

UPDATES ON STATE FUNDED ONSITE WASTEWATER RESEARCH AT TEXAS A&M UNIVERSITY

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¹Texas A&M AgriLife Extension and Research Center, Temple, TX

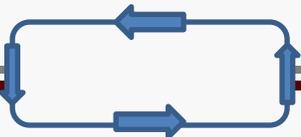
²Biological and Agricultural Engineering Department, Texas A&M University, TX.

For Presentation at the Onsite Wastewater Mega Conference
Organized by the National Onsite Wastewater Recycling Association
October 17-20, 2021

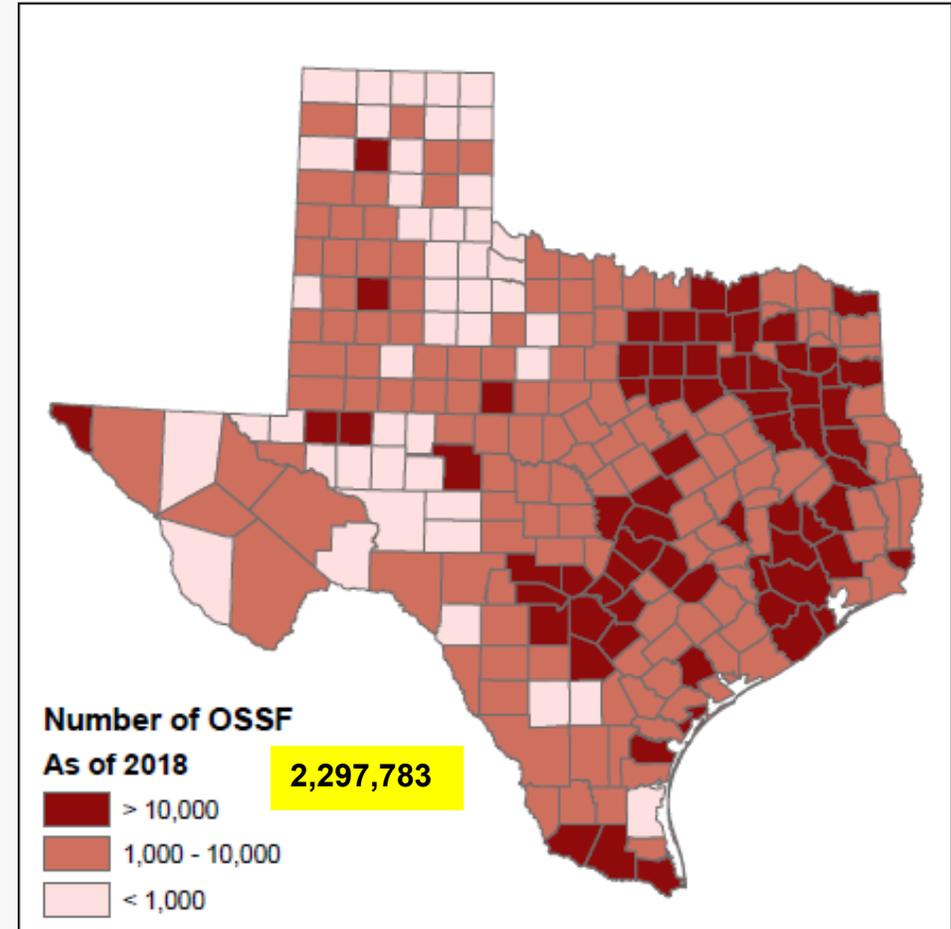
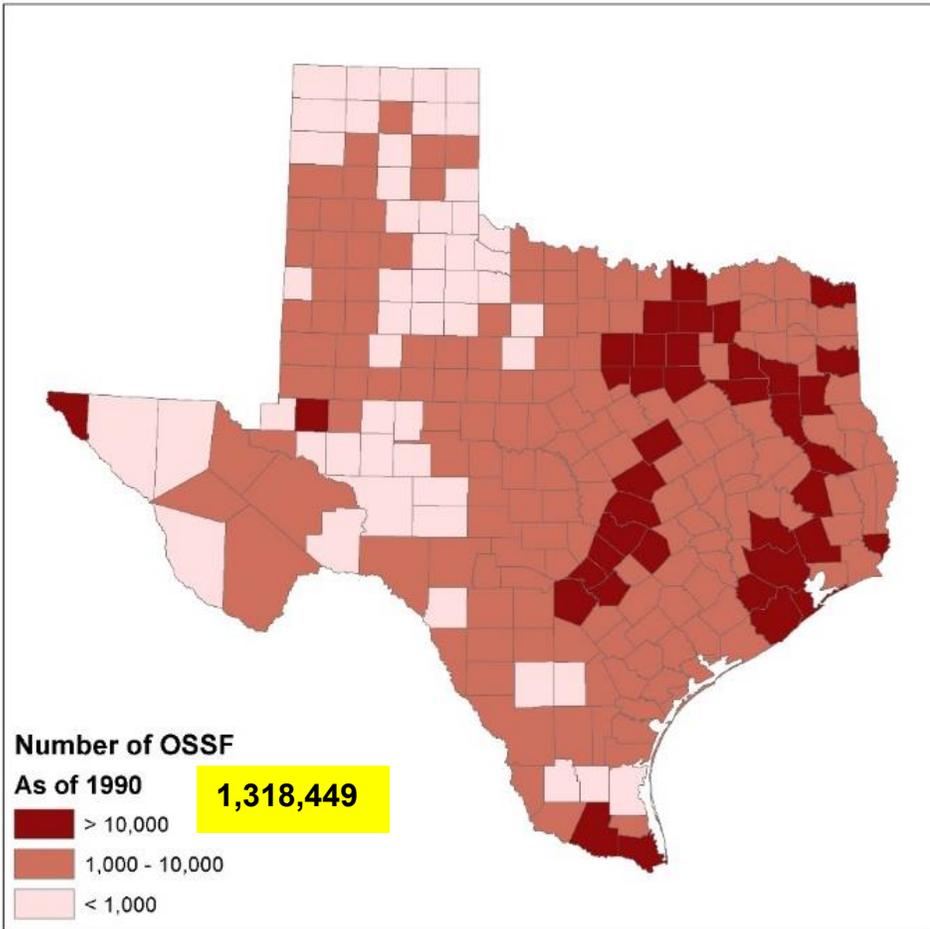
*The materials being presented represent the speaker's own opinions and
do NOT reflect the opinions of NOWRA.*

