2021 Onsite Wastewater MEGA-CONFERENCE

Essential Work in the Lone Star State

NOWRA NAWT SORA TOWA

University of Minnesota

Onsite Sewage Treatment Program

CHALLENGING WASTEWATER STREAMS

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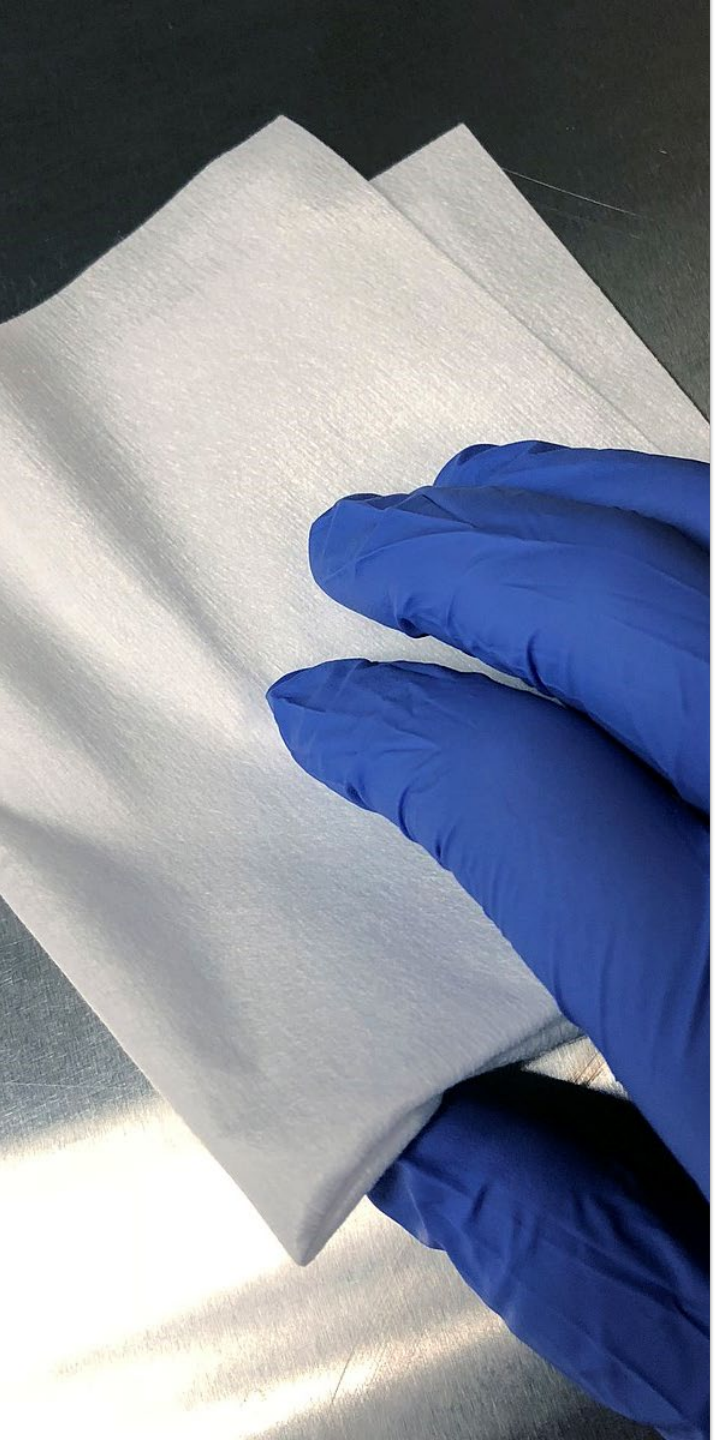
The materials being presented represent the speaker's own opinions and do NOT reflect the opinions of NOWRA

