TOWA 2022 ANNUAL CONFERENCE MARCH 8-9, 2022

Current and *Future* Status of the TCEQ funded Research at TAMU OSSF Center

TCEQ / TAMU Research Project Update

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June Wolfe III – AgriLife Research

Gabriele Bonaiti – AgriLife Extension

Ryan Gerlich – AgriLife Extension

Texas A&M AgriLife Research

BIOLOGICAL AND AGRICULTURAL ENGINEERING

Texas A&M AgriLife Extension

Agenda

- Project #1, #2, and #3 **Round 1 Funding (2019 – 2021)**
- Challenges, Main Achievements, Results, Finding, and Lessons Learned (JW, GB, and AJ)
- Project #1, #2, and #3 **Round 2 Funding (2021 – 2023)**
- Future of Research Program at TAMU OSSF Center
- Questions and Discussion

4 Research Topics

TCEQ RFGA 2019: 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

3 Research Projects Funded

TAMU Response 2019: 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

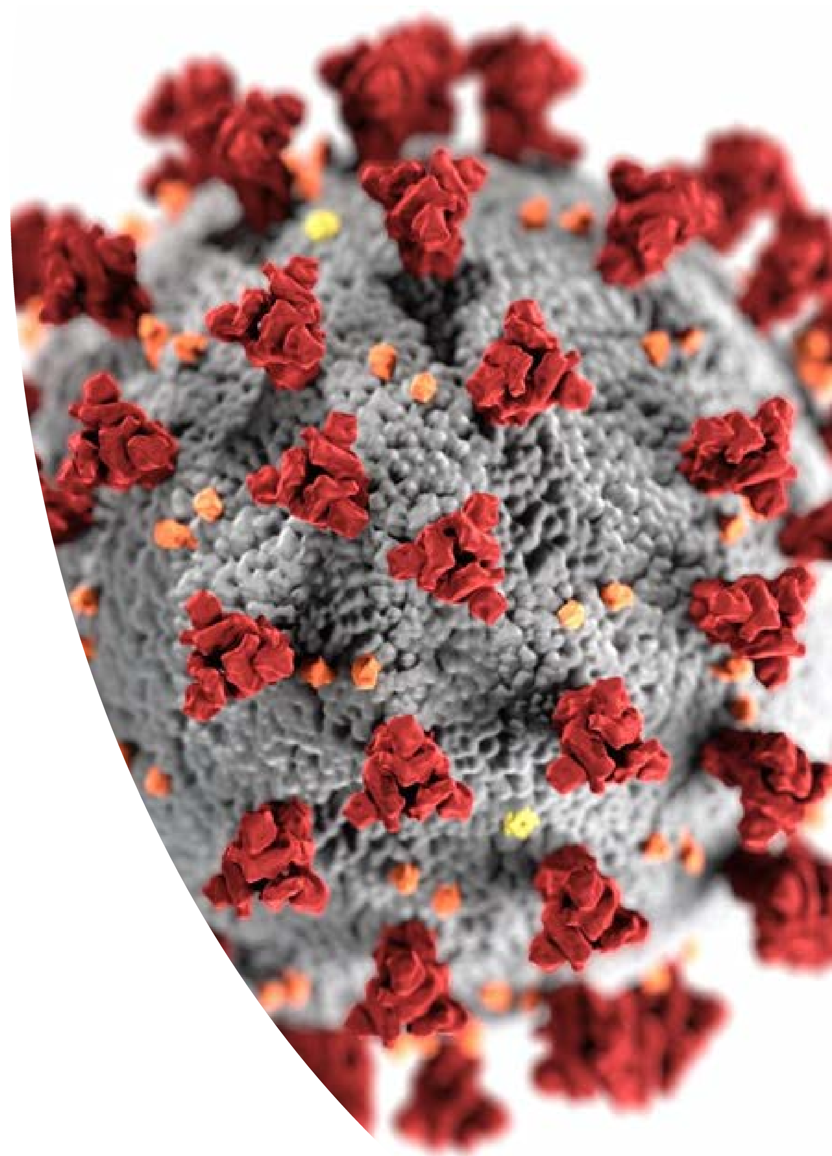
3. Feasibility Study to Evaluate On-Site Treatment of Wastewater for Non-Potable Reuse **(Reuse).**

Contracts signed by late August 2019, Project Started September 2019, and….

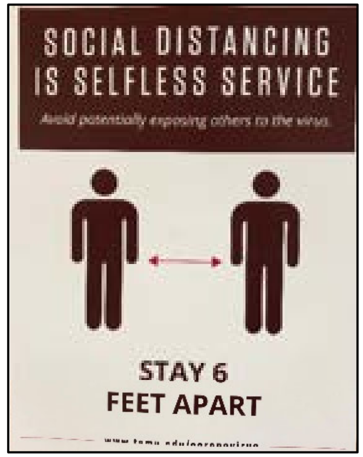
COVID-19 Effect upon OSSF research
Grant awarded and projects started in September 2019……

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
- 1 Oct 2020 – QAPP approved by TCEQ, can start spending $$$$
- Upgraded infrastructure at RELLIS OSS Research Facility
- Developed synthetic high strength waste recipe
- Data collection – December 2020 – August 2021
- Data analysis and report preparation completed November 2021
- *Funding for Phase-II projects secured – November 2021*
- Final reports for Phase-I projects submitted and review comments addressed Feb 2022.



Following Federal, State, and University working guidelines



Main Achievements
Research Facility New Additions

1. RELLIS sewer realignment,
2. Updated instrumentation with *abilities to amend raw WW*
3. Office/lab building

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.

ATU Research Approach

Topic 2 - Dosing Method

	Demand	Equalized Time
Design	ATU **Baseline** (adequate)	Does ATU performance **improve**?
Higher	Is ATU design **adequate*** for use?	Does ATU performance **improve**?

Topic 1
Increasing organic strength due to water conservation and reuse

*Adequate = meets NSF/ANSI Standard 40 effluent requirements

Flow reductions - described in current Texas OSSF Rules

- Chapter 285.91(3) Wastewater Usage Rate; effects of water-saving devices

TYPE OF FACILITY	USAGE RATE GALLONS/DAY (Without Water Saving Devices)	USAGE RATE GALLONS /DAY (With Water Saving Devices)
Single family dwelling (one or two bedrooms) - less than 1,500 square feet.	225	180

- Chapter 285.81(b) Adjusted Hydraulic Flow; effect of graywater reuse on % hydraulic flow reductions

Table I. Potential Percent Reduction

Sewage sources entering the graywater reuse system or combined reuse system	**Potential percent reduction to the effluent disposal system required in §285.33 of this title**
Clothes-washing machine only	20
Showers, bathtubs, hand-washing lavatories, and sinks that are not used for the disposal of hazardous or toxic ingredients	30
Clothes-washing machines, showers, bathtubs, hand-washing lavatories, and sinks that are not used for the disposal of hazardous or toxic ingredients	50

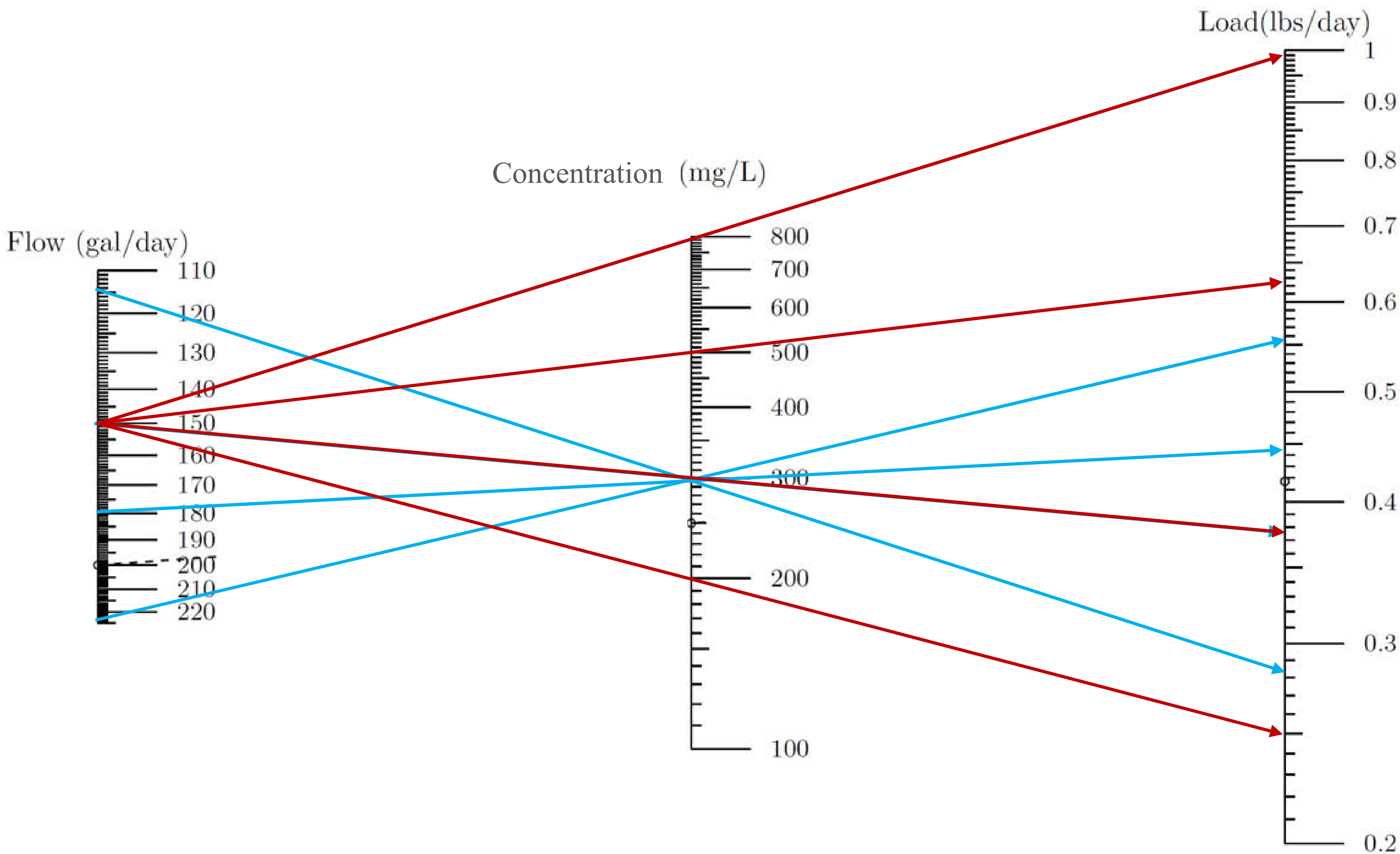
Organic strength - described in current Texas OSSF Rules

- Chapter 285.81(d) Adjusted Organic Strength; effect of graywater reuse

Table II. Adjusted Organic Strength

Sewage sources entering a graywater reuse system or a combined reuse system	**Five-day Biochemical Oxygen Demand (BOD_5) design strength for sewage entering on-site sewage facilities milligrams per liter (mg/l)**
Clothes-washing machine only	375
Showers, bathtubs, hand-washing lavatories, and sinks that are not used for the disposal of hazardous or toxic ingredients	430
Clothes-washing machines, showers, bathtubs, hand-washing lavatories, and sinks that are not used for the disposal of hazardous or toxic ingredients	600

Flow (gal/day) x Concentration (mg/L) x 0.00000834 = Load (lbs/day)



