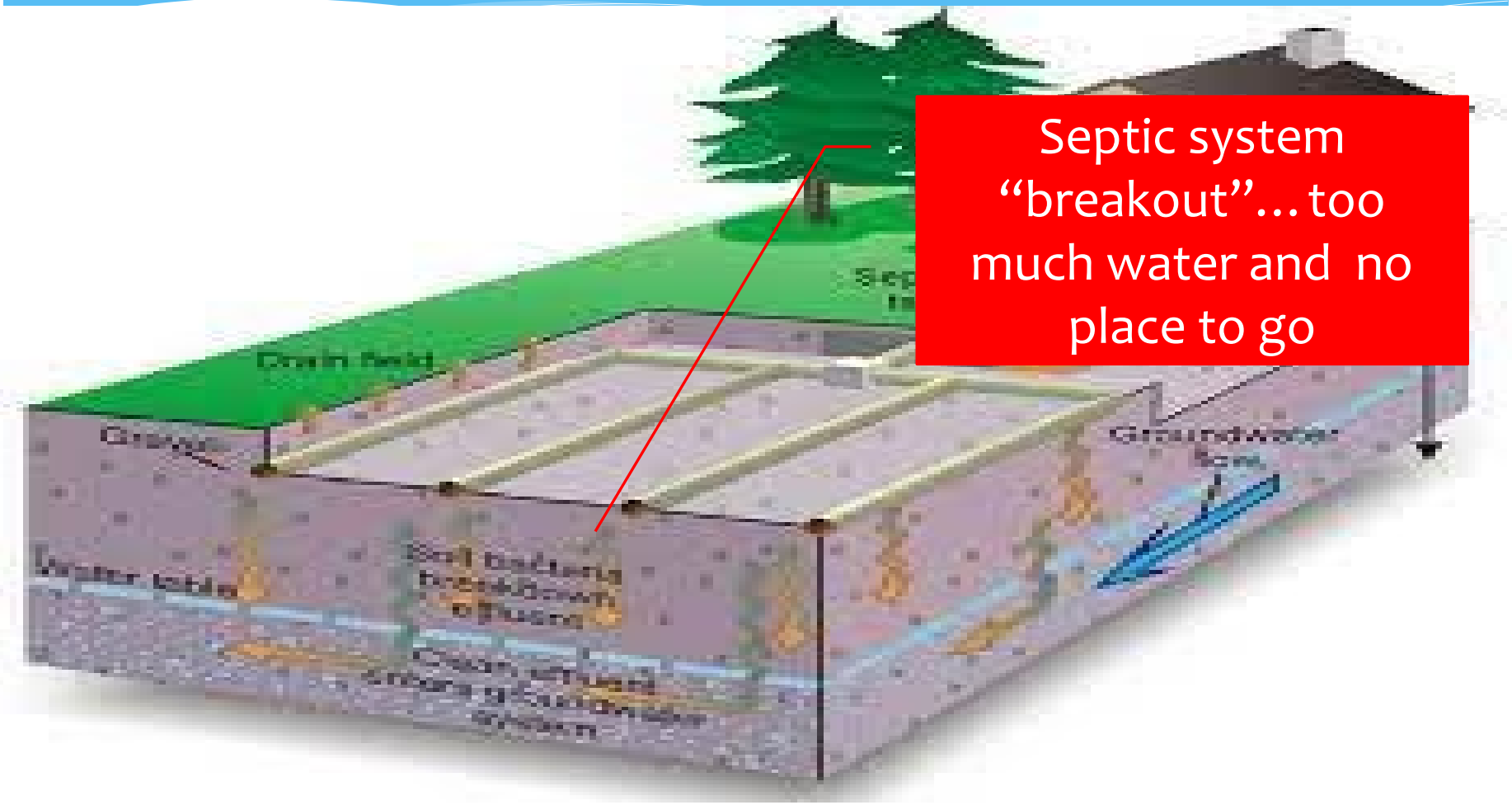
Practicing Preventative Maintenance

- Map location of septic tank, pump tank, and leach field
- Conserve water
- Be careful of what is flushed down drains or toilet
- Install effluent filter, inspect and clean it quarterly
- Inspect and pump out septic tank once every three years (as per USEPA)
- Annually inspect your leach field