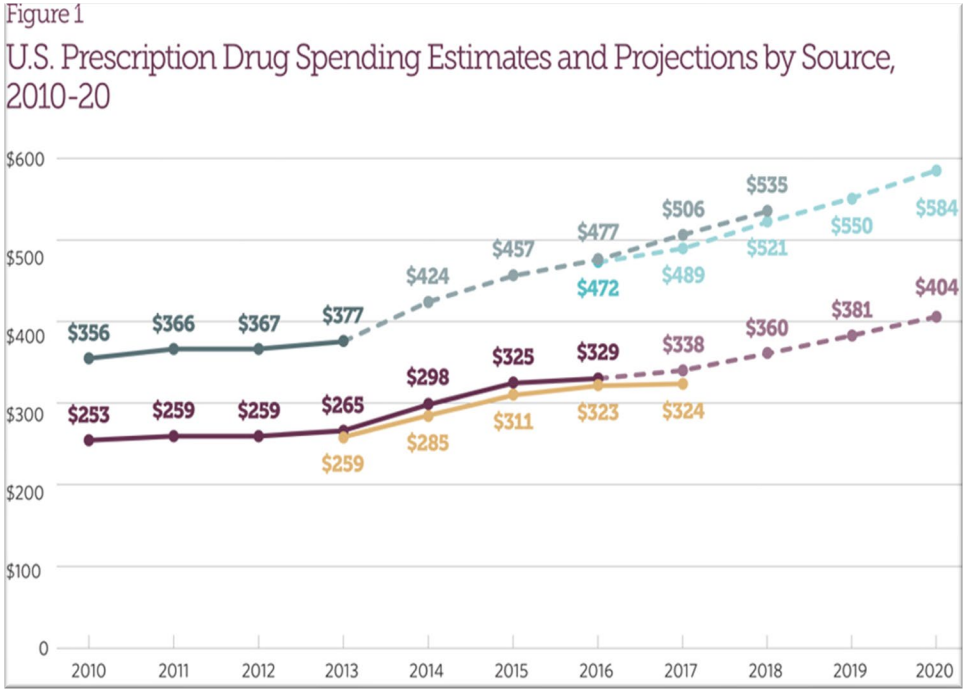
PRESENTATION OVERVIEW

- General considerations
- Antibiotics
- Chemotherapy
- Case Studies
  - Dialysis
  - Campgrounds
  - RV chemicals
  - Convenience store coffee/soda
  - Adult care faculties



MEDICAL ISSUES IN GENERAL

- Problems
  - Sanitizing
  - pH impacts
- Antibiotic soaps and wipes are now used by 75% of American households
- They have cumulative effects on system performance



PRESCRIPTIONS DRUGS

- Nearly 50% of US is on at least 1 prescription drug
  - 30% on two or more
  - 10% on five or more
- Up to 90 percent of oral medications pass through the body unchanged

NATIONAL DRUG TAKE-BACK DAY AND DROP OFF LOCATIONS

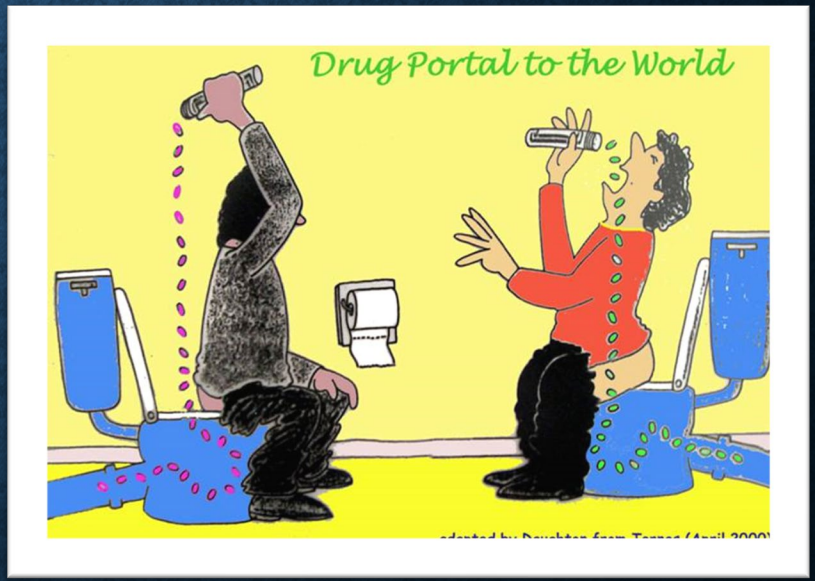
- Many areas are now promoting the return of unused pharmaceuticals
  - Take back days
  - Drop off locations