Presentation Outline

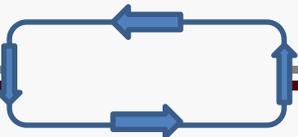
- Background Information and Intro to RELLIS Campus;
- On-Site Sewage Facilities (OSSFs) in Texas;
- Research Methods and Challenges;
- Preliminary Data Analysis and Updates;
- Discussion / Q & A



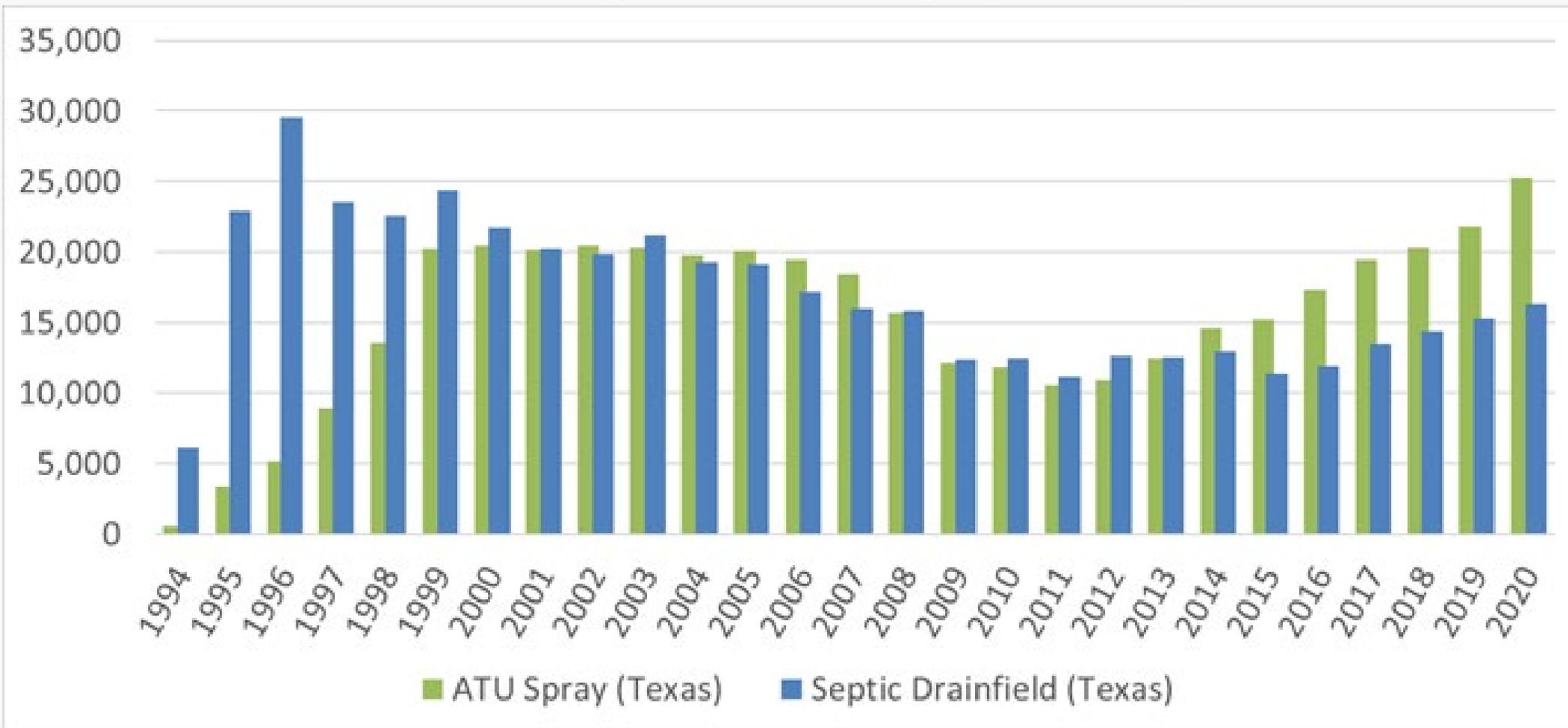
On-Site Sewage Facility (OSSF) in Texas



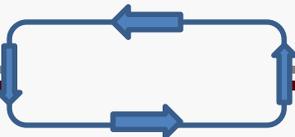
Total as of 2020 = 2,383,349



On-Site Sewage Facility (OSSF) in Texas



About 927,000 new permits issued since 1990... of which about 418,000 (~45%) were for ATU Spray



Owts Progress during the 20th Century

- Septic tank drain-field



- Primary treatment by a septic tank (~20%), rest (~80%) by soil.

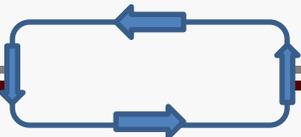
- Aerobic tank spray-field



- Secondary treatment by ATU or Media filter (~80%), rest (~20%) by soil



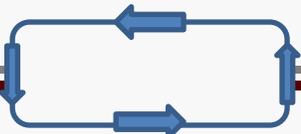
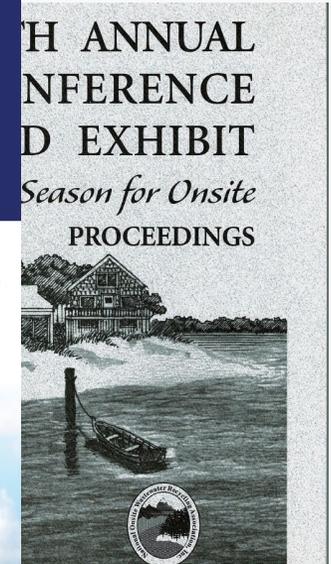
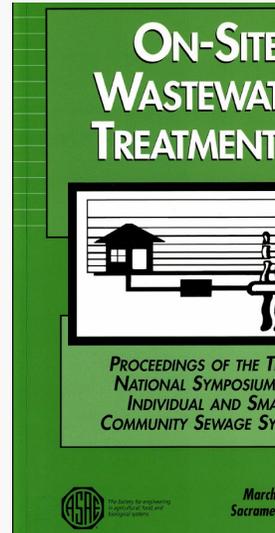
OSSF Systems in Texas, Then and Now



\$ Research \$

Impacts of Research Findings on Knowledge Formation & Dissemination in Academic World....

- 4 Main Sources in U.S.A.
 - ASAE (now ASABE)
 - NSFC (now not active)
 - NOWRA (and state associations)
 - WEF



\$ Research \$

Background on Research Funding in Texas....