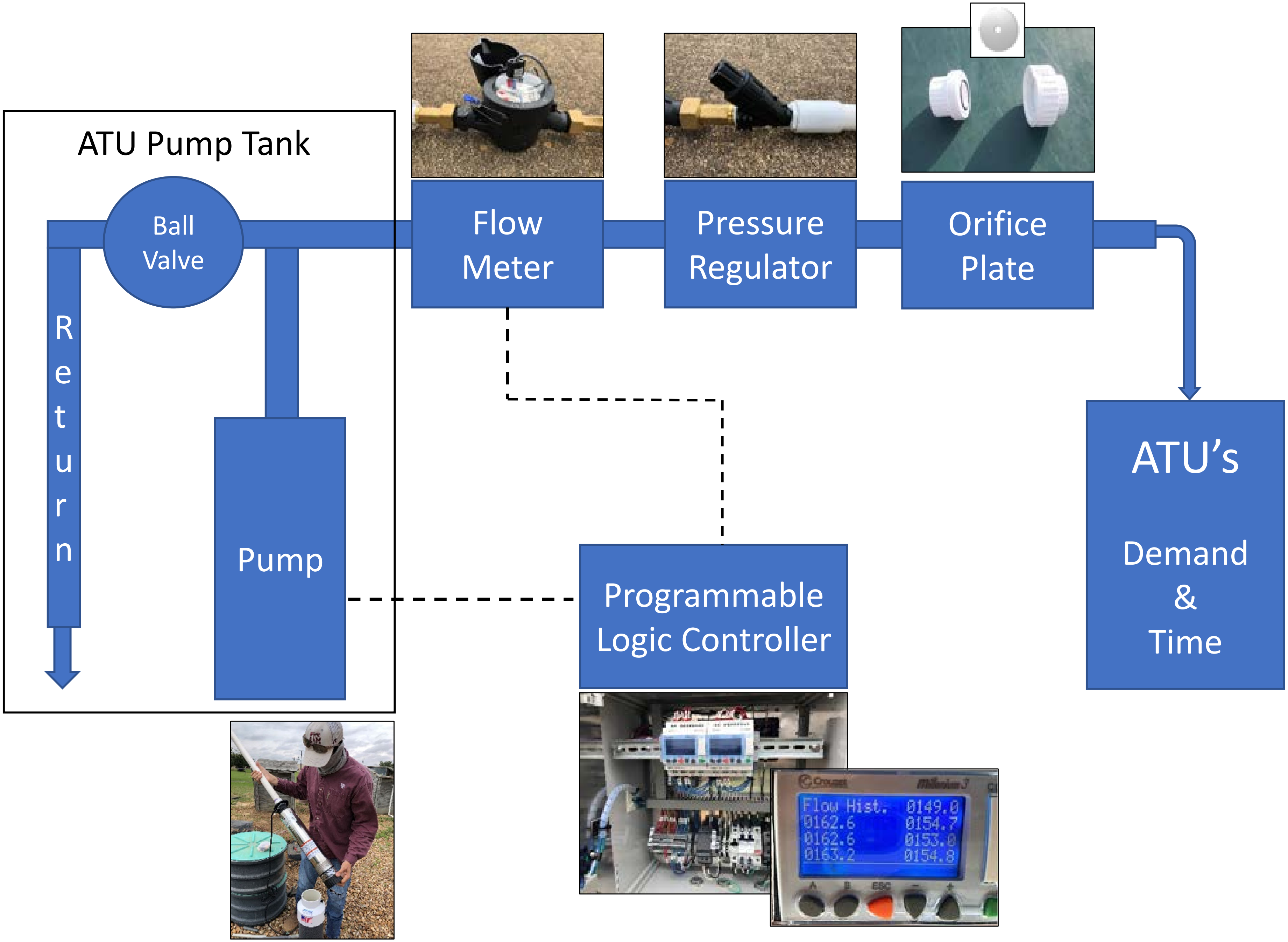
Research plan

Aerobic Treatment Unit Evaluation Plan – Parallel ATU's – Demand vs Time Dose			
Experiment*	Flow	Concentration	Load
	[gal/day]	[mg/L]	[lb/day]
1	225	300	0.56
2	180	375	0.56
3	157	430	0.56
4	112	600	0.56
5	112	800	0.75
6	157	900	1.18
7	180	1000	1.50
8	225	1000	1.88

***Six weeks per experiment:**

2-week equilibration, 2-week sampling, 2-week data review and prep for next

Flow control – Pump timer with orifice plate




Splice Box

Synthetic High-Strength Waste Formulation

- Constituent characterization
- Measured mass/volume (i.e., concentration)
- BOD_5 determination
- Relationship - Concentration vs BOD_5

AMENDMENT DELIVERY

Results – Flow Reduction

EXP	Demand Dose (gpd)	Time Dose (gpd)	Average (gpd)	Reduction (%)
1	225	225	225	0%
2	225	225	225	0%
3	180	180	180	20%
4	156	161	159	30%
5	157	157	157	30%
6	110	111	111	51%
7	113	111	112	50%
8	115	113	114	49%
9	113	113	113	50%
10	104	106	105	53%

Results– Synthetic High-Strength* Amendments

Exp	Average** Raw Sewage Influent BOD_5 [mg/L]	Average SHSW Amended Influent BOD_5 [mg/L]	SHSW Amended Influent Percentage increase from Raw Sewage Influent
1	56	230	311%
2	82	163	99%
3***	123	403	228%
4	120	201	68%
5	122	190	56%
6	261	461	77%
7	210	548	161%
8	136	650	378%
9	60	956	1493%
10	344	2943	756%

* > 300 mg/L BOD_5

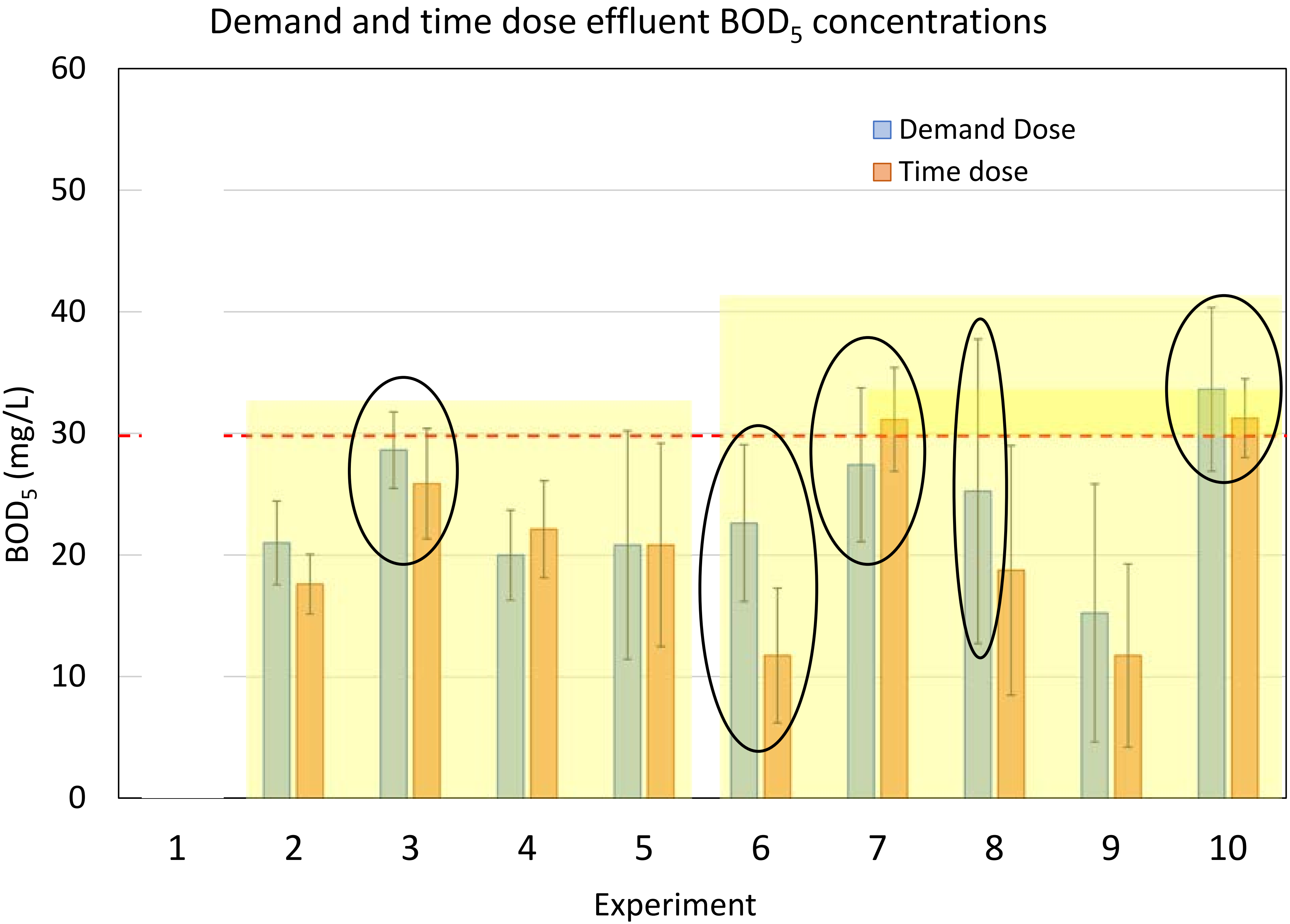
** Average of 8 samples over 2-week experimental period

*** Average of 6 samples over 3-week experimental period, freeze

Results – BOD_5

Common Influent (Demand and Time Dose)					Demand Dose Effluent		Time Dose Effluent	
EXP	Flow Reduction [% of normal]	Average* Influent Flow [gal/day]	Average Influent BOD_5 [mg/L]	Average Influent BOD_5 Load [lb/day]	Average Effluent BOD_5 [mg/L]	Average Effluent BOD_5 Reduction	Average Effluent BOD_5 [mg/L]	Average Effluent BOD_5 Reduction
1	100% -	225	230	0.43	**42**	**82%**	**42**	**82%**
2	100% -	225	163	0.31	21	87%	18	89%
3	80% ↓	180	403	0.60	21	95%	21	95%
4	70% ↓	159	201	0.27	20	90%	22	89%
5	70% -	157	190	0.25	29	85%	26	86%
6	50% ↓	111	461	0.42	23	95%	12	97%
7	50% -	112	548	0.51	25	95%	31	94%
8	50% -	114	650	0.62	25	96%	19	97%
9	50% -	113	956	0.90	15	98%	12	99%
10	50% -	105	2943	2.58	34	>99%	31	>99%

* Average of 8 samples over 2-week experimental period (6 for Experiment 3)



Demand and time dose effluent BOD_5 concentrations
60
50
40
30
20
10
0
BOD_5 (mg/L)
Demand Dose
Time dose
1
2
3
4
5
6
7
8
9
10
Experiment

Summary

- Installed parallel ATU treatment trains at TAMU RELLIS OSSF
- Developed precision flow and dosing procedures
- Developed synthetic high-strength waste formulation
- Implemented 10, 2-week experiments, 8 sample measurements
- Lowered flow to 50% of normal; simulating conservation/reuse
- Raised BOD_5 concentration >300 mg/L; simulating high strength
- Majority of Demand and Time dosed ATUs achieved BOD_5 < 30 mg/L
- Cannot statistically support BOD < 30 mg/L for all experiments
- All Demand and Time dosed ATUs achieved TSS < 45 mg/L
- Can statistically support TSS < 45 mg/L for all experiments
- Demand vs Time dosing not statistically different for all but one experiment

Lessons Learned & Recommendations….