BACTERIA – THE PUBLIC MAY NOT LIKE THEM

- But we need these guys
  - bacteria and fungi are the workhorses of wastewater treatment
  - they prefer their carbon source to be non-toxic

THEY ARE EXPOSED TO EVERYTHING WE PUT DOWN THE DRAIN

- The good news
  - Most waste organic compounds can be degraded by the microbes
    - in the septic tank
    - in the soil
- The bad news
  - there are plenty of organic compounds that will kill them



ANTIBIOTICS AND SIMILAR MEDS

Antibiotics are not selective in which bacteria are killed

While antibiotics help a patient by killing harmful bacteria, the medicine often kills good bacteria also

Recommendations: Use them only when needed, dispose of unused ones properly (Do NOT flush)

ANTIBIOTICS

Single short-term doses will cause a small impact but system will likely recover

- Example – antibiotic for bacterial infection

Long term low doses may impact system but will depend on amount, duration, other inputs

- Example – acne medication
- Monitor system

Long term high dose will very likely kill off the system and cause clogging of filters, pretreatment units and the soil

- Example – daily infusion of antibiotic for micro-bacteria lung infection
- Use system as a holding tank or get a port-a-potty

CHEMOTHERAPY

- Two risks:
  - Septic systems
  - Human health

RISK TO SEPTIC SYSTEMS

Approximately 85% are immediately sent home after a treatment

Courses of treatment are generally given at 3 – 4 week intervals

In the 2-3 days after treatment the patient is excreting relatively high amounts of the cytotoxin in their urine, feces, vomit, and sweat

RISK TO SEPTIC SYSTEMS

Many of the drugs used for chemotherapy could damage the bacteria in a septic system

Due to being immune compromised use of sanitizer/antibacterial is high in homes undergoing chemo

MANAGEMENT

Evaluate the system to determine if pretreatment in tanks or units is operating normally

If not increase the frequency of maintenance

Consider holding tank or port-a-potty if system is very upset

SECOND HAND CHEMOTHERAPY

Some forms of chemotherapy are called cytotoxins

Cytotoxic drugs can be used to destroy tumors, boost the outcomes of surgery or radiotherapy, reduce metastases and alleviate cancer symptoms

27 chemotherapy drugs have been identified with a high risk to the impact human health at low doses

85% percent of those undergoing chemo get their infusions at a hospital and are immediately sent home

SECOND HAND CHEMO

2 – 3 days after treatment the patient is excreting relatively high amounts of the cytotoxin in their urine, feces, vomit, and sweat

Cytotoxins are known to cause birth defects, immune dysfunction such as myelodysplastic syndrome (pre-leukemia), and miscarriages

Risk in septic system due to the lack of dilution the cytotoxins could be at high enough concentrations to damage the beneficial bacteria needed in the septic system

OPTIONS

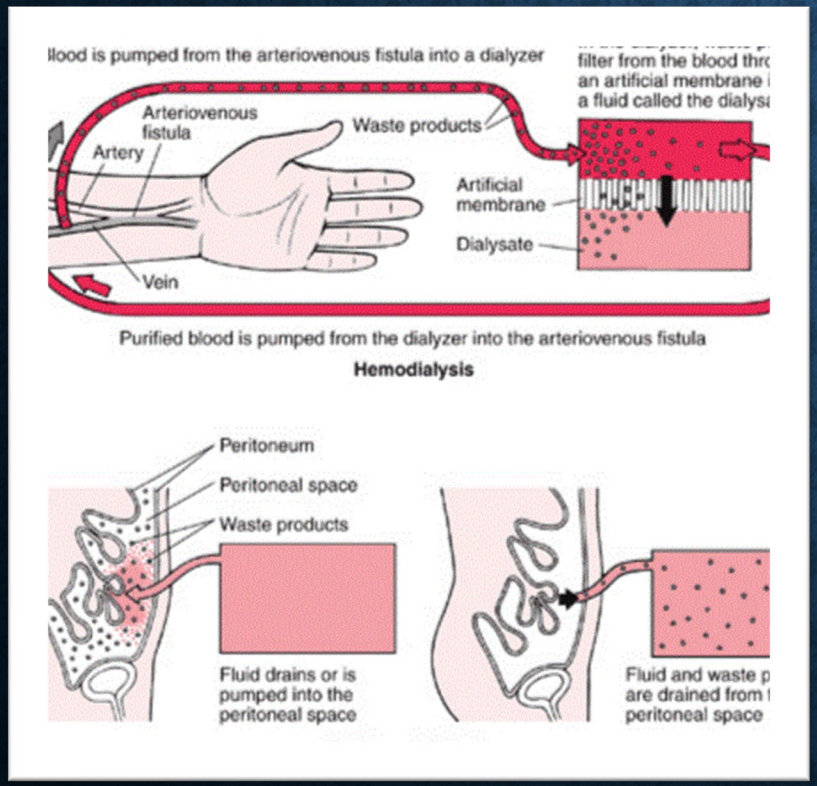
- Shock load
  - One time addition
  - Wait and see if it comes back or clean out and start over
- Short-term usage (<1 year)
  - Monitor tank
  - Holding tank if very upset
  - Manage
- Long term usage
  - Monitor
  - More maintenance needed?
  - Design in advanced treatment?