What Goes Around Comes Around

- Don’t flush paper towels, feminine hygiene products, condoms, latex gloves, cotton swabs, cigarettes, dental floss
- Don’t backwash water conditioner residuals into system
- Don’t install or operate garbage disposal and limit dumping kitchen grease / waste down drain
- Don’t flush or dump down drain paint, hazardous materials, etc
- Don’t flush down kitty litter
- Avoid use of caustic drain cleaners
- Don’t use bacterial additives; properly maintained septic tank has enough bacteria to breakdown waste.
- Direct runoff away from leach field

Excessive Hydraulic Loading



Physical Damage

Compaction of septic field

Broken laterals

Alternative Systems

- Elevated Bed
- Soil Replacement
- Infiltrators

Compensate for poor site soils and/or limited separation from restrictive horizon (groundwater and/or bedrock)

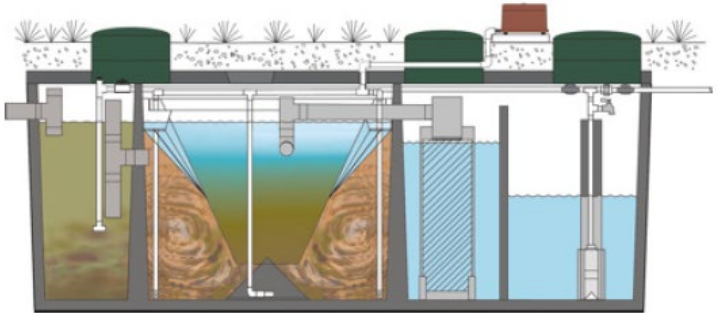
- Pre-Treatment Systems… May require special Treatment Works Approval permit

Decrease organic / nutrient load of effluent before discharge to leach field

- Hybrid and small flow systems

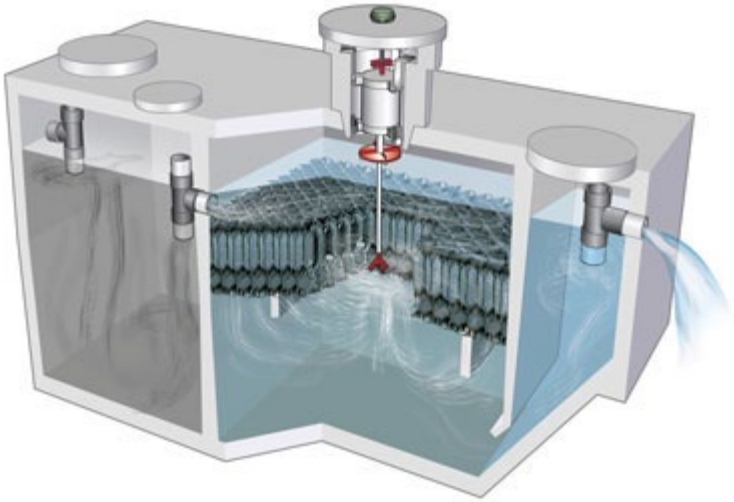
Retain septic tank for settling, may use a communal leach field

