

CCWT Analytical Capabilities: Beyond Nitrogen

Dr. Roy E. Price
CCWT Research Coordinator

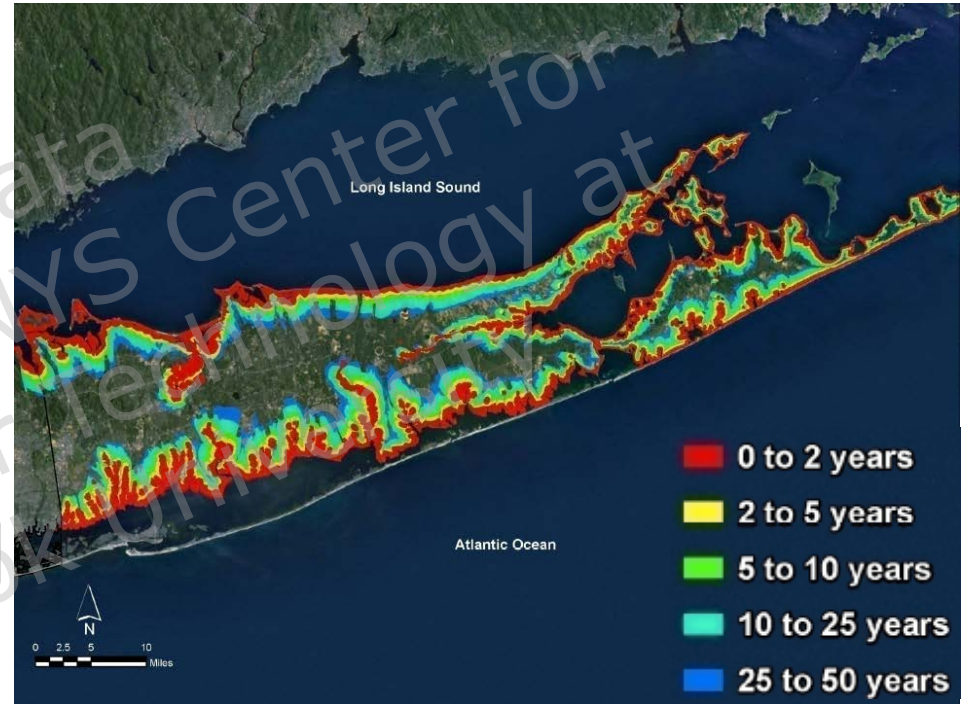
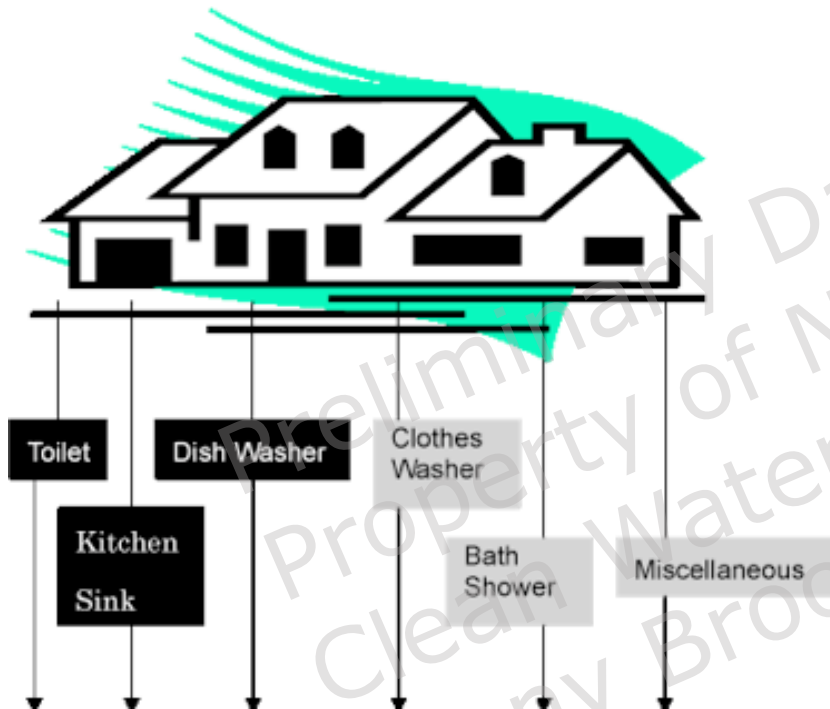
SBU Research Professor
School of Marine and Atmospheric Sciences

➤ Conventional parameters:

- Nitrogen species
- BOD (biological oxygen demand)
- TSS (total suspended solids)
- pH
- Alkalinity



What other compounds enter your septic system besides nitrogen?