KIDNEY DIALYSIS AND SEPTIC SYSTEM IMPACTS

KIDNEY DIALYSIS

- Dialysis is a treatment for kidney failure that removes waste and extra fluid from the blood, using a filter
- More than 661,000 Americans have kidney failure
  - 468,000 individuals are on dialysis
  - 50% doing it in their homes

TWO TYPES OF DIALYSIS



- Hemodialysis (HD): blood is taken out of the body through a set of tubes, run through a filter called a dialyzer, cleaned off various impurities, and returned back to the patient
- Peritoneal Dialysis (PD): a synthetic tube is placed in the abdominal cavity which then allows dialysis by exchange of dialysis fluid at regular intervals

DIALYSIS IMPACTS

- The effluent from both types of dialysis has been shown to damage septic systems and should not be discarded to septic systems
- It will add additional water and contaminants the septic system is not designed to treat/remove and can negatively impact the beneftial microbes needed to treat the wastewater

DIALYSIS IMPACTS - HD

- Reverse osmosis (RO) reject water clean should be reused or applied to the surface
- Post dialysis effluent has a high concentration of sodium and chloride (over 3,000 mg/l for both)
  - Can alter, kill, or to cause unwanted and incorrect organism overgrowth in the septic tank and downstream
  - Can negatively impact concrete
- Each individual session is from 3-6 hours is typical using around 100 gallons per week

DIALYSIS IMPACTS - PD

PD *influent* for the patient has a glucose concentrations ranging from 1.5 – 4.25% glucose (1.5gm/100ml of glucose = 15gm/L or 15,000 mg/L - 4.25% PD fluid contains 42,500 mg/L)

Depending on the system, 40-50% of the glucose is absorbed by the patient so this generates BOD in the effluent

PD is done every day for 6-8 hours with 6 cycles every day generating approximately 25 gallons per week of effluent