- ATUs are resilient under lower hydraulic flows
- Biological lag time must be considered
- Require longer assessment period (30 days)
- Require more samples for statistical certainty
- Change in mass load more important than concentration alone

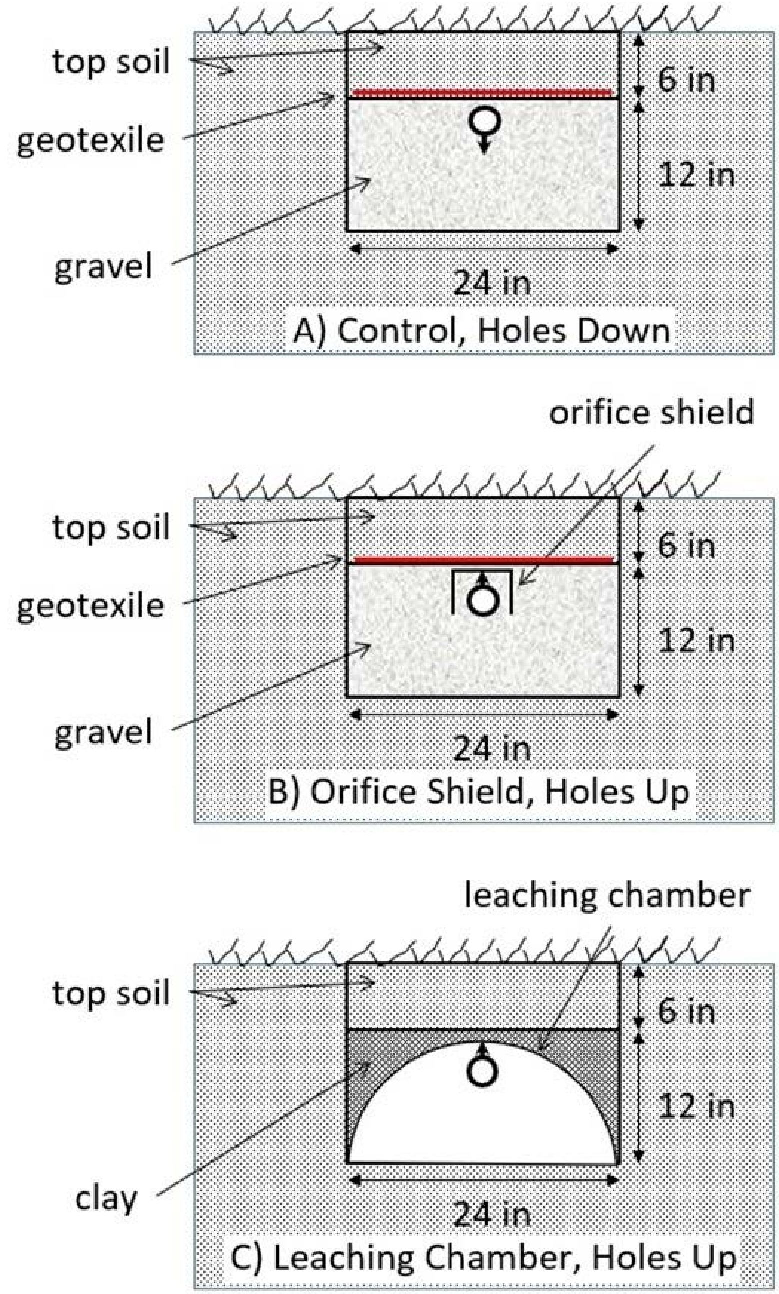
Project 2: Contract # 582-19-96830

- 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.

- Project questions:
  - What are the operational problems faced by the users and operators with the current LPD design in Texas?
  - Can the current design with holes facing down be improved with holes facing up, to achieve better distribution of effluent and to allow for better maintenance of LPD systems?
  - Are changes required in the current design specifications of an LPD system in 30 TAC Chapter 285, and if so, what changes are to be recommended?

Research Approach

1. Conduct a Survey (in-person and online)
2. Experiment design, permitting, and construction
3. Wastewater distribution, data collection, analysis, and reporting



1. Survey

TEXAS A&M AGRILIFE EXTENSION

Survey to get your feedback for improving low-pressure dosing (LPD) design in terms of effluent distribution uniformity, and ability to maintain the system

Please complete the following questions to the best of your ability.

About you

Indicate if you are a:

☐ Owner ☐ Designer ☐ Installer ☐ Maintenance Provider ☐ Regulator

Estimate number of LPD systems designed/installed/maintained/inspected: ____

Observed problems

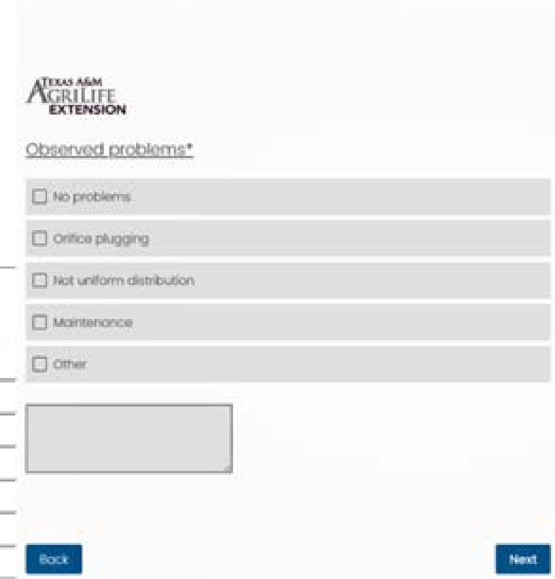
☐ No problems
☐ Orifice plugging
☐ Not uniform distribution
☐ Maintenance
☐ Other ______________________

Please describe the type and frequency of problem/s: ______________________

Suggestions

Indicate your suggestions for improving LPD design:

Additional comments



FAQs

How will this information be used? Texas A&M AgriLife Extension is a public entity, therefore data collected is classified as public information. Data collected from surveys may be published in a report intended for research and educational purposes.

Why should I answer these questions? TCEQ have provided Texas A&M AgriLife Extension grant money[1] to conduct research to investigate whether the design of LPD systems can be improved in terms of effluent distribution over time, and ability to maintain the distribution system[2].

For more information contact:

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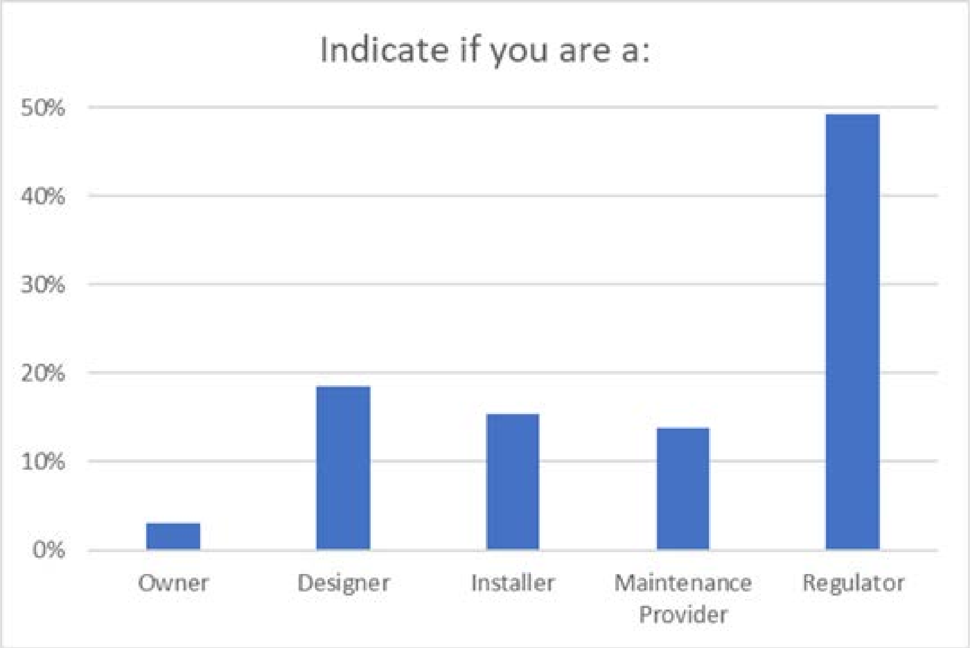
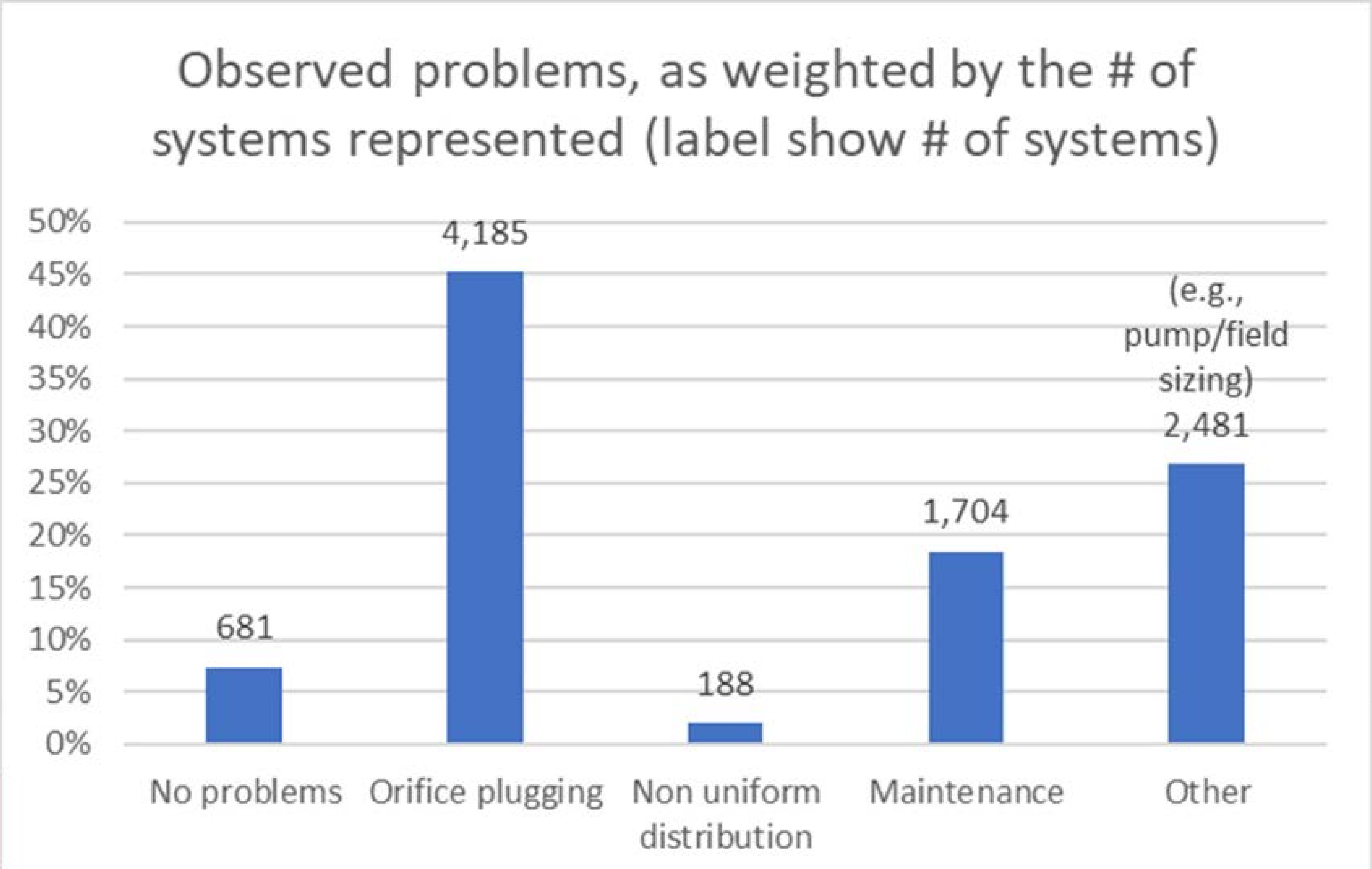
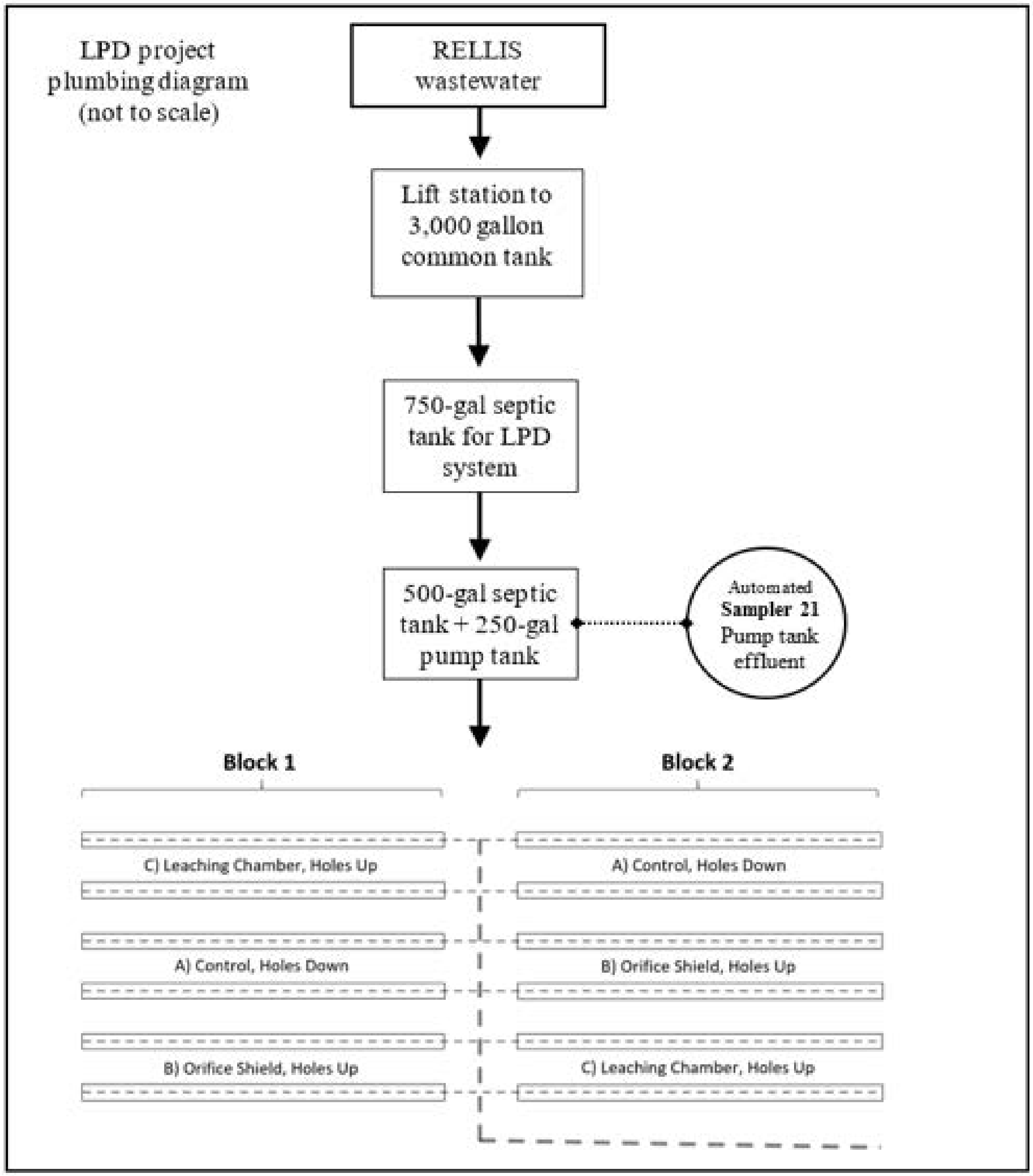
[1] TCEQ Solicitation 582-19-9377, RT-2.3.3
[2] North Carolina State Sea Grant College Publication UNC-S82-03 is currently used to aid in low-pressure dosing field design