From Suffolk County Comprehensive Water Resources Management Plan

Anything that goes into your septic system can be drawn into nearby *drinking water* wells and reach / impact *delicate coastal ecosystems*

Non-nitrogenous compounds of concern

- Pharmaceuticals and other drugs
- Antibiotics
- Hormones
- Steroids
- Quaternary Ammonium Compounds (QACs)
- Surfactants
- Personal Care Products
- Viruses and other pathogens
- Metals
- Other Anions (Phosphate)
- Cations (Boron)

➤ There are complex interactions between many of these compounds and the nitrogen cycle

"Contaminants of Emerging Concern"

➤ Includes:

1. Pharmaceuticals and many other drugs
2. Personal Care Products
3. Quaternary Ammonium Compounds

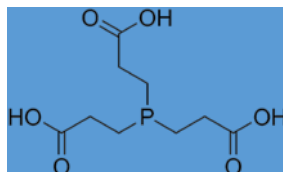


➤ Concerns

- Common in many household products
- Carcinogenic
- Endocrine disruptors
- Can decrease the efficiency of sewage treatment

➤ List of some Contaminants of Emerging Concern currently being measured by CCWT

- | | | |
|-----------------|-----------------|------------------------|
| Acesulfame K | DEET | Nifedipine |
| Acetaminophen | Diclofenac | Nonylphenol |
| Amoxicillin | Diltiazem | Paraxanthine |
| Atenolol | Diphenhydramine | Primidone |
| Atorvastatin | Estrone | Propranolol |
| Azithromycin | Fenofibrate | Ranitidine |
| B-estradiol | Fluoxetine | Salbutamol (Albuterol) |
| Bisphenol A | Furosemide | Sulfamethoxazole |
| Caffeine | Gemfibrozil | TCEP |
| Carbamezapine | Ibuprofen | Trimethoprim |
| Chlofibric Acid | Ketoprofen | Warfarin |
| Cimetidine | Metoprolol | |
| Ciprofloxacin | Naproxen | |
| Cotinine | Nicotine | |



TCEP (*Tris(2-chloroethyl) phosphate*)
A fire retardant found in clothes and many other household products

Measuring Contaminants of Emerging Concern Requires special instrumentation....

Time-of-flight Mass Spectrometry (TOF-MS) coupled to Liquid chromatography (LC), from Agilent Technologies



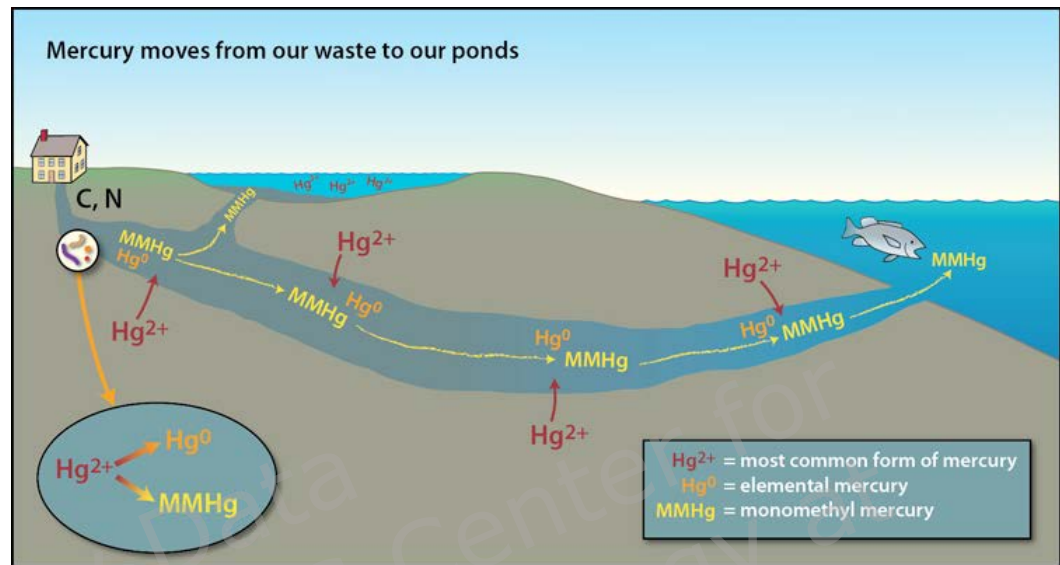
Separates and measures the concentration of complex organic compounds intact

Laboratory: Dr. Bruce Brownawell

Students: Patricia Clyde, Ph.D.