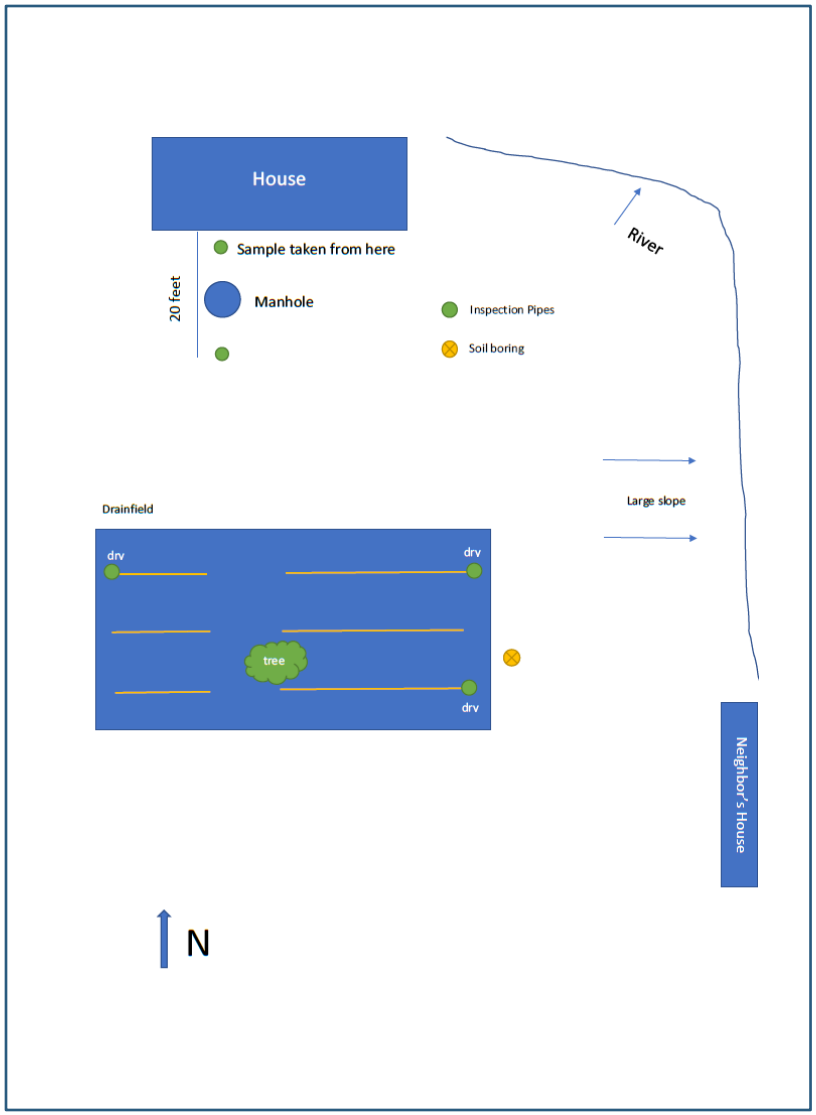
The high glucose content of PD effluent can also promote the formation of a co-polymer that can coat the surface of the soil and can block the lateral lines

DIALYSIS CASE STUDY

- Does home hemodialysis affect the function of a septic tank?

  - Field samples, from the homeowner's septic tank, were taken and tested for TSS, BOD, P, TKN, sodium and chloride
  - A site assessment was performed to ensure the system was working properly

HOME USES HEMODIALYSIS THEIR DIALYSIS MACHINE INTO THEIR HOME PLUMBING SYSTEM



SITE ASSESSMENT

- **Septic System**
- 1,500 gallon septic tank
- Wastewater flows via gravity to rock trenches
- The system is sized appropriately for the number of bedrooms and soil conditions
- Demand-based water softener in operation
- Inspected in 2017 → 36 inches to the limiting condition according to the Minnesota state code

RESULTS

Wastewater Parameters	Site Septic Tank Effluent	Typical Septic Tank Effluent	Analytical Method
Total Kjeldahl Nitrogen (TKN)	132 mg/L	40-100 mg/L *	EPA 351.2 rev.2
Biochemical Oxygen Demand (BOD)	198 mg/L	140-200 mg/L*	Hach 10360 Rev.1
Total Suspended Solids (TSS)	142 mg/L	50-100 mg/L*	SM 2540D
Fecal Coliform	Too numerous to count	1000000 – 100000000 MPN per 100ml**	SM 9222D
Sodium	742 mg/L	50 mg/L***	EPA 200.7
Chloride	1,250 mg/L	18 mg/L***	SM 4500-Cl E
Phosphorus	7.3 mg/L	6 - 12 mg/L**	SM 4500-P F

*EPA (2002) ** Siegrist (2017) ***Lowe (2009)

GENERAL RECOMMENDATIONS FOR HOMEOWNERS

There needs to be more data collected to observe contaminant concentration trends.