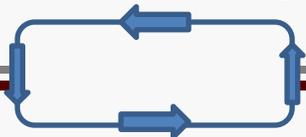
- NOWRA 1997? in College Station, TX – Visit to the OWTS Center;
- Partially funded through the \$10 per permit research funds;
- Research funding lasted for 20 years, ~\$6M funded 30 projects;
- Center was established by Dr. Bruce Lasiker and operated for ~15 years....



Riverside Training Center since early 2011...



W/O Responsible Management Nothing Works... w/o \$\$\$ no RME!

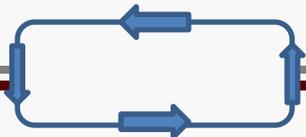


\$ Research \$

Riverside Training Center....



November 2014...



\$ Research \$

Riverside Training Center....

Got \$\$\$\$ help from...

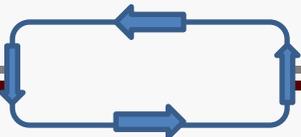
- AgriLife Extension and BAEN. Thanks to:



Dr. Douglas Steele
Director, Texas A&M AgriLife
Extension Service



Dr. Steve Searcy
Professor & Department Head
BAEN



Riverside Training Center.... Got \$\$\$\$ help from...

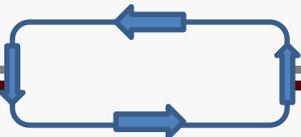
- AgriLife Extension and BAEN. Thanks to:



**Dr. Travis Miller, Interim
Associate Director,
Texas A&M AgriLife
Extension Service**



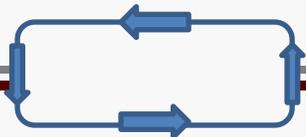
**Dr. Dana Porter
Extension Program Leader and
Associate Department Head
BAEN**



Real workforce so far has been....

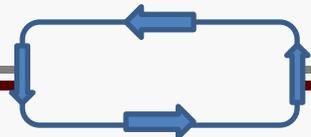


PLUS, a number of work study students and TOWA members

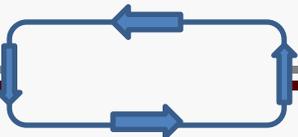


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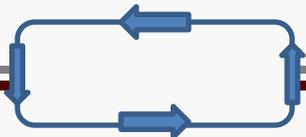
Riverside/RELLIS Center....



OSSF Center Rededication Ceremony... September 2015



OSSF Site Survived the CUT!



\$ Research \$

TAMU OSSF Center on RELLIS Campus



2-Acre facility with access to water and sewer lines, wastewater treatment and reuse systems, drinking water treatment systems, and a field laboratory!

\$ Research \$

Background on Research Funding in Texas....



- Research Council sunset in 2011, stopping the research funding but not the \$10 fee collection;
- House Bill 2771 was proposed and passed in 2017, restarting the funding;
- 2/4/'19 TCEQ issued *RFGA Solicitation No: 582-19-93772*.
- 3/29/'19 TAMU submitted 3 proposals: ATU, LPD, and Reuse.
- 5/2/'19 TCEQ notification to TAMU, all 3 proposals were selected for funding!
- 8/8/'19 all 3 contracts signed and project accounts setup.

4 Research Topics in the RFGA.

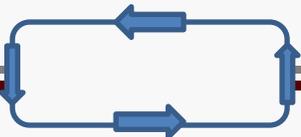
TCEQ RFGA: Eligible Projects

2.3.1 Adequacy of Current Designs with Higher Strength Wastewater

2.3.2 Dosing vs. Non-Dosing

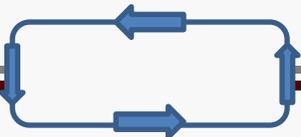
2.3.3 Implementation of Low-Pressure Dose Systems with Various Configurations

2.3.4 Black Water Non-Potable Reuse



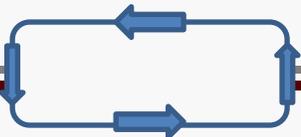
Team TAMU Proposed 3 Research Projects

1. Evaluation of Equalized Dosing and High-Strength Wastewater on the Performance of Aerobic Treatment Units (ATU);
2. Evaluation of Low-Pressure Dosing Systems with Various Configurations (LPD); and
3. Feasibility Study to Evaluate On-Site Treatment of Wastewater for Non-Potable Reuse (Reuse).



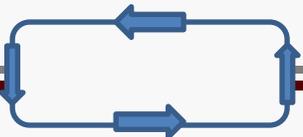
Project 1: Contract # 582-19-96831

- Project Name: **Evaluation of Equalized Dosing and High-Strength Wastewater on the Performance of Aerobic Treatment Units (ATU);**
- Principal Investigator: June Wolfe III, AgriLife Research;
- Co-PI: Anish Jantrania, Ryan Gerlich, and Gabriele Bonaiti, AgriLife Extension.



Project 2: Contract # 582-19-96830

- Project Name: **Evaluation of Low-Pressure Dosing Systems with Various Configurations;**
- Principal Investigator: Gabriele Bonaiti, AgriLife Extension;
- Co-PI: Anish Jantrania and Ryan Gerlich, AgriLife Extension; June Wolfe III, AgriLife Research.

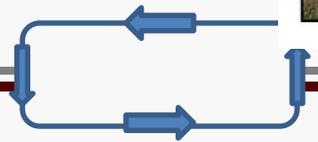




- A: WWTP
- B: Cleanout
- C: Feed Tank
- D: ATU Septic Tank
- E: ATU 1
- F: ATU 2
- G: LPD Septic Tank**
- H: LPD Drainfield (H1-4 = Design Replicates)**
- I: ATU 3
- J: MBR

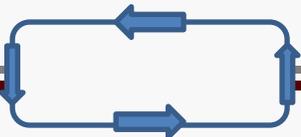
**Details at
10:30AM in
Track #7**

\$ Research \$



Project 3: Contract # 582-19-96829

- Project Name: **Feasibility Study to Evaluate On-Site Treatment of Wastewater for Non-Potable Reuse;**
- Principal Investigator: Anish Jantrania, AgriLife Extension;
- Co-PI: Gabriele Bonaiti and Ryan Gerlich, AgriLife Extension; June Wolfe III, AgriLife Research.

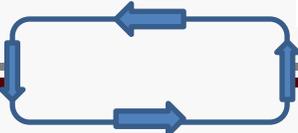


- A: WWTP
- B: Cleanout
- C: Feed Tank
- D: ATU Septic Tank
- E: ATU 1
- F: ATU 2
- G: LPD Septic Tank
- H: LPD Drainfield (H1-4 = Design Replicates)
- I: ATU
- J: MBR



Details in a few minutes

\$ Research \$



Research projects progress and updates....