- Total: 45 surveys
- 6,248 problems entries



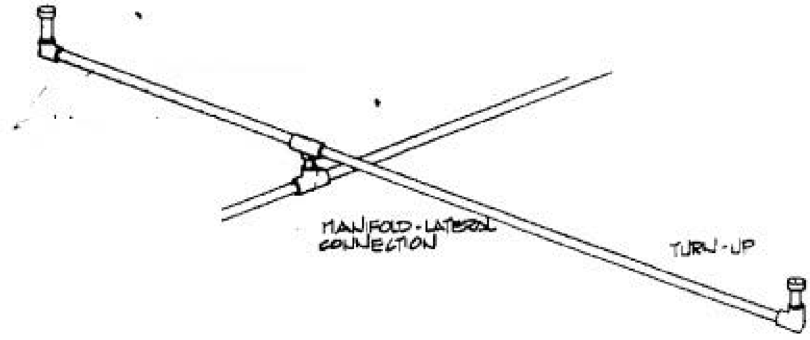


2. Experiment Design, Permitting, and Construction

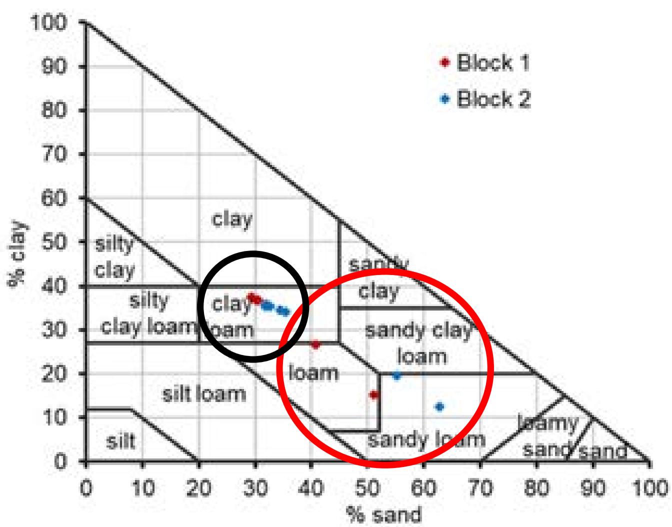


Design (30 TAC Chapter 285 and UNC-S82-03 30)

- Effluent Loading Rate (Ra): 0.1 gal/sf/d
- Wastewater Usage Rate (V): 240 gpd
- Absorptive Area (A) = V/Ra: 2400 sqft
- Width of excavation (w): 2 ft
- Excavation length: A/(w+2) = 2400/(2+2) = 600 ft
- Pressure head: 5 ft
- Minimum dosing volume: 41 gal



Permit from Brazos County Health District



Lab analysis results

OSSF Soil & Site Evaluation **Date Performed: 2/14/2020**

Site Location: Onsite Wastewater Training Center – RELLIS Campus
Proposed Excavation Depth: 18"

Soil Boring # 1				
Depth (inches)	**Soil Class**	**Soil Texture**	**Groundwater/ Water Table**	**Topography**
0 – 10"	III	Sandy Clay Loam	No	Flat
10 – 48"	IV	Silty Clay	No	Flat

Soil Boring # 2				
Depth (inches)	**Soil Class**	**Soil Texture**	**Groundwater/ Water Table**	**Topography**
0 – 12"	III	Sandy Clay Loam	No	Flat
12 – 48"	IV	Silty Clay	No	Flat

FEATURES OF SITE AREA

Presence of 100 Year Flood Zone	☐ Yes ☑ No
Presence of Seasonal High Water Table	☐ Yes ☑ No
Presence of Adjacent Ponds, Streams, Water Impoundments	☐ Yes ☑ No
Existing or Proposed Water Well in Nearby Area (within 150 feet)	☐ Yes ☑ No
Restrictive rock horizon	☐ Yes ☑ No
Ground Slope 0.8 %	

I certify that the findings of this report are based on my field observations and are accurate to the best of my ability.

(Signature of person performing evaluation) 2/21/2020 (Date) OS0031317 Registration Number and Type

Construction


S → N

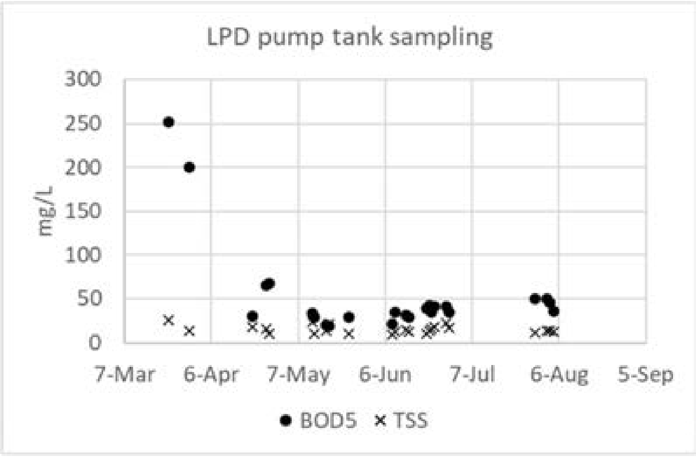
S → N


TEEX

3. Wastewater distribution, data collection and analysis

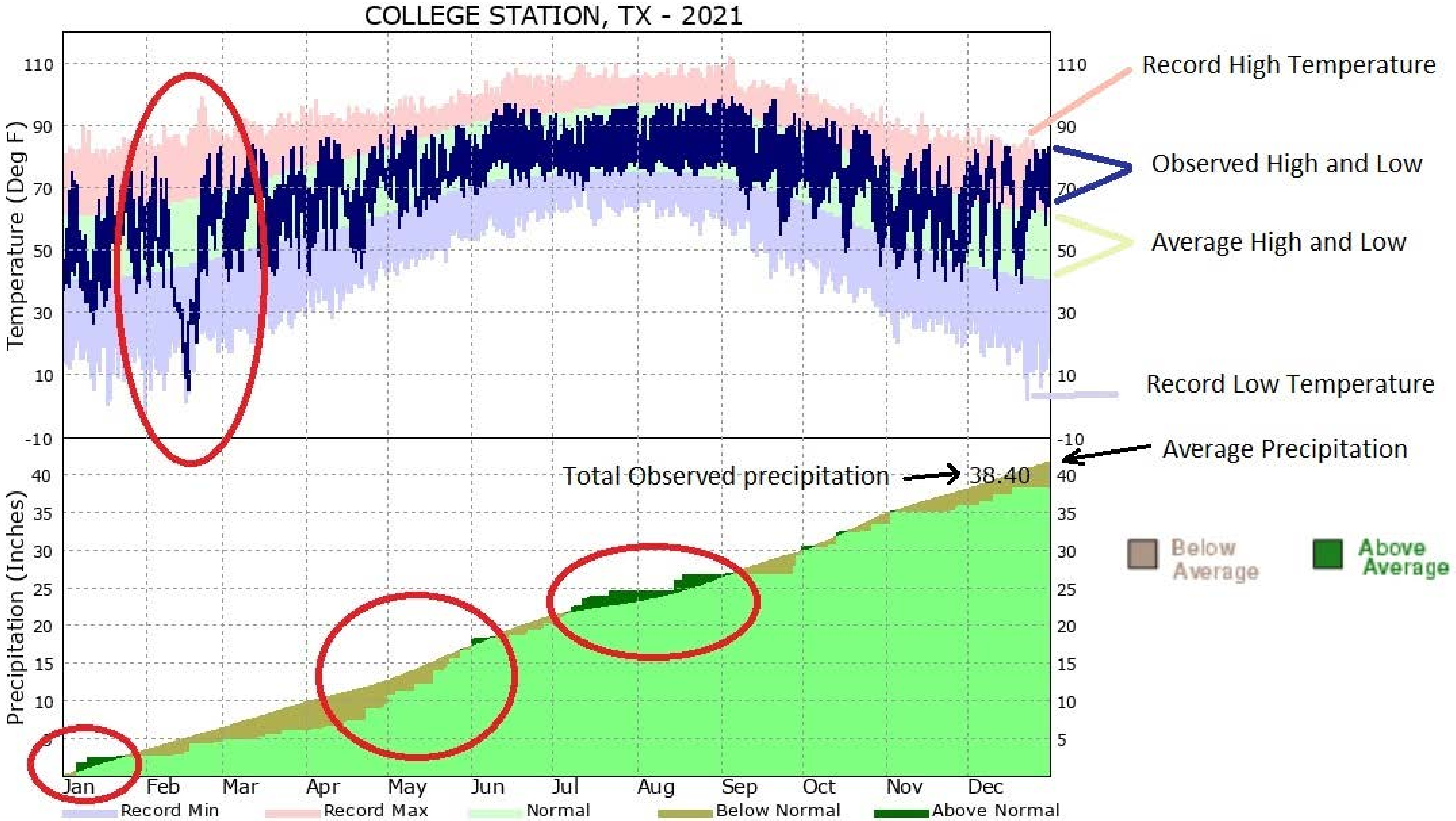
Wastewater distribution (and sampling):

- One minute/hour from feed tank (~9.2 gal/run = 221 gal/d)
- LPD pump tank on demand (~3 runs/day, ~65 gal/dose)
- Issues: calibration failure, 600 gal/d → 1 week interruption; two intentional interruptions before heavy rain forecast; minor power outages