DEPARTMENT OF NATURAL RESOURCES

CASE STUDY: CAMPGROUND SHOWER HOUSES AND RV DUMP STATIONS

SITE #1 PROJECT SYNOPSIS

- The purpose of this project was to provide an evaluation of the wastewater stream from Park A's:
  - Recreational vehicle (RV) dump station
  - Campground bathroom

SAMPLING LOCATIONS

Campground Bathrooms

RV Dumping Station

RESULTS

- The waste stream is not typical domestic-strength waste.
- Before a new system is designed, more wastewater contaminant data should be collected and flow rate data for the park analyzed as well
- The range of parameters tested in this report should be repeated monthly during the summer months of 2020 park operation

Park A

	RV Dump Station Effluent	*Campground Bathrooms Effluent*	*Typical Domestic Effluent*
	Wastewater Concentrations (mg/L)		
TKN	769	135	60***
BOD	1280	195	140-200*
TSS	230	74	50-100*
Chloride	395	48.9	18***
Phosphorus	56.4	17.8	6-12**

*USEPA (2002) **Siegrist (2017) ***Lowe (2009)

SITE #2 PROJECT SYNOPSIS

- The purpose of this project was to evaluate the new septic systems with secondary treatment units, treating waste from Park B's:
  - RV dumping station
  - Campground shower house
- Provide recommendations to the DNR on how to move forward with the management of these systems

RV DUMPING STATION

- Designed for 1,800 gal/day
- Secondary treatment unit:
  - Two 4,200 gallon Nibbler tanks.
  - Each holds one 10-pod pretreatment unit
- **Samples Taken from:**
  - Flow equalization tank for the Nibbler
  - Lift station to analyze treatment achieved by the Nibbler
- Sludge and scum were measured as well

CAMPGROUND SHOWERHOUSE

- Designed for 1,900 gallons per day
- Advantex AX-100 recirculating secondary treatment unit
- Wastewater is directed to two mounds
- **Samples Taken from:**
  - Outlet of the septic tank.
  - Lift station, to understand the treatment achieved by the Advantex
- Sludge and scum were measured as well

RESULTS - RV DUMPING STATION

Park B	- RV Dump Station		
	Wastewater Concentrations (mg/L)		
	Septic Tank	*After pre-treatment (Nibbler)*	% reduction
BOD	1530	< 20.0	>99
TSS	92	15	84
Chloride	372	328	12
Phosphorus	85.5	32.3	62
Nitrate + Nitrite	-	0.58	-
TKN	757	154	80
Total nitrogen	757	273	64
Fecal Coliform	-	74 CFU/100 mL	99.9

RESULTS – CAMPGROUND SHOWERHOUSE

Park B - Campground Shower House and Bathrooms			
	Wastewater Concentrations (mg/L)		
	Septic Tank	*After pre-treatment (Advantex)*	% reduction
BOD	213	6.8	97
TSS	60	< 10.0	>83
Chloride	74.6	82.1	-
Phosphorus	25.7	28.3	-
Nitrate + Nitrite	-	0.58	-
TKN	139	20.4	85
Total nitrogen	139	21	85
Fecal Coliform	-	200 CFU/100 mL	99.9

RECOMMENDATIONS AND FUTURE WORK

1. Septic tanks at both locations need to be pumped.

2. Time-dosed control panel on sludge return pump at RV Dumping Station to improve nitrogen treatment.

3. Hire a MPCA certified service provider.

4. Gather and analyze flow data to gain a better understanding of how the systems are working compared to how much use they are getting.

RV CHEMICALS

- After DNR report we wondered about the chemicals used
- Went to Amazon and picked the top 4 star selling products
  - Happy Campers Organic RV Holding Tank Treatment
    - monohydrate blend of minerals and micronutrients
  - Thetford Aqua-KEM Original Deodorizer
    - formaldehyde and methyl alcohol
  - Walex Porta-Pak Holding Tank Deodorizer
    - 2-Bromo-2-nitropropane-1,3-diol (Bronopol)
  - Walex Natural Holding Tank Deodorizer
    - enzymes, >50% of composition is not provided (trade secrets)
- Adding recommended chemical to simulate a full 40-gallon load

RESULTS

	Happy Campers	Aqua-Kem	Walex-Porta-Pak	Walex Bio Pal
BOD	<1	1209	55	23
COD	6	2728	121	46
TSS	6	1	3	6
Phosphorus	<1	<1	5	58
TKN	<1	<1	1	<1
pH	5.2	5.7	6.3	6.1

RECOMMENDATIONS

Formaldehyde should be avoided

Education/signage directly people not use?