- 9/12/'19 First meeting with TCEQ and TOWA Team Members....
- TAMU-TCEQ-TOWA Advisory Committee formed to guide the research projects;
- 11/18/'20 Second meeting with the Committee on Zoom!
- Sampling started and stopped and re-started *slowly* in Dec 2020.... And finished in Aug 2021....

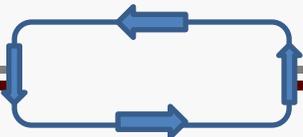
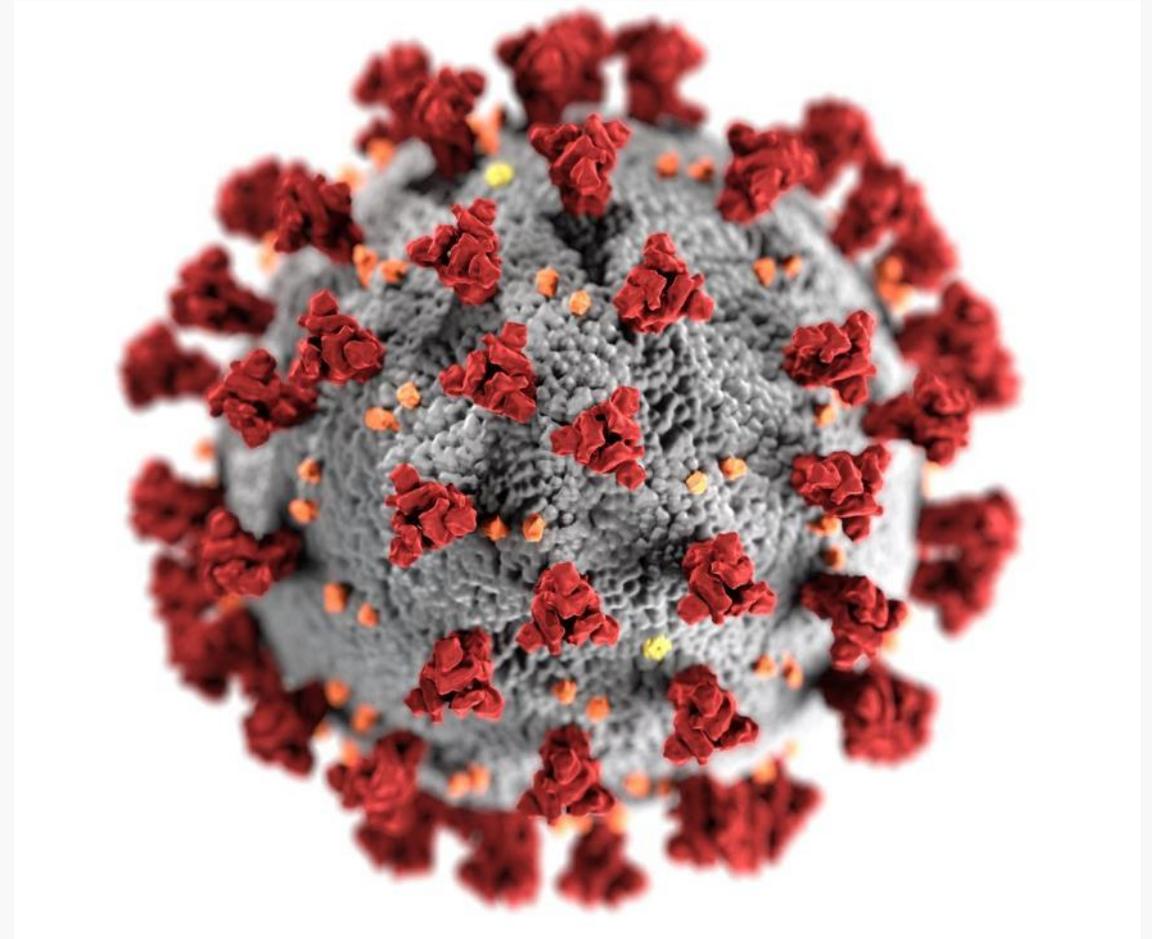
COVID-19 Effect upon OSSF research timeline.....

Timeline

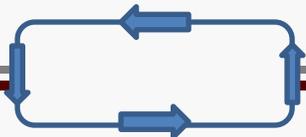
- 16 March 2020 – AgriLife suspends all field and lab activity
- 15 May 2020 – AgriLife resumes 25% activity
- 1 Jun 2020 – AgriLife resumes 50% activity
- 6 Aug 2020 – TCEQ requests plan to complete project
- 14 Aug 2020 – AgriLife responds with completion plan
- 26 Aug 2020 – AgriLife resumes 75% activity - CURRENT

OSSF Research Progress under COVID conditions

- Upgraded infrastructure at RELLIS OSSF Research Facility
- Completed QAPP (approved by TCEQ – 1 Oct 2020)
- Developed synthetic high strength waste recipe (ATU/Reuse)
- Procured equipment, instrumentation, and supplies
- Completed installation work for all three projects



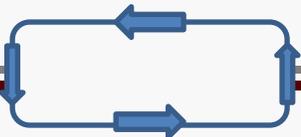
Following Federal, State, and University working guidelines



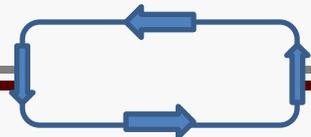
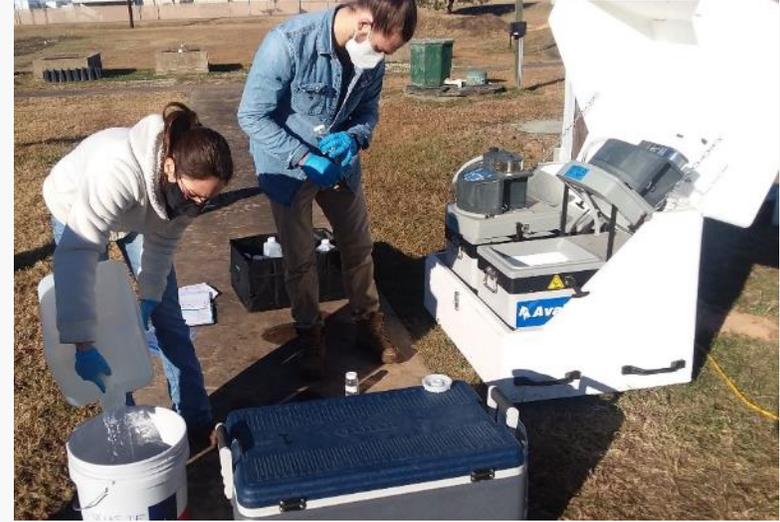
Getting Enough Supply of Raw Wastewater for all 3 research projects, ~1,000 GPD....