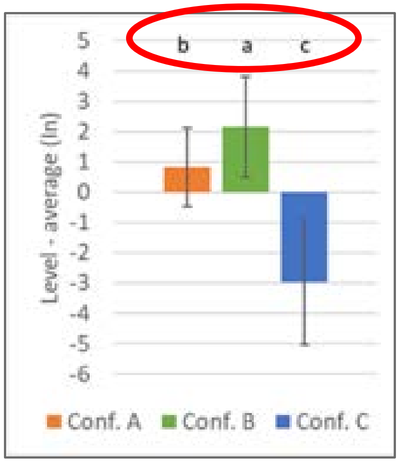


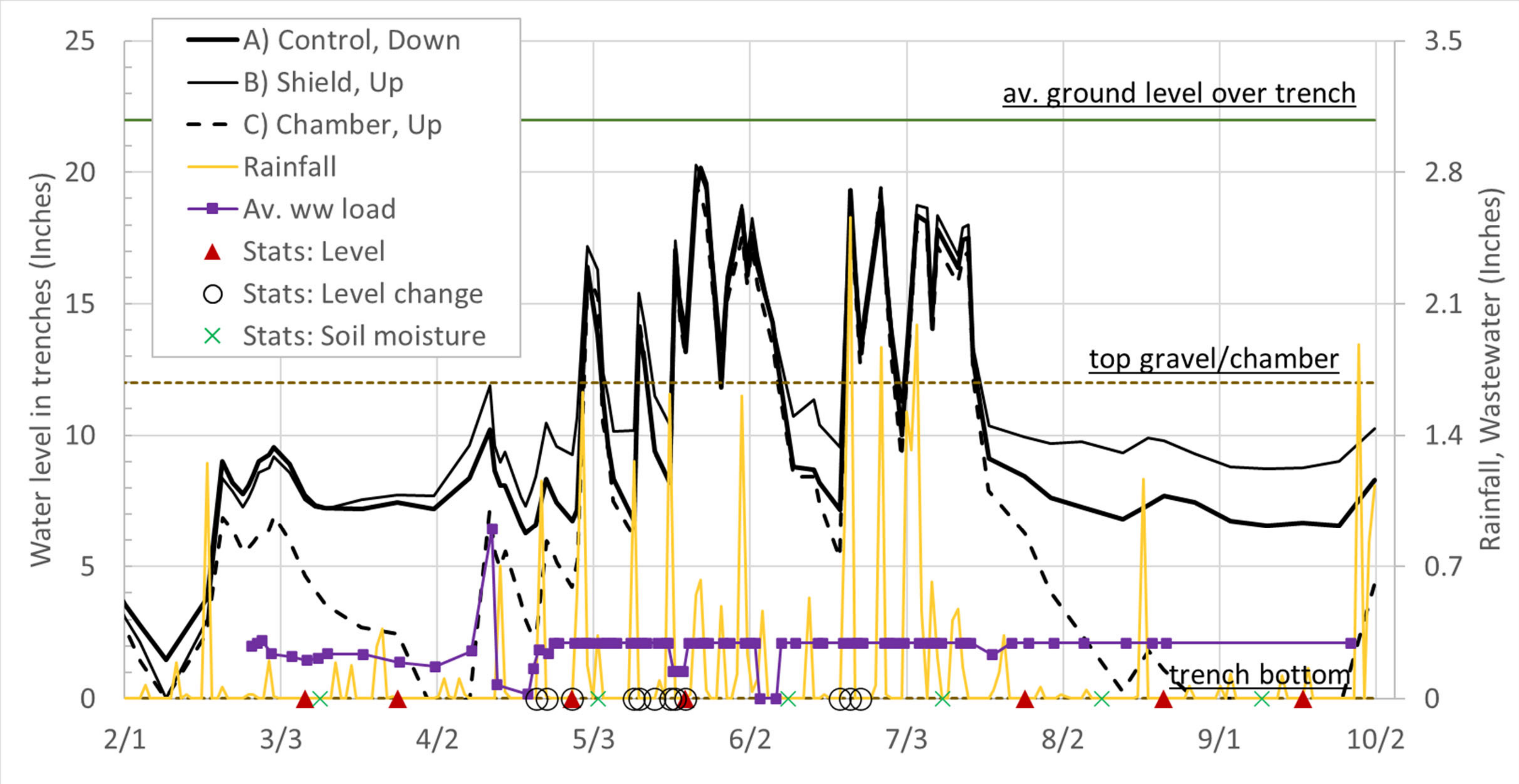
Weather data:

- Tipping bucket rain gauge + manual rain gauge
- NOAA College Station weather station (precipitation, air temperature, wind speed)

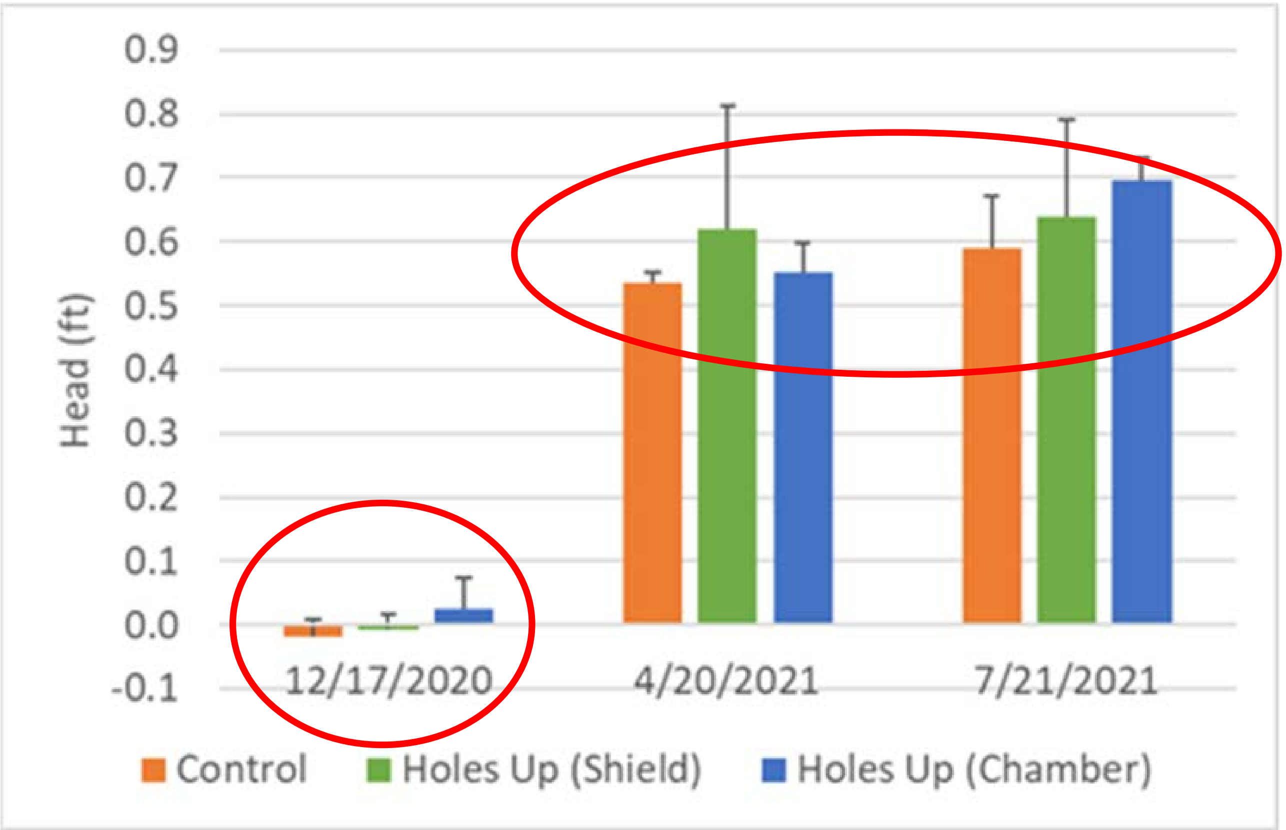


Effluent depth:



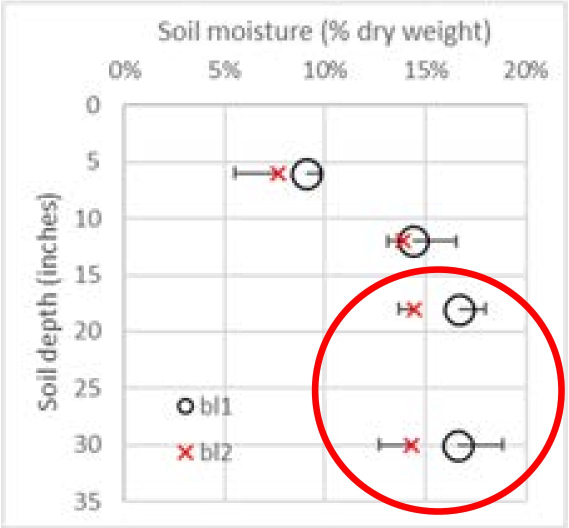


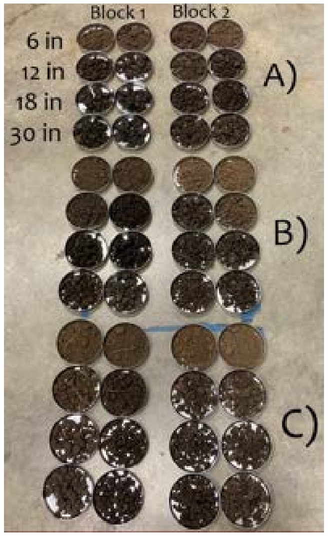
Pressure on laterals :



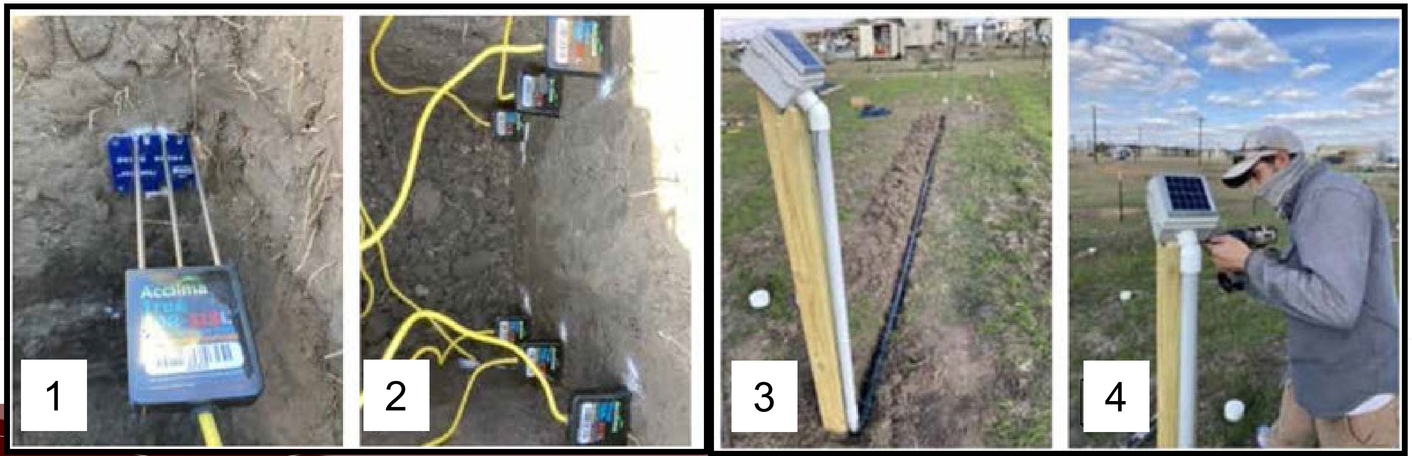
Soil moisture:

- Preliminary, gravimetric, 12 locations, 4 depths:

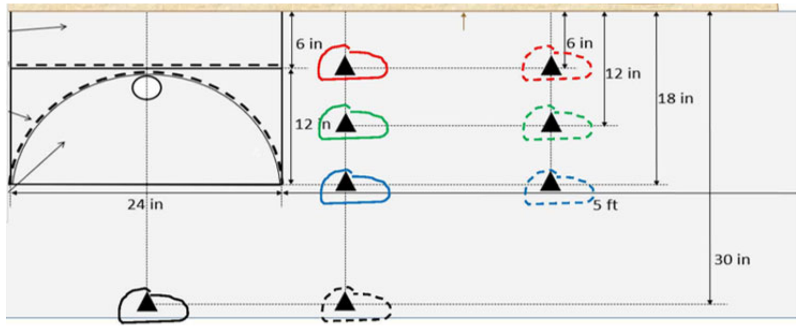


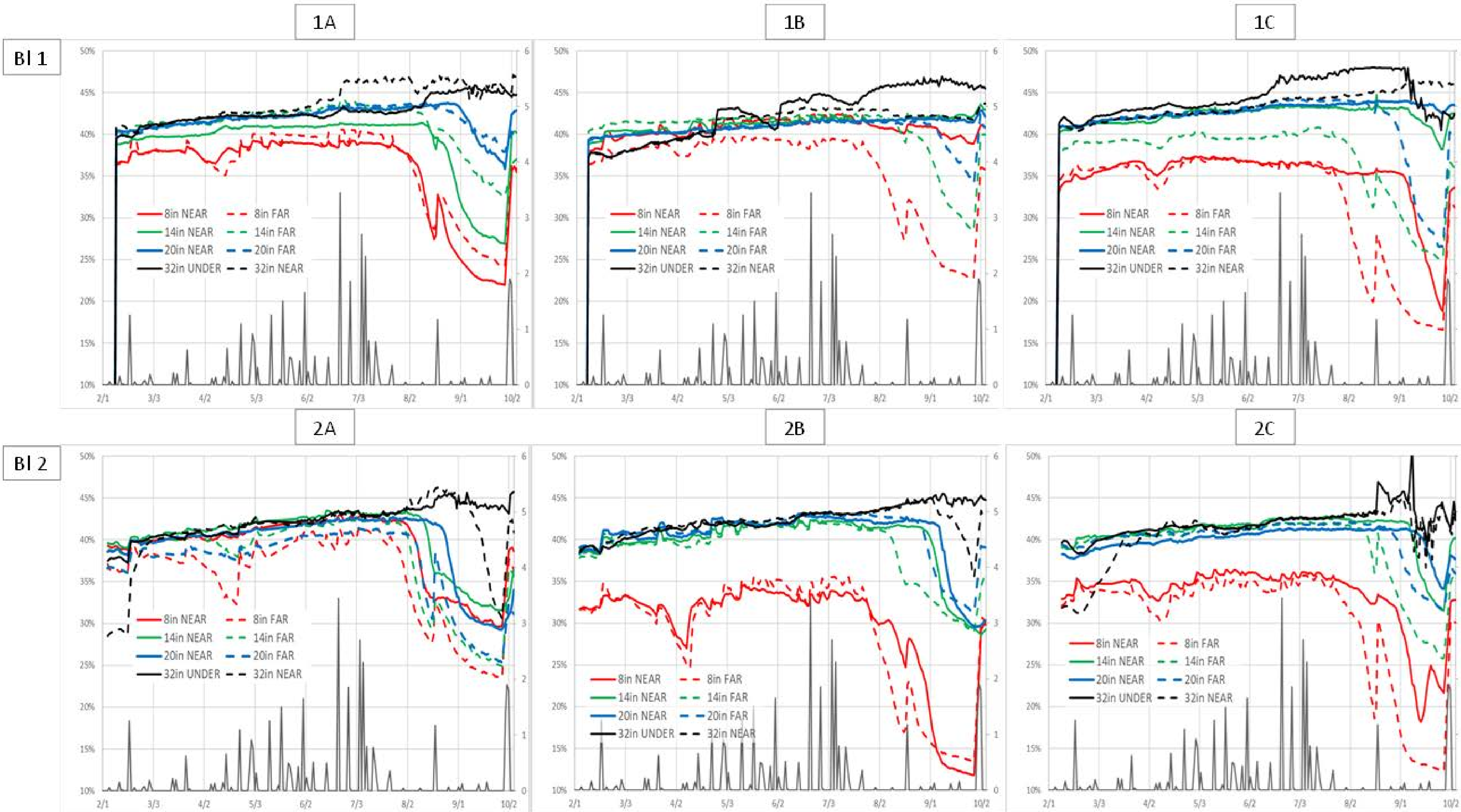


- Hourly Time Domain Reflectometer (TDR), 6 locations, 4 depths, 2 lateral distances:



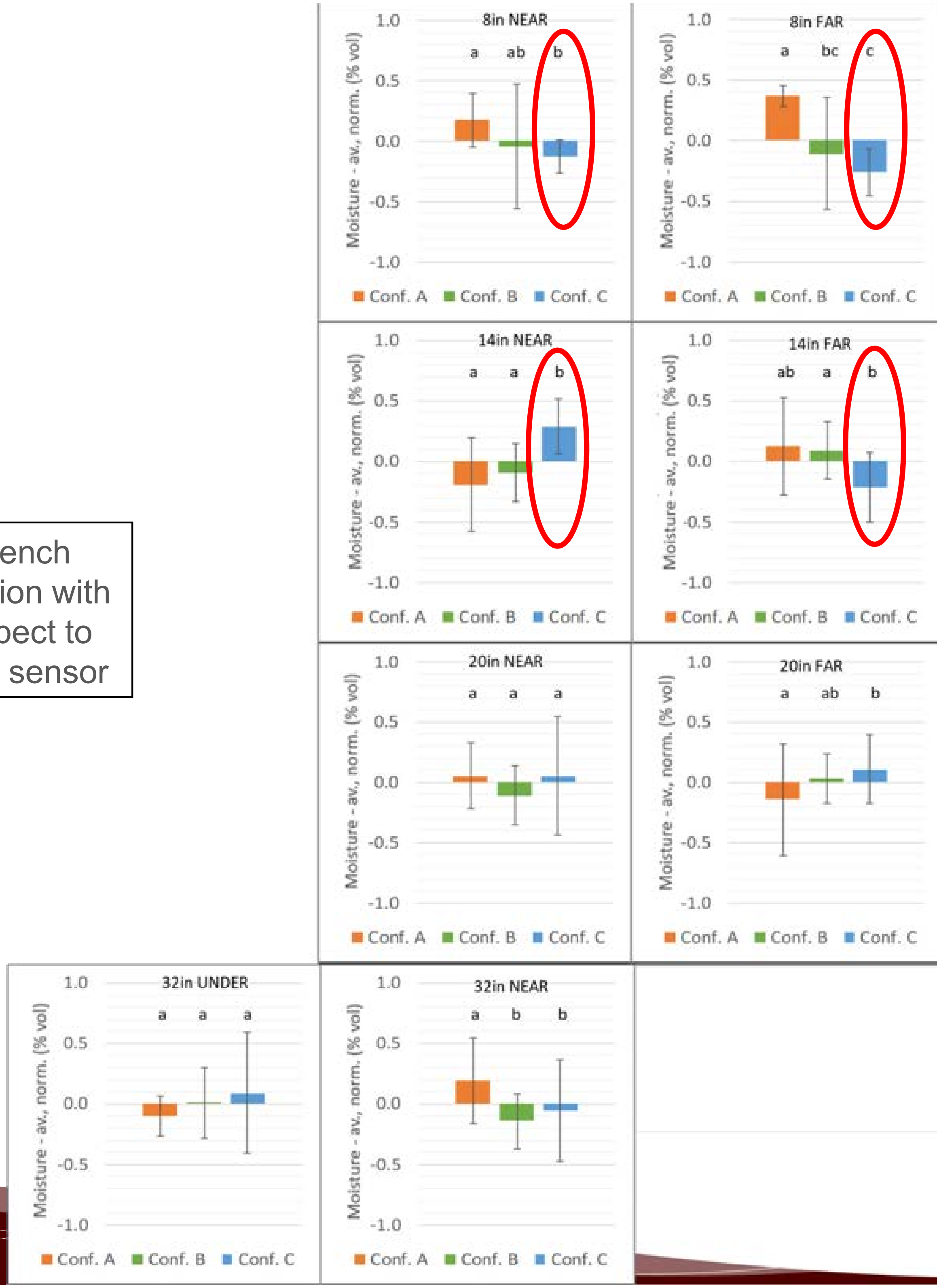
% volume


6 in
6 in
12 in
18 in
12 in
24 in
5 ft
30 in


1A
1B
1C
Bl 1
2A
2B
2C
Bl 2
8in NEAR
8in FAR
14in NEAR
14in FAR
20in NEAR
20in FAR
32in UNDER
32in NEAR
50%
45%
40%
35%
30%
25%
20%
15%
10%
6
5
4
3
2
1
0
2/1
3/3
4/2
5/3
6/2
7/3
8/2
9/1
10/2

% volume
(difference from
average)

Trench position with respect to TDR sensor



8 inches

14 inches

20 inches

32 inches

Summary

- Carefully planned but short experiment period; *need >1 Yr.*
- Blocks reduced effects of soil variability (moisture, texture)
- Slow set up (site, experiment, safety, loading calibration)
- Good variation in climatic conditions, despite the short period
- Results:
  - Effluent filters effective in reducing BOD5 and TSS
  - Effluent levels responsive to rainfall and loading, and significantly different among configurations (Shields>Control>Chamber)
  - Effluent pressure significantly higher after first quarter (+0.6 in)
  - Slight differences between two blocks in preliminary soil moisture
  - Hourly soil moisture consistent with effluent levels

Lessons Learned & Recommendations….

- Operational problems in Texas: Based on the survey that was conducted, the main issues are related **to orifice plugging and maintenance.**
- Improvement of current design with holes facing down: In the experiment, holes **facing up did not present evident issues compared to holes facing down**. Differences in water levels were statistically significant among designs (Design B, Orifice shield with holes facing up > Design A, Control with holes facing down > Design C, Leaching chamber with holes facing up).

Lessons Learned & Recommendations….

- Changes recommended in the current design specifications of an LPD system in 30 TAC Chapter 285: Based on the field experiment results, it appears that the smallest differences in site conditions (e.g., elevation, texture) had significant effect on most results, which indicates that **soil evaluation has a key role in the at design phases** and should be emphasized. **As no major issues were identified with the alternative designs with holes facing up, such configurations should be considered for further testing and possible inclusion in the rules.**

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.

Two Reuse Technologies

Desired Reuse Water Quality

BOD_5 or $CBOD_5$	5 mg/l
Turbidity	3 NTU
Fecal coliform or *E. coli*	20 CFU/100 ml*
Fecal coliform or *E. coli*	75 CFU/100 ml**
Enterococci	4 CFU/100 ml*
Enterococci	9 CFR/100 ml**

* 30-day geometric mean

** maximum single grab sample

(8) Water from an alternative water reuse system that is used for toilet or urinal flushing must meet the following requirements. Property owners may refer to the regulatory guidance document that is required by the Texas Health and Safety Code, §341.039, for assistance in complying with these requirements.

(A) For residential toilet or urinal flushing, *Escherichia coli (E. coli)* must be less than 14 most probable number (MPN) or colony-forming units (CFU) per 100 milliliters for 30-day geometric mean and less than 240 MPN or CFU per 100 milliliters maximum single grab sample. For industrial, commercial, or agricultural toilet or urinal flushing, *E. coli* must be less than 2.2 MPN or CFU per 100 milliliters for 30-day geometric mean and less than 200 MPN or CFU per 100 milliliters maximum single grab sample.

(B) Total suspended solids must be less than 10.0 milligrams per liter for 30-day geometric mean and less than 30.0 milligrams per liter maximum single grab sample.