Flow data along with more wastewater samples from RV dump stations should be collected

WASTEWATER CHARACTERISTICS ANALYSIS OF COFFEE AND SODA PRODUCTS

BEVERAGE IMPACTS AT CONVENIENCE STORES AND FOOD ESTABLISHMENTS

- Considerable amounts of liquid beverages is discharged to septic systems
- What is the impact of coffee and soda on wastewater levels?
- Five different types of product were used for this study:
  1. black coffee
  2. iced coffee
  3. coffee with a sweetened creamer
  4. coffee with regular half and half added
  5. coke (regular)

RESULTS

	Black Coffee	Iced Coffee	Soda-Regular Coke	Coffee with Hershey's Creamer	Coffee with Half and Half
			Wastewater Concentrations (mg/L)		
Biochemical Oxygen Demand (BOD)	5,560	168,000	84,400	53,000	19800
Chemical Oxygen Demand (COD)	12,700	321,000	110,000	46,000	32,100
Total Suspended Solids (TTS)	260	960	265	1150	667
Chloride	127	760	27.3	374	383
Total Phosphorus	28.9	155	159	88.9	52
Total Kjeldahl Nitrogen (TKN)	331	547	42.3	347	531
pH	5.6	5.8	1.9	6.5	6.3

Wastewater Concentrations in a 1000-gal tank, one day of use (mg/L)		
	Black Coffee (12 gallons into the tank per day)	Soda- Regular Coke (2 gallons into the tank per day)
Biochemical Oxygen Demand (BOD)	67	1,688
Chemical Oxygen Demand (COD)	1,524	220
Total Suspended Solids (TTS)	3	<1
Chloride	2	<1
Total Phosphorus	<1	<1
Total Kjeldahl Nitrogen (TKN)	4	<1

IMPACTS TO SEPTIC SYSTEM

RECOMMENDATIONS

- Characterize the facility to determine if there are self-serve soda or coffee dispensers.
- CIDWT forms for Analyzing Wastewater Treatment Systems for High Strength Waste and Hydraulic Loading
  - http://cidwt.org/awtschecklists.html
- Discuss with the facility owner/manager if changes can be made to the equipment or management practices to reduce the amount of beverage waste entering the system
- During design or management for all existing facilities, several samples should be taken and analyzed, as the influent levels are likely to be variable

CASE STUDY: ADULT CARE FACILITIES

BACKGROUND

- 6 foster homes owned by same individual had reported various issues with their septic system operation and performance, including:
  - surface discharge of wastewater and
  - premature system failure
- The systems evaluated are conventional systems with septic tanks followed by in-ground soil treatment areas or mound systems
- Septic tanks pumped annually

EXAMPLE FACILITY

Permanent Residents:	**4**
Ave. Onsite Staff:	**2**
Bedrooms:	**4**
Bathrooms:	**2**

METHODS

- *Water Usage* - staff who work in the facilities collected daily water meter readings for April–August 2013
- *Onsite Practices and Behaviors*
  - Staff provided feedback and assisted in completing a survey
  - Provided inventories for each site listing all pharmaceuticals and personal care products used in the facilities

RESULTS – WATER USAGE

Site	Flow, gpd		
	Mean Ave. Recorded	70% of Design	Design
A. Maple View	321 ± 13	525	750
B. Shady Lane	462 ± 6	420	600
C. Woods	326 ± 22	420	600
D. Jocelyn	630 ± 19	525	750
E. Upland	521 ± 6	840	600/1200
F. Meadows	491 ± 23	525	750

RESULTS – WATER USAGE

- Flow was higher than the ideal operating maximum (70%) at 2 sites (3 if you take into account system that was expanded)
- None of the sites exceeded the maximum design flow (on average)
- **Recommendations:**
  - **Laundry**
    - All sites use top-loading washers
    - 1 to 12 loads in a single day
    - Convert to front-loading laundry machines
    - Limit bleach usage
  - **Bathing, Washing, and Toilet Use**
    - None of the homes had low-flow showerheads or toilets
    - Convert to:
      - low-flow showerheads (<2.0 gal per minute, gpm)
      - sink faucets/fixtures (0.5–1.5 gpm), and
      - toilets (<1.6 gal per flush)