Metals

- Copper
- Manganese
- Lead
- Mercury
- Cadmium
- Zinc



Lamborg et al., 2013

- Concerning for several reasons
- Copper pipes with lead solder in many homes
 - Toxic, Carcinogenic
 - Speciation (oxidation state) important
 - Can decrease the efficiency of sewage treatment
 - Composting generates Mn, Cadmium Contamination In Willet's Creek

➤ Total Metals Analyses

Inductively Coupled Plasma –
Mass Spectrometry (ICP-MS),
Element 2 from Finnigan



Atomic Fluorescence
Spectrometer (AFS), Illumina
3300 from Aurora



➤ Metal Speciation

-Couple these instruments to
High Performance Liquid
Chromatograph, from Shimadzu

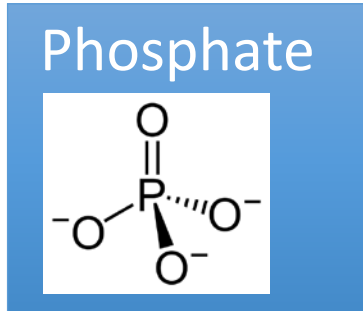


Laboratory: Dr. Roy Price

Students: Zoe Smith, M.S.

Phosphorus

Inorganic forms:



Organic forms:

Inositol phosphates (phytin)	Sugar phosphates	Phospholipids	Nucleic acids
------------------------------	------------------	---------------	---------------

➤ Concerns:

- Enriched in waste water
- Can also cause HABs
- Used as a nutrient source for septic system microbes

Lake Ronkonkoma HABs



Photo credit: Chris Gobler

Measuring phosphorus and other anions

Phosphate and total phosphorus



Flow Injection
Colorimeter, QC5000
from Lachat

Laboratory: SoMAS
Nutrients Lab

All Anions:

Phosphate

Fluoride

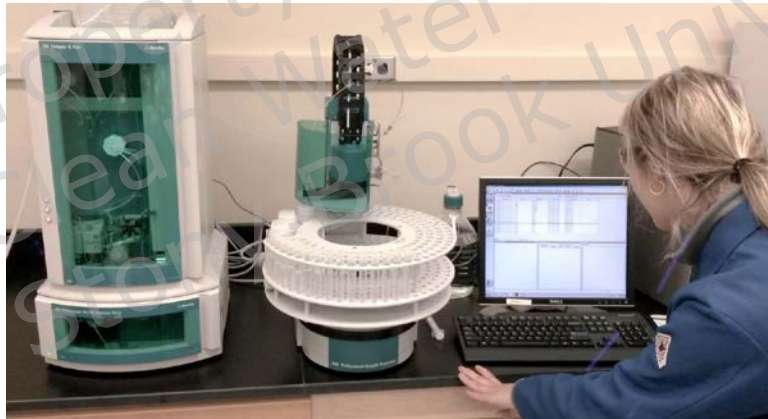
Chloride

Nitrate

Nitrite

Sulfate

Plus organic acids (Lactate, formate, acetate, etc.)



Ion Chromatograph with matrix
elimination, 930 Compact from
Metrohm

Laboratory: Dr. Laura Wehrmann

Students: Jeanette Lee, M.S.

Cations

- Boron
- Sodium
- Aluminum
- Potassium
- Iron
- Magnesium
- Silicon
- Strontium
- Calcium
- Many more



Inductively Coupled Plasma – Optical Emission Spectrometer (ICP-OES),
Ultima 2C from Horiba

Laboratory: Dr. David Black
SoMAS

Summary

- There are many – potentially harmful - compounds besides N that can get into groundwater and reach coastal areas
- Not only can these compounds be toxic to humans, they can also decrease the efficiency of the microbial cycling of nitrogen

The CCWT currently has a comprehensive capacity to analyze and evaluate the importance of these compounds in wastewater and groundwater