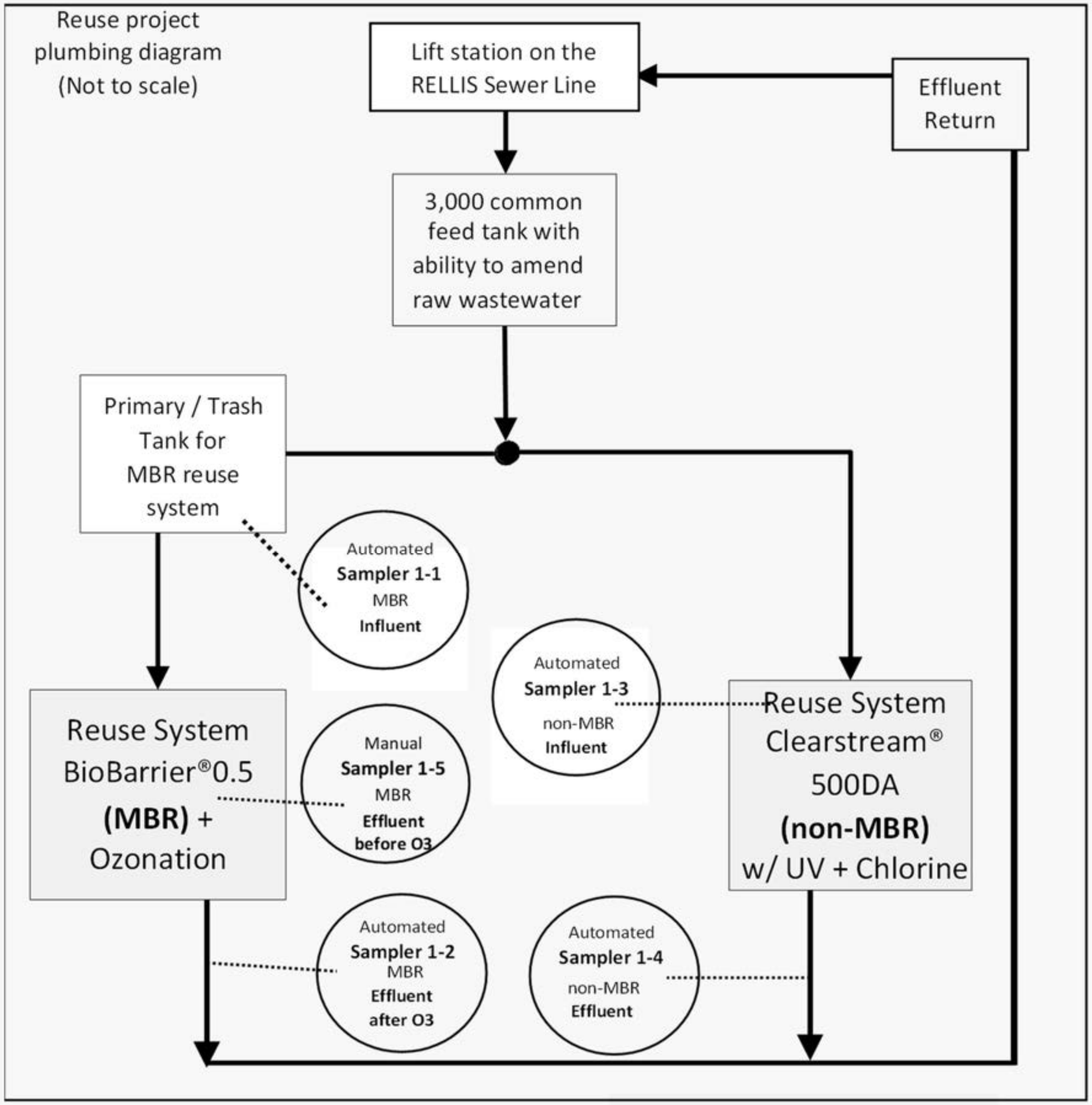
Research Questions

1. Do NSF/ANSI-350 approved technologies with and without a membrane operating in a real-world condition meet the reuse water quality standards specified in the TCEQ Chapter 210 (§210.33 and §210.82)?

2. Are modifications needed to a standard on-site wastewater treatment train or maintenance requirements to improve quality and reliability of effluent for non-potable reuse?

3. Are the experiences with existing on-site reuse facilities operating in Harris County and at TXDOT rest area satisfactory?

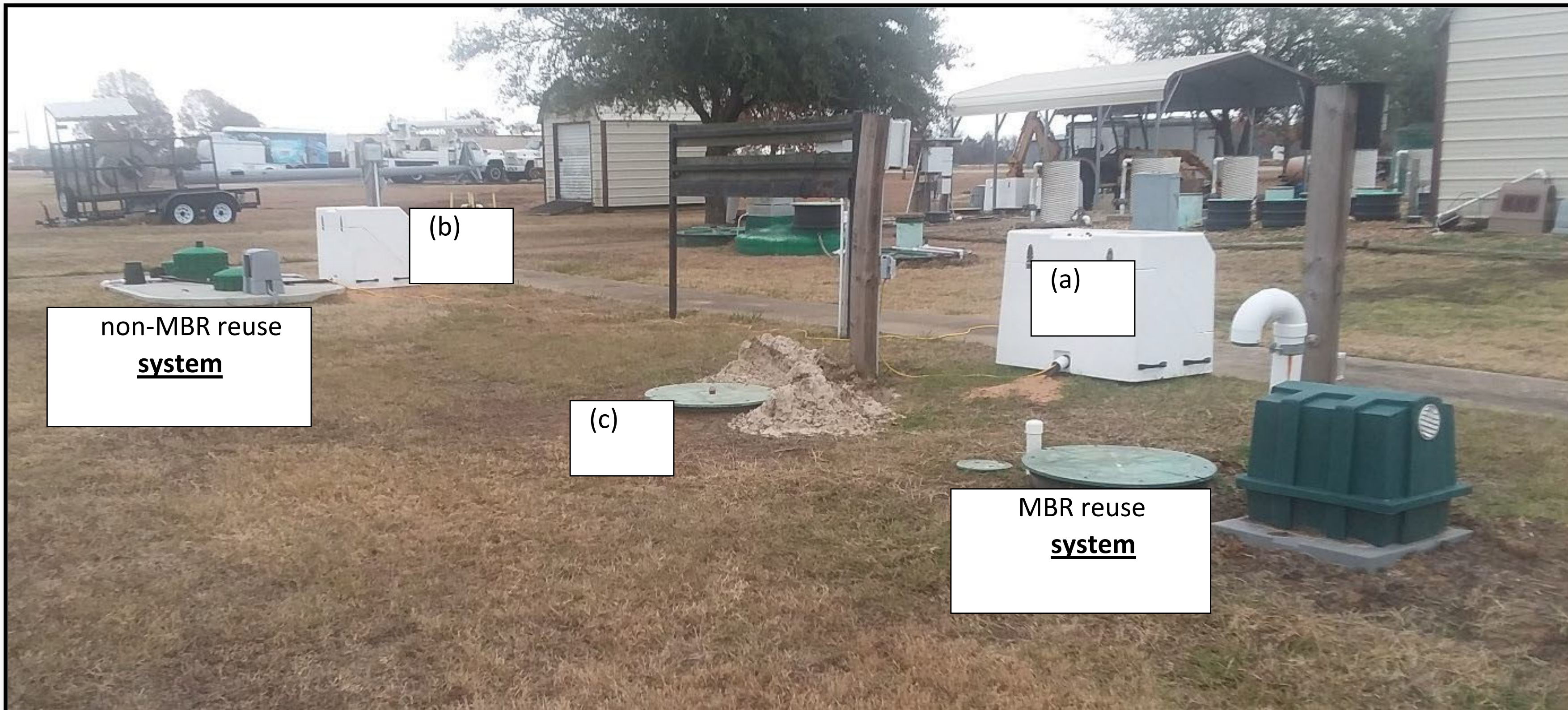
Experimental Set Up



Normal operating conditions, i.e., Ryan attending the systems….

Abnormal operating conditions, i.e., Ryan turning things Off or extreme weather conditions!

Experimental Set Up



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

NOTE: All 4 refrigerated composite samplers were loaned from TWRI; THANKS, TWRI…

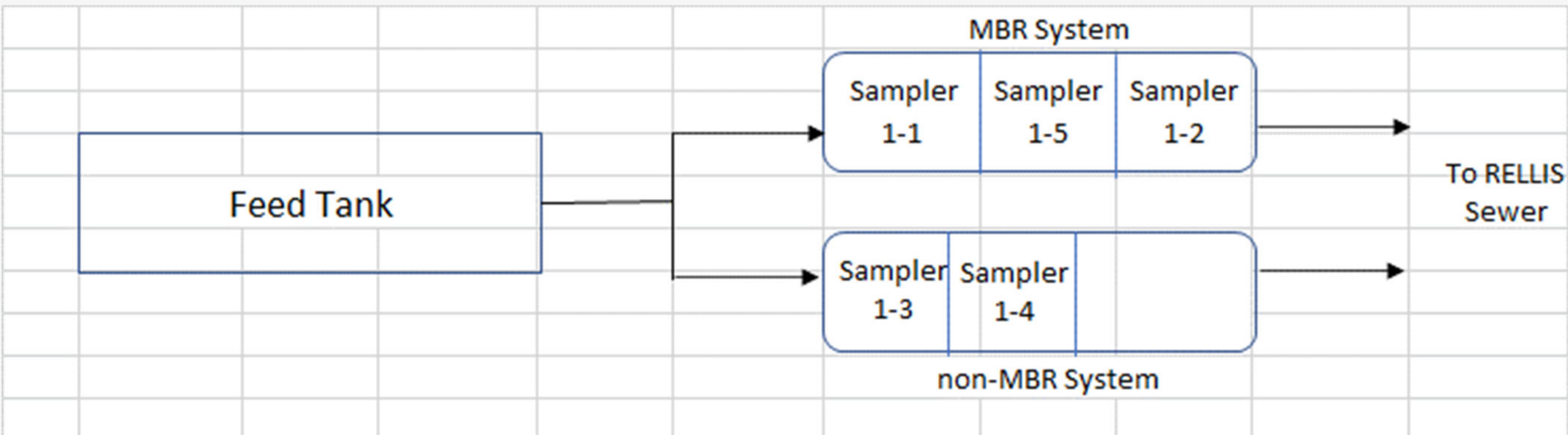
Why Ozone?

Pic taken in Nov. 2020

Effect of Ozonation…. Raw WW – to MBR effluent – <u>to Ozonated effluent</u>

Starting the Experiment

MBR and non-MBR Treatment Trains (*Systems*) and Sampling Locations…..



Common influent to the first tank (trash-tank) of both the systems; Sampler 1-5 added late for another research project for collecting grab sample of MBR before Ozone.

Starting the Experiment

Getting the systems ready…. *(Aug-Nov 2020)*

Seed material

- Tank installed
- Seeding both tanks
- Sludge observation after two months
- Replace membrane

Starting the Experiment

Getting the systems ready…. *(Aug-Nov 2020)*

- Samplers installed, programmed, and connected to four tanks, 1-1, 1-2, 1-3, and 1-4;
- Amendment for the feed tank finalized

Starting the Experiment

Sampling starts and TCEQ inspection…. *(Dec - Jan)*

Starting the Experiment

Sampling starts and TCEQ inspection…. *(Dec - Jan)*

Effluent Sampling Schedules

May 2021

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

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

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

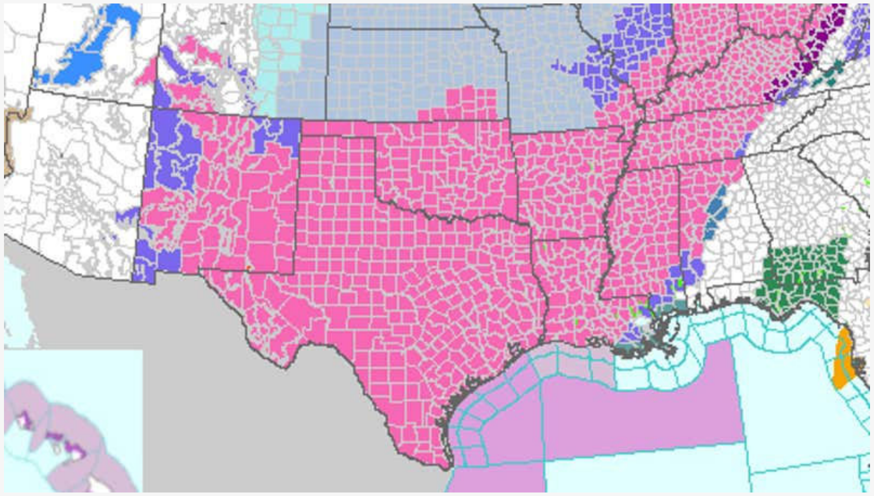
ProjectCalendar-Details.xlsx

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

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

February 2021 Abnormal Conditions



before winter storm shut-down (2/11)

after winter storm shut-down (2/22)