RESULTS - CLEANING PRODUCTS

- Soap and detergents are often a significant part of maintaining a clean and hygienic home
- These cleaning products, however, can often stress septic systems when overused or disposed of improperly
- **Personal Care Products -** It would be prudent to reassess all cleaning products and personal care products
- Opting to use perfume- and dye-free alternatives will help cut down on unnecessary chemicals in wastewater

RESULTS – SOAPS AND DETERGENTS

- Several antibacterial soap products and disinfectants are listed in the site inventories
- Some may be necessary (antibacterial denture cleaning tabs) while others (hand soaps and dish detergents) are not*
- Replacing these products with non-antibacterial alternatives should reduce stress to the microbial communities and will not affect hygiene
- Not all troublesome products are labeled as antibacterial. Mouthwash and toothpaste brands with triclosan as an active ingredient should be avoided

* Aiello, et al., 2007

RESULTS – DISPOSABLE WIPES

- During several site visits, non-biodegradable products were observed in the pretreatment tanks at 3 sites
- Recommendation – Remove from facilities and remind staff as well as guests wipes, personal wet-cloths, and moist towelettes are not suitable for septic systems
  - These should be disposed of with solid waste

BOD_5 DATA

Site	BOD_5, mg/L		
	Mean	Min.	Max.
A. Maple View	143 ± 31.0	80.8	166
B. Shady Lane	129 ± 12.4	110	147
C. Woods	193 ± 34.2	159	235
D. Jocelyn	144 ± 41.5	93.4	195
E. Upland	182 ± 49.9	119	244
F. Meadows	132 ± 64.9	48.7	191
G. Control Site	64 ± 30.7	38.6	114

TSS DATA AND ANALYSIS

Site	TSS, mg/L		
	Mean Ave.	Min.	Max.
A. Maple View	46.5 ± 2.7	44.1	51.0
B. Shady Lane	38.9 ± 16.9	20.5	67.4
C. Woods	39.6 ± 8.7	28.2	54.5
D. Jocelyn	48.6 ± 10.5	36.7	65.3
E. Upland	51.1 ± 18.7	31.9	84.7
F. Meadows	24.7 ± 6.3	17.5	32.0
G. Control Site	40.3 ± 24.4	17.3	71.8

- All sites had TSS concentrations within the standard range*
- Lint filters and effluent screens recommended

METHYLENE BLUE ACTIVE SUBSTANCES

- MBAS are a group of anionic surfactants accounting for as much as 63% of synthetic surfactant production worldwide*
- Detergents, cleaners, and soaps
- Surfactants do not typically pose a risk to groundwater, unless under saturated conditions, because of a strong tendency for soil sorption*

Hubbard, 2002, Reneau and Pettry, 1975, Weil-Shafran *et al.*, 2006

MBABS & SEPTIC SYSTEMS

Concentration (mg/L MBAS)	Potential Effects (Hernández Leal et al., 2011, and Weil-Shafran et al., 2006)
≥1.0	Risk of long-term accumulation of surfactants in soil, leading to decreased hydraulic conductivity and increased water repellence
10	Inhibition of hydrolysis, leading to greater accumulation of solids in anaerobic sewage treatment systems
30	Direct degradation of soil structure and decrease in hydraulic conductivity

MBAS RESULTS
(1 SAMPLING EVENT)

Site	Anionic Surfactants (MBAS), mg/L
A. Maple View	2.0
B. Shady Lane	0.76
C. Woods	3.8
D. Jocelyn	8.6
E. Upland	1.5
F. Meadows	3.4
G. Control Site	2.7

- 6/7 sites showed concentrations above the recommended 1.0 mg/L for soil treatment

ADDITIONAL RECOMMENDATION

- Some of the existing systems are not up to basic standards
- Effluent screens and alarms should be added
- New systems or those being upgraded should time dosing and incorporate secondary treatment prior to soil treatment to mediate:
  - flow,
  - waste strength, and
  - CECs

MORE INFORMATION

SEE OUR WEBSITE AT: SEPTIC.UMN.EDU/RESEARCH

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