Alternative Systems

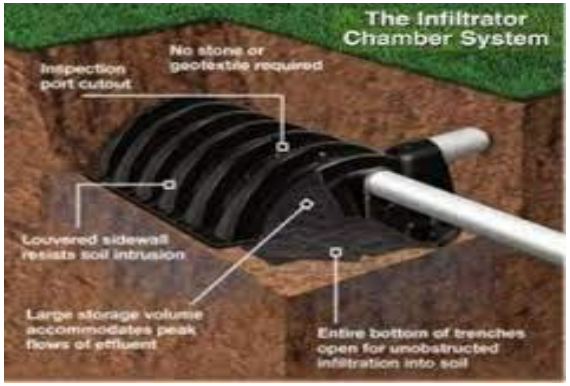


Hoot ANR Technology

EcoFlo – Coco and Peat Filter

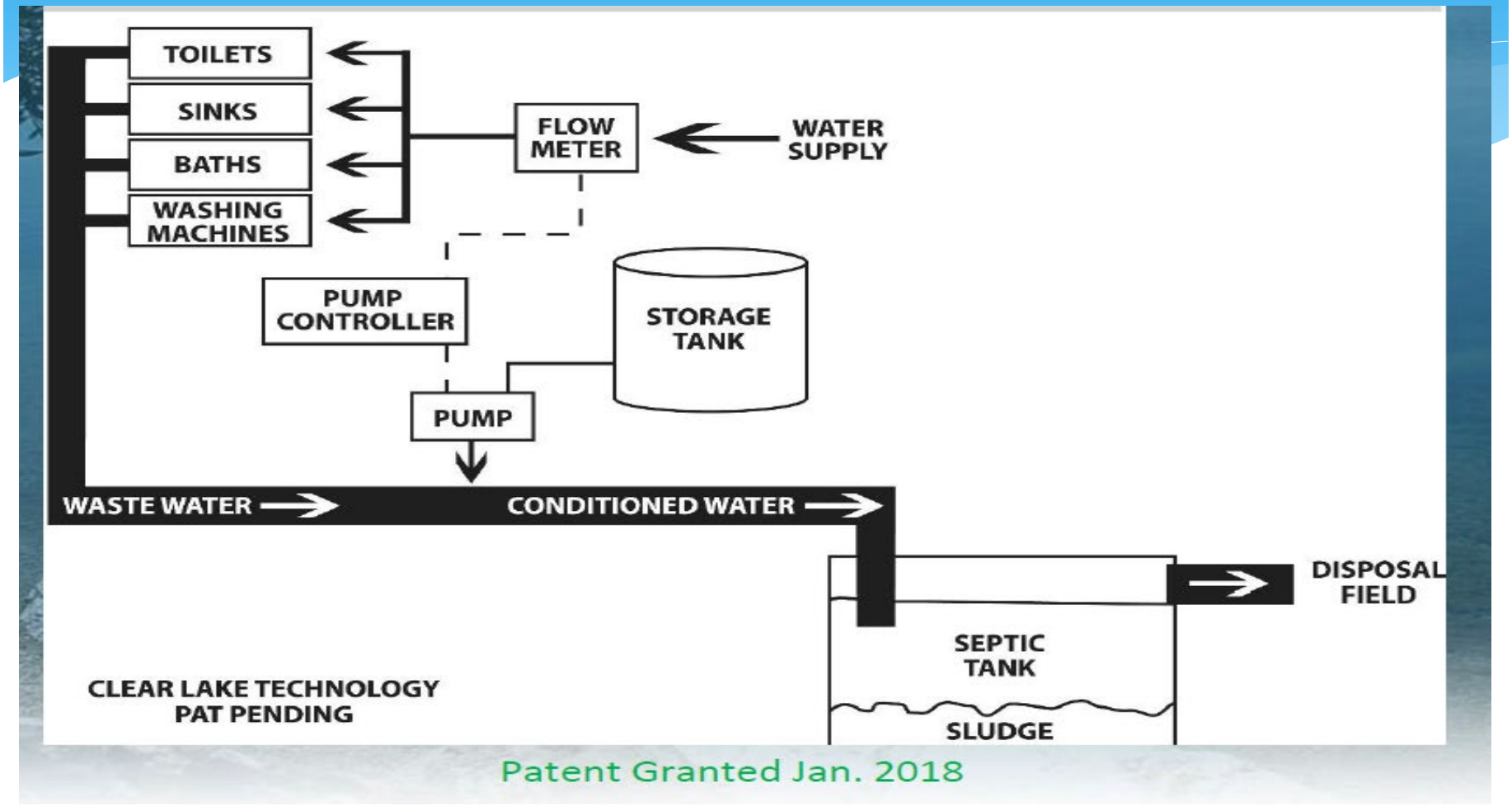


Jet Aerobic w BAT Media



Infiltrator Chamber System

Clear Lake Technology
Alum Injection System



Patent Granted Jan. 2018

Wastewater Conditioning System

Alum Injection System

System Specifics

- Installed in home, requires no modification of septic system and no NJDEP/BOH approvals
- Operating system basically same as a water supply chlorinator plus 30-gallon alum tank (typically enough for 2-3 years of use)
- Service system once every 2 years
- No additional sludge (may actually decrease sludge buildup in septic tank)… no septic tank or field modifications
- Measured phosphorus removal >90%
- Measured coliform removal >90%

Further details contact Paul Sutphen / Clear Lake Technology
973-222-3450 / phsutphen@earthlink.net
Clearlaketechnology.com