Connecting the Center with the RELLIS Sewer Main instead of just one building.... Original flow to the Center was <200 GPD!



Sampling for all three projects Dec '20 – Aug '21



\$ Research \$

Sampling for all three projects Dec '20 – Aug '21

May 2021

April '21							June '21								
S	M	T	W	T	F	S	S	M	T	W	T	F	S		
				1	2	3					1	2	3	4	5
4	5	6	7	8	9	10	6	7	8	9	10	11	12		
11	12	13	14	15	16	17	13	14	15	16	17	18	19		
18	19	20	21	22	23	24	20	21	22	23	24	25	26		
25	26	27	28	29	30		27	28	29	30					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
25	26	27	28	29	30	1

ProjectCalendar-Details.xlsx

Sampling Points =>	LIFT STATION	FEED TANK	Sampler 1-1	Sampler 1-2	Sampler 1-3	Sampler 1-4	Sampler 2-1	Sampler 3-1	Sampler 3-2	Sampler 3-3		Total # of Samples
Parameters							Only five times					
BOD	X	X	X	X	X	X	X	X	X	X		74
TSS	X	X	X	X	X	X	X	X	X	X		74
Turbidity			X	X	X	X						32
E Coli			X	X	X	X						32
NH3N			X	X	X	X						32
TKN			X	X	X	X						32
NO3N NO2N			X	X	X	X						32

23	24	25	26	27	28	29
Day 13	END TR5 Day 14 AT - Sample 7	LPD Sample AT - Sample 8				
30	31 REEU Check IN Day	Notes				

Calendar Templates by Vertex42
<https://www.vertex42.com/calendars/>

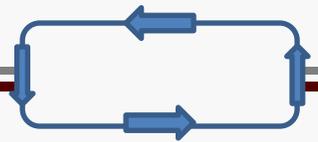
Sampling for all three projects Dec '20 – Aug '21

June 2021

May '21							July '21							
S	M	T	W	T	F	S	S	M	T	W	T	F	S	
						1						1	2	3
2	3	4	5	6	7	8	4	5	6	7	8	9	10	
9	10	11	12	13	14	15	11	12	13	14	15	16	17	
16	17	18	19	20	21	22	18	19	20	21	22	23	24	
23	24	25	26	27	28	29	25	26	27	28	29	30	31	
30	31													

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31 REEU Week 1	1 REEU Starts	2	3	4	5
6	7 REEU Week 2	8	9	10	11	12
13	14 REEU Week 3	15 START TR6 All 3 Projects Day 1	16 Day 2	17 Day 3	18 Day 4	19 Day 5
			AT - Sample 1	AT - Sample 2		
20	21 REEU Week 4	22	23	24	25	26
Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
	AT - Sample 3	AT - Sample 4	AT - Sample 5	AT - Sample 6		
27	28 REEU Week 5	29	30	1	2	3
Day 13	END TR6 Day 14	LPD Sample				
	AT - Sample 7	AT - Sample 8				
4	5	Notes				

Calendar Templates by Vertex42
<https://www.vertex42.com/calendars/>



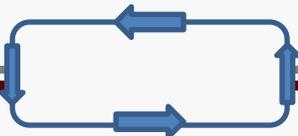
\$ Research \$

Two Reuse Technologies



Clearstream® Original System (Std-30) installed in early 1990s was replaced in March 2020...

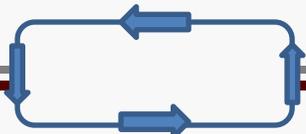
Clearstream® Model 500-DA (Std-350) Reuse and Nutrient Reduction System.



Two Reuse Technologies

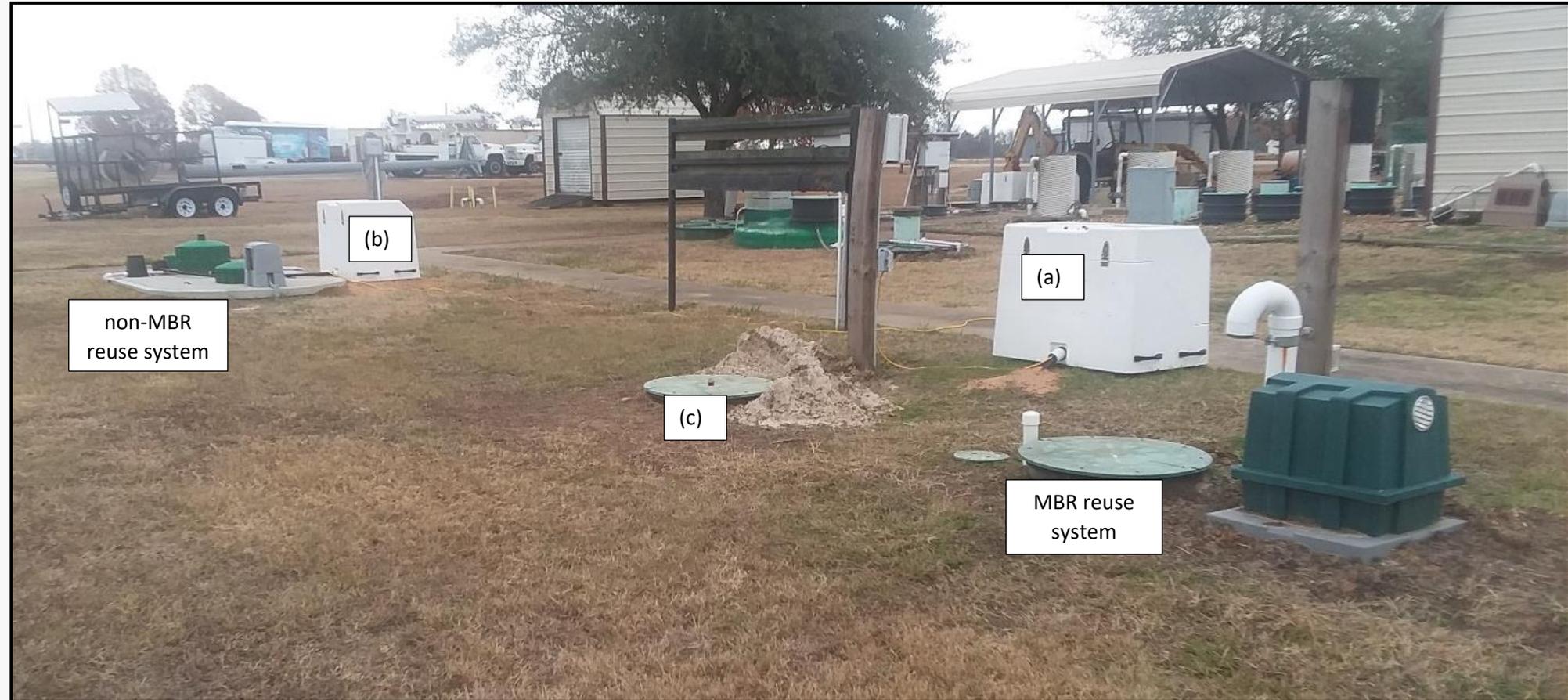


**BioMicrobics Model
BioBarrier® MBR 0.5 (Std-350)
installed in 2016 and
membrane changed Dec 2020**

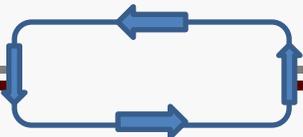


\$ Research \$

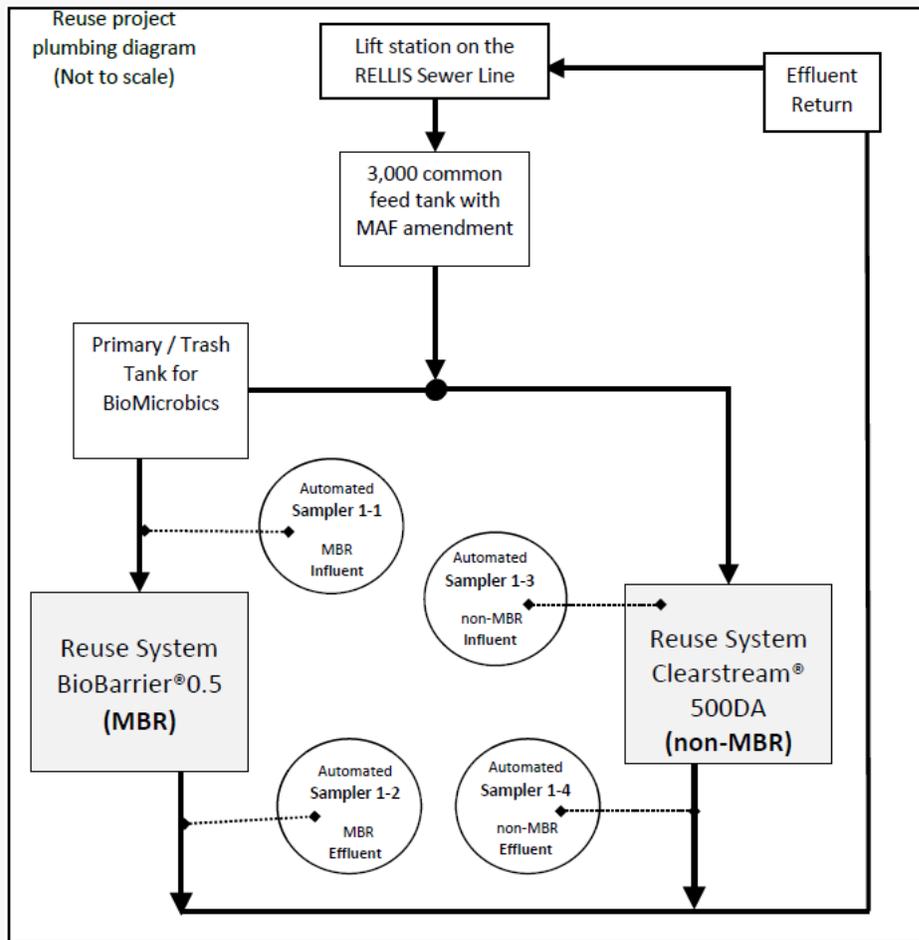
Two Reuse Technologies



(a) and (b) are the weather-proof boxes each housing two refrigerated composite samplers. (c) is ozone tank for MBR effluent.



Flow Path for Reuse Project



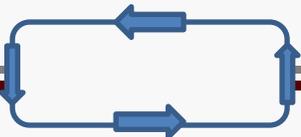
NOTE:

- MBR effluent is disinfected using Ozone (40 min ON 20 min OFF Cycle)
- non-MBR effluent is disinfected using UV and liquid chlorination (continuous operation)

Two Reuse Technologies

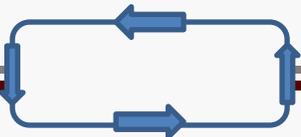


- Added a sampling point 1-5, for collecting MBR effluent BEFORE Ozonation;
- Adding a sampling point after starting experiment is not a good idea, but we did it anyway!
- Will have a few sample results to compare MBR before and after Ozonation!