Why Not Sewer

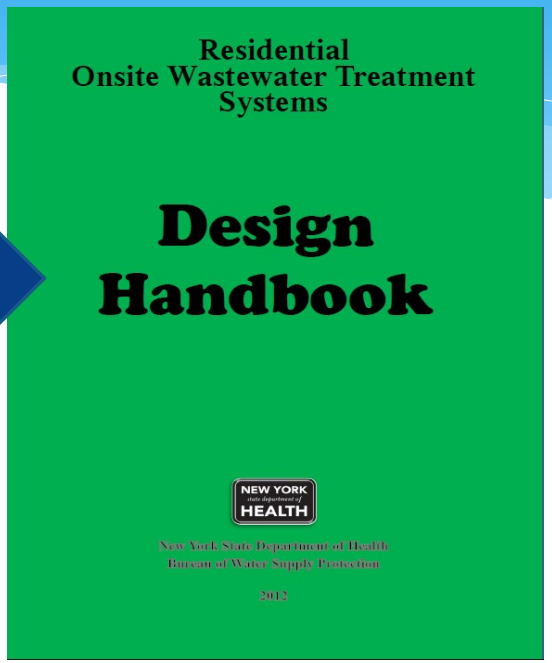
- Expensive to construct and expensive to maintain
- Not always feasible
  - Too remote
  - Not enough homes
  - Topography and related site constraints
  - Lack of suitable point of discharge (stream or groundwater)
  - No WWTP capacity
- Increases the likelihood of more development and associated development related impacts

Summary

- Septic systems can do a good job of managing wastewater but… they are a source of nutrient loading that can't be overlooked
- Keys to decreasing septic impacts:
  - Proper design and routine maintenance
  - Performance aided by water conservation and use of non- or low-phosphorus wash products
  - Alternative designs increase system performance and functional capacity of leach field
  - Alum injection simple means of decreasing septic related phosphorus loading

Sources of Information

NYSDOH - https://www.health.ny.gov/environmental/water/drinking/wastewater_treatment_systems/docs



NATIONAL SMALL FLOWS CLEARINGHOUSE

New Jersey Pinelands Commission
Alternate Design Treatment Systems Pilot Program

STATE OF NEW JERSEY · PINELANDS COMMISSION ·

2019 Annual Report

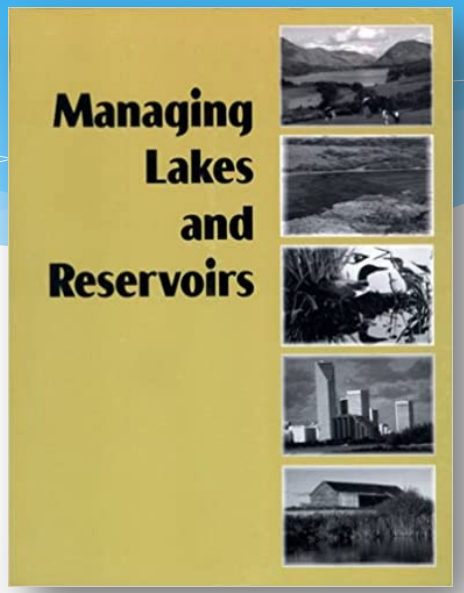
NJDEP/Pinelands https://www.nj.gov/pinelands/landuse/current/altseptic/

USEPA – Small Flows Clearing House https://www.nesc.wvu.edu/about-actat/national-small-flows-clearinghouse

Sources of Information

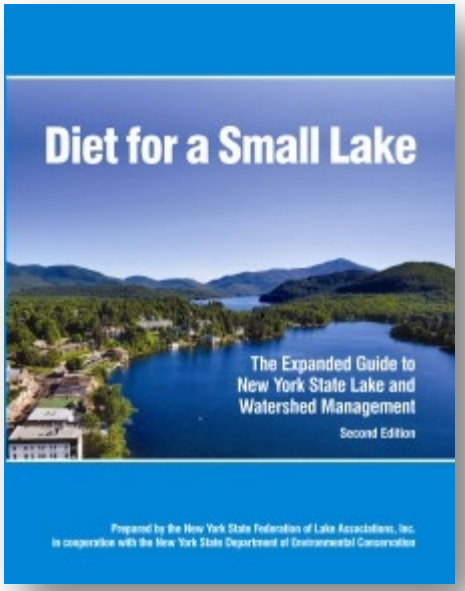
NALMS

Managing Lakes and Reservoirs



NYSFOLA

Diet for a Small Lake



Thank You… Questions

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