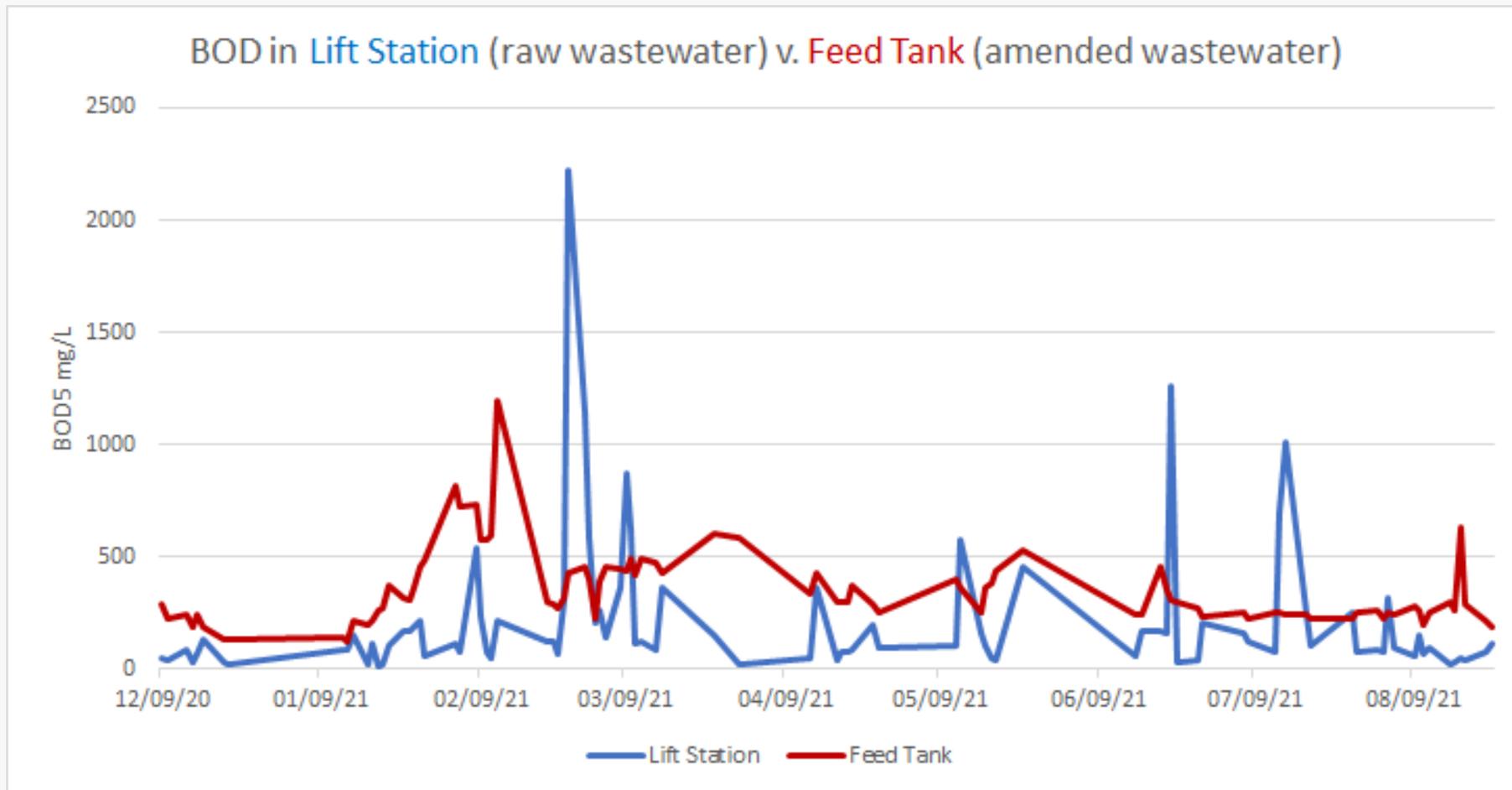


Preliminary Results & Discussion

- Private Lab (Aqua-Tech) collected samples, 8 times per month for 9 months (Dec '20 - Aug '21) and conducted >2,200 analysis;
- Samples collected from:
 - Lift station (Raw Wastewater from RELLIS Sewer);
 - Feed tank (Amended Wastewater with ~10 lb/d MAF);
 - 4 samplers at Reuse (influent and effluent), 3 samplers at ATU (influent and effluent), and 1 sampler at LPD (influent to LPD)



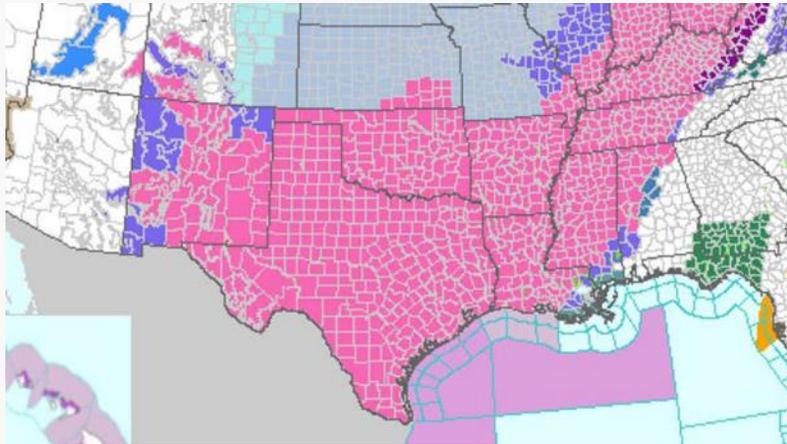
Preliminary Results & Discussion



Parameter	Lift Station			Feed Tank		
	Min	Max	Avg	Min	Max	Avg
BOD (5 day), mg/L	ND	>2,200	185	125	1,210	364
TSS, mg/L	8	11,000	690	100	1,020	251

Preliminary Results & Discussion

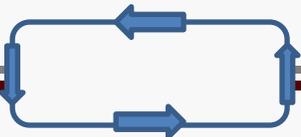
COVID + Deep Freeze in February 2021 (*Double Trouble*)...



Screen shot of weather map from local TV



Pictures taken by Mesut... *brave student*...



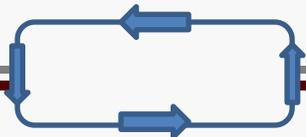
\$ Research \$

Preliminary Results & Discussion

Effluent from Reuse Systems before winter storm shut-down (2/11)



Effluent from Reuse Systems after winter storm shut-down (2/22)

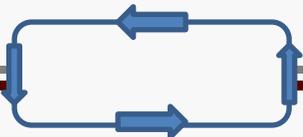


Preliminary Results & Discussion



*Pic taken
in Nov.
2020*

Effect of Ozonation.... Raw WW – to MBR effluent – to Ozonated effluent



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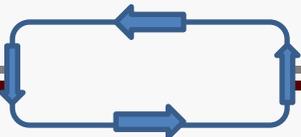
Data analysis continues.....

	non-MBR+UV+Chlorine	MBR+O ₃
Normal Conditions	BOD5 TSS Turbidity <i>E. Coli</i>	BOD5 TSS Turbidity <i>E. Coli</i>
Abnormal Conditions	BOD5 TSS Turbidity <i>E. Coli</i>	BOD5 TSS Turbidity <i>E. Coli</i>

*Extreme cold week;
Turn off disinfection,
aeration, and ignore
alarm conditions.*



\$ Research \$

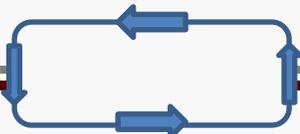


Preliminary DRAFT Results & Discussion

Month	Avg Daily Flow (GPD)	
	non-MBR	MBR
December	219	219
January	275	275
February	223	241
March	242	250
April	227	278
May	218	271
June	217	267
July	207	264
August	211	267

	TSS (mg/L)		<i>E. Coli.</i> (MPN/100 mL)	
	non-MBR	MBR+O3	non-MBR	MBR+O3
0-Dec	18	0	0	0
1-Jan	12	0	0	0
2-Feb	4	1	0	93
3-Mar	17	1	61	25
4-Apr	10	1	0	5
5-May	10	2	57	0
6-Jun	11	0	0	0
7-Jul	8	5	9	23
8-Aug	6	2	11	15

TCEQ 210.82 Reuse Standards for residential toilet flushing:
 TSS <10 mg/L and *E. Coli* <14 MPN/100 mL
30-day geometric mean value...

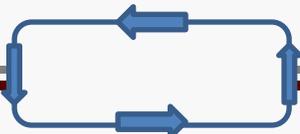


\$ Research \$

Preliminary DRAFT Results & Discussion

MBR								
Location	Sampler 1-1 Influent							
	n		Average		Min		Max	
	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	45	N/A	22	N/A	72
1-Jan	N/A	8	N/A	66	N/A	51	N/A	82
2-Feb	6	6	311	101	203	72	443	120
3-Mar	8	8	276	352	178	252	420	687
4-Apr	8	8	81	140	61	93	118	202
5-May	8	8	64	108	0	77	81	144
6-Jun	12	12	76	124	62	51	84	220
7-Jul	2	2	83	151	53	98	113	204
8-Aug	6	6	98	75	83	40	129	174
	50	66						
Location	Sampler 1-2 Effluent							
	n		Average		Min		Max	
	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	0	N/A	0	N/A	1
1-Jan	N/A	8	N/A	0	N/A	0	N/A	3
2-Feb	6	6	2	1	1	0	5	5
3-Mar	8	8	2	1	1	0	3	2
4-Apr	8	8	2	1	1	0	5	2
5-May	8	8	2	2	0	0	6	3
6-Jun	12	12	2	0	0	0	5	1
7-Jul	2	2	14	5	5	2	22	8
8-Aug	6	6	4	2	1	1	9	5
	50	66						

non-MBR								
Location	Sampler 1-3 Influent							
	n		Average		Min		Max	
	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	50				
1-Jan	N/A	8	N/A	65				
2-Feb	6	6	361	205				
3-Mar	23	8	283	370				
4-Apr	8	8	182	260				
5-May	7	7	142	333				
6-Jun	12	12	199	1157				
7-Jul	2	2	235	1800				
8-Aug	6	6	183	603				
	64	65						
Location	Sampler 1-4 Effluent							
	n		Average		Min		Max	
	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	18				
1-Jan	N/A	8	N/A	12				
2-Feb	6	6	34	4				
3-Mar	7	7	19	17				
4-Apr	8	8	5	10				
5-May	7	7	9	10				
6-Jun	12	12	6	11				
7-Jul	2	2	6	8				
8-Aug	6	6	4	6				



Indoor Non-Potable Reuse at Public Facilities in Texas

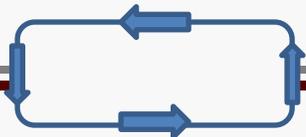


Net-Zero Bathroom facility in Harris County, (*Carter Park*)

TxDOT Rest Area on I-45

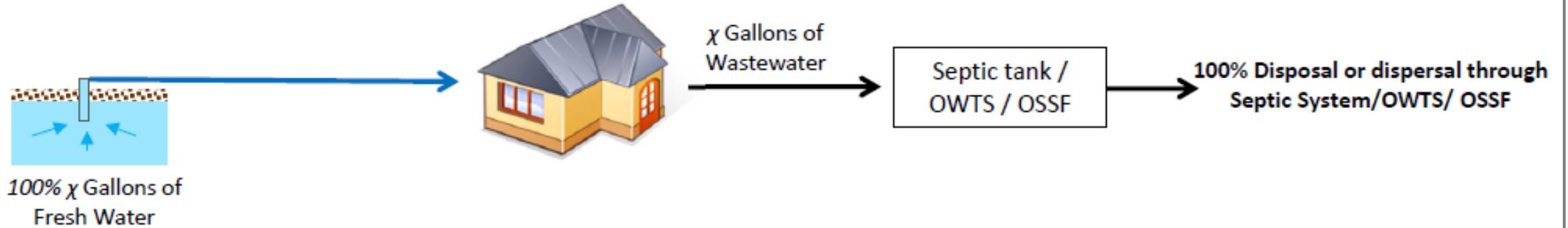


\$ Research \$

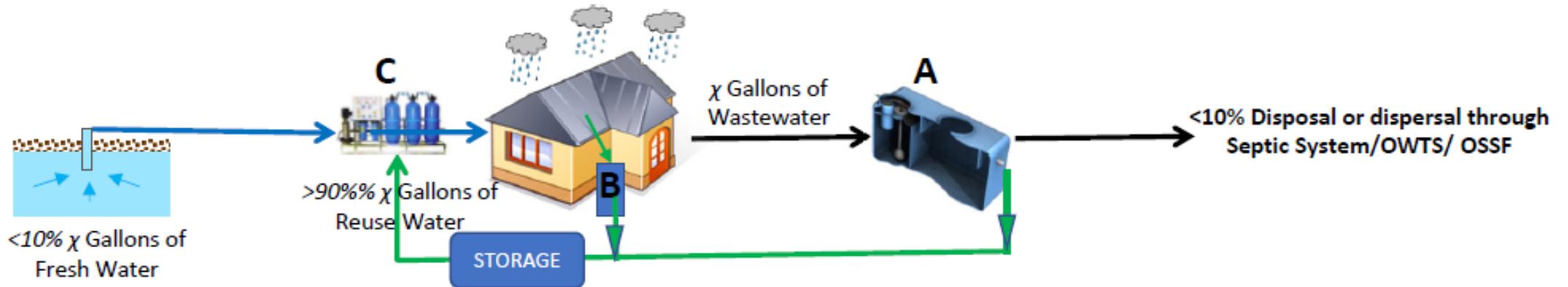


Big Research Question

Is the Onsite Industry ready to go from this:



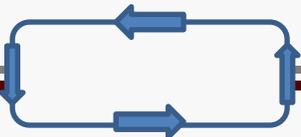
to this by 2050?:



\$ Research \$

What's Next....

- Complete data analysis and final report by November 29;
- TOGP 2nd Round RFGA, TAMU submitted three proposals to address four topics:
 - *Use of Onsite Systems in RV Parks – challenges*
 - *Reduction of Effluent Quantity from OSSF – how to do it*
 - *Proper Dosing Techniques and Application Rates for Drip*
- **Work with NOWRA team to prepare the report / recommendations from NOW-R² project to shape the TOGP's future round of research topics!**



THANK YOU

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