	Average		Average	
	Turbidity	*E. Coli.*	Turbidity	*E. Coli.*
0-Dec	1	45	11	150
1-Jan	1	31	14	21
2-Feb	2	93	45	103
3-Mar	1	25	21	61
4-Apr	1	5	9	8
5-May	1	5	8	57
6-Jun	1	7	4	5
7-Jul	3	23	5	9
8-Aug	2	15	4	11

Effluent Quantity Results (GPD)

Month	ATU	Reuse Total	LPD	TOTAL
December	450	589	0	1,039
January	450	574	0	1,024
February	360	545	204	1,109
March	317	585	154	1,056
April	314	619	220	1,153
May	224	597	210	1,031
June	221	588	190	999
July	228	575	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]

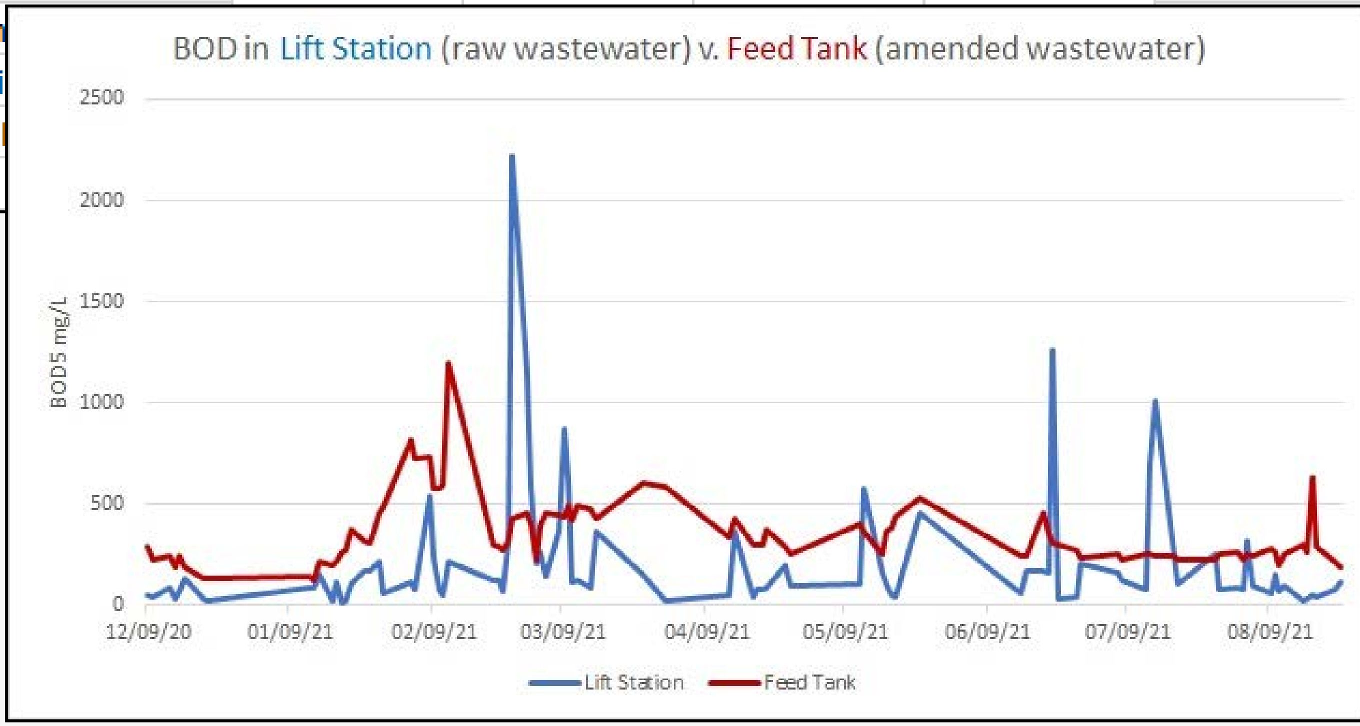
Month	non-MBR	MBR
December	219	219
January	275	275
February	223	241
March	242	250
April	227	278
May	218	271
June	217	267
July	207	264
August	211	267

Average = 227 259

Effluent Quality Results

Sampling Period: December 2020 to August 2021

	Common for all Projects		Research Project			TOTAL
Parameter\Location	Lift Station	Feed Tank	ATU	LPD	Reuse	
BOD (5 day)	102	118	276	24	231	751
Total Suspended Solids	79	82	237	24	265	687
E. Coli					252	252
Turbidity					245	245
Ammon						94
Nitrate/Ni						94
Total Kjeldahl						94
						2217



Effluent Quality Results

Descriptive Statistics Tables

MBR

Location: Sampler 1-1 Influent

	n		Average		Min	Max	StdDev
	BOD	TSS	BOD	TSS			
0-Dec	N/A	8	N/A	45			
1-Jan	N/A	8	N/A	66			
2-Feb	6	6	311	101			
3-Mar	8	8	276	352			
4-Apr	8	8	81	140			
5-May	8	8	64	108			
6-Jun	12	12	76	124			
7-Jul	2	2	83	151			
8-Aug	6	6	98	75			
	50	*66*					

Location: Sampler 1-2 Effluent

	n		Average	
	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	0
1-Jan	N/A	8	N/A	0
2-Feb	6	6	2	1
3-Mar	8	8	2	1
4-Apr	8	8	2	1
5-May	8	8	2	2
6-Jun	12	12	2	0
7-Jul	2	2	14	5
8-Aug	6	6	4	2
	50	*66*		

non-MBR

Location: Sampler 1-3 Influent

	n		Average		Min		Max		StdDev	
	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	50	N/A	24	N/A	87	N/A	22
1-Jan	N/A	8	N/A	65	N/A	53	N/A	80	N/A	10
2-Feb	6	6	361	205	208	122	546	316	130	77
3-Mar	23	8	283	370	213	134	498	827	94	203
4-Apr	8	8	182	260	101	68	245	472	53	149
5-May	7	7	142	333	66	76	293	1040	82	370
6-Jun	12	12	199	1157	54	72	1260	9680	336	2696
7-Jul	2	2	235	1800	211	1520	258	2080	33	396
8-Aug	6	6	183	603	132	142	247	980	39	304
	64	*65*								

Location: Sampler 1-4 Effluent

	n		Average		Min		Max		StdDev	
	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
0-Dec	N/A	8	N/A	18	N/A	8	N/A	38	N/A	10
1-Jan	N/A	8	N/A	12	N/A	8	N/A	18	N/A	4
2-Feb	6	6	34	4	22	2	50	7	11	2
3-Mar	7	7	19	17	8	6	38	35	12	11
4-Apr	8	8	5	10	3	7	12	16	3	3
5-May	7	7	9	10	7	6	11	12	1	3
6-Jun	12	12	6	11	4	5	7	17	1	4
7-Jul	2	2	6	8	5	7	7	8	1	1
8-Aug	6	6	4	6	2	5	6	7	1	1
	48	*64*								

Effluent Quality Results

Summary Table for Selected Parameter
Entire Sampling Period (NC and AC)

Parameters	MBR		Non-MBR	
	Average	Single Max	Average	Single Max
BOD_5 (mg/L)	3	22	11	50[2]
TSS (mg/L)	1	5	11	38[3]
Turbidity (NTU)	1	6	14	80[2]
E. coli[1] (MPN/100 mL)	17	980[2]	28	921[2]

[1]Calculated as geomean, excluding 0 reading. [2]Observed in Feb-2021. [3]Observed in Dec-2020.

Parameters	MBR		Non-MBR	
	n	StdDev	n	StdDev
BOD_5 (mg/L)	50	3	48	11
TSS (mg/L)	66	1	64	7
Turbidity (NTU)	62	1	60	15
E. coli (MPN/100 mL)	62	134	60	170

Effluent Quality Results

Summary Table for Selected Parameter For NC and AC

Table 15: Effluent quality observed during normal conditions (NC)

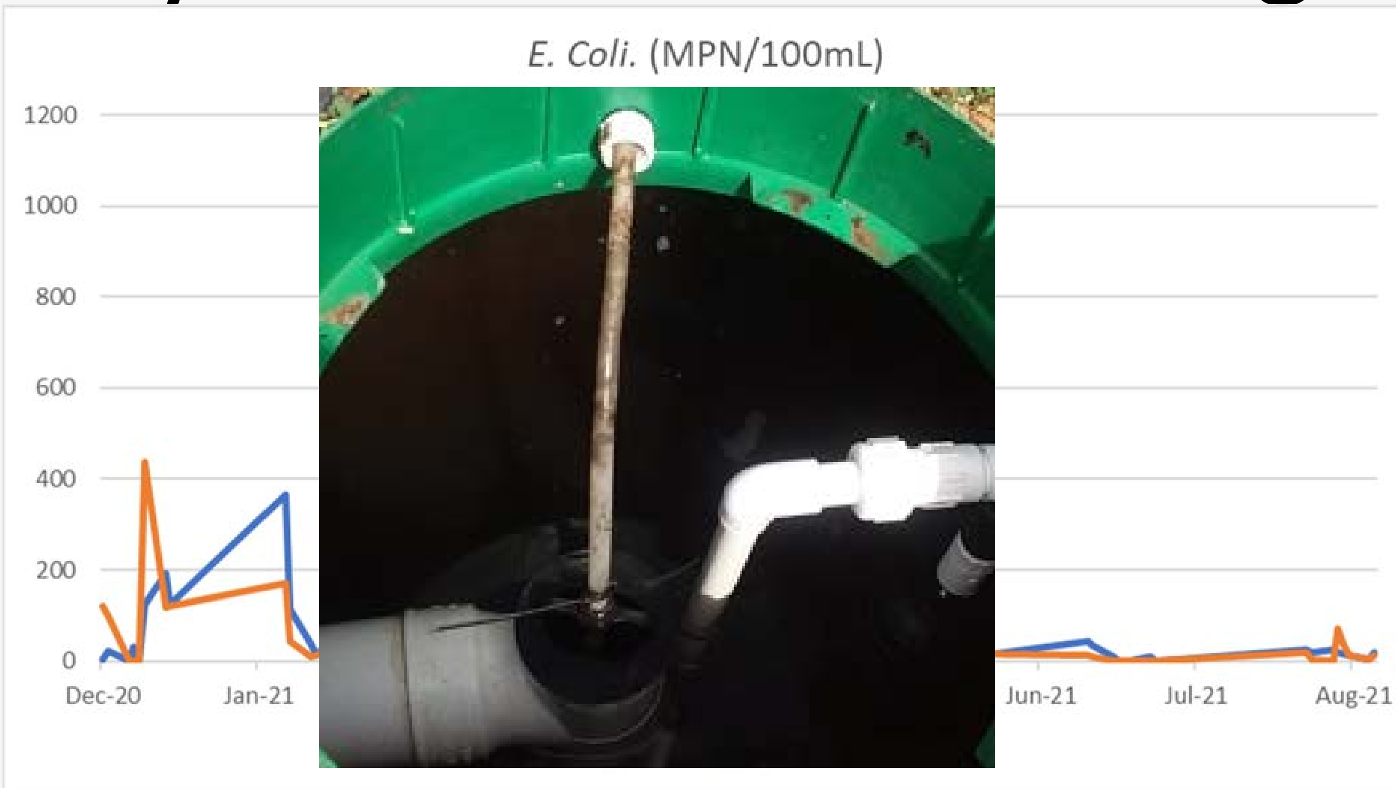
	MBR		non-MBR	
	Average	Single Max	Average	Single Max
BOD	7	22	5	7
TSS	1	8	11	38
Turbidity	2	3	8	24
E. Coli	20	365	17	437

Table 16: Effluent quality observed during abnormal conditions (AC)

	MBR		non-MBR	
	Average	Single Max	Average	Single Max
BOD	2	6	16	50
TSS	1	5	10	35
Turbidity	1	6	21	80
E. Coli	16	980	41	921

Effluent Quality	Is the Difference in Mean Values Significant During NC?	Is the Difference in Mean Values Significant During AC?
BOD	N	Y
TSS	Y	Y
Turbidity	Y	Y
E. coli	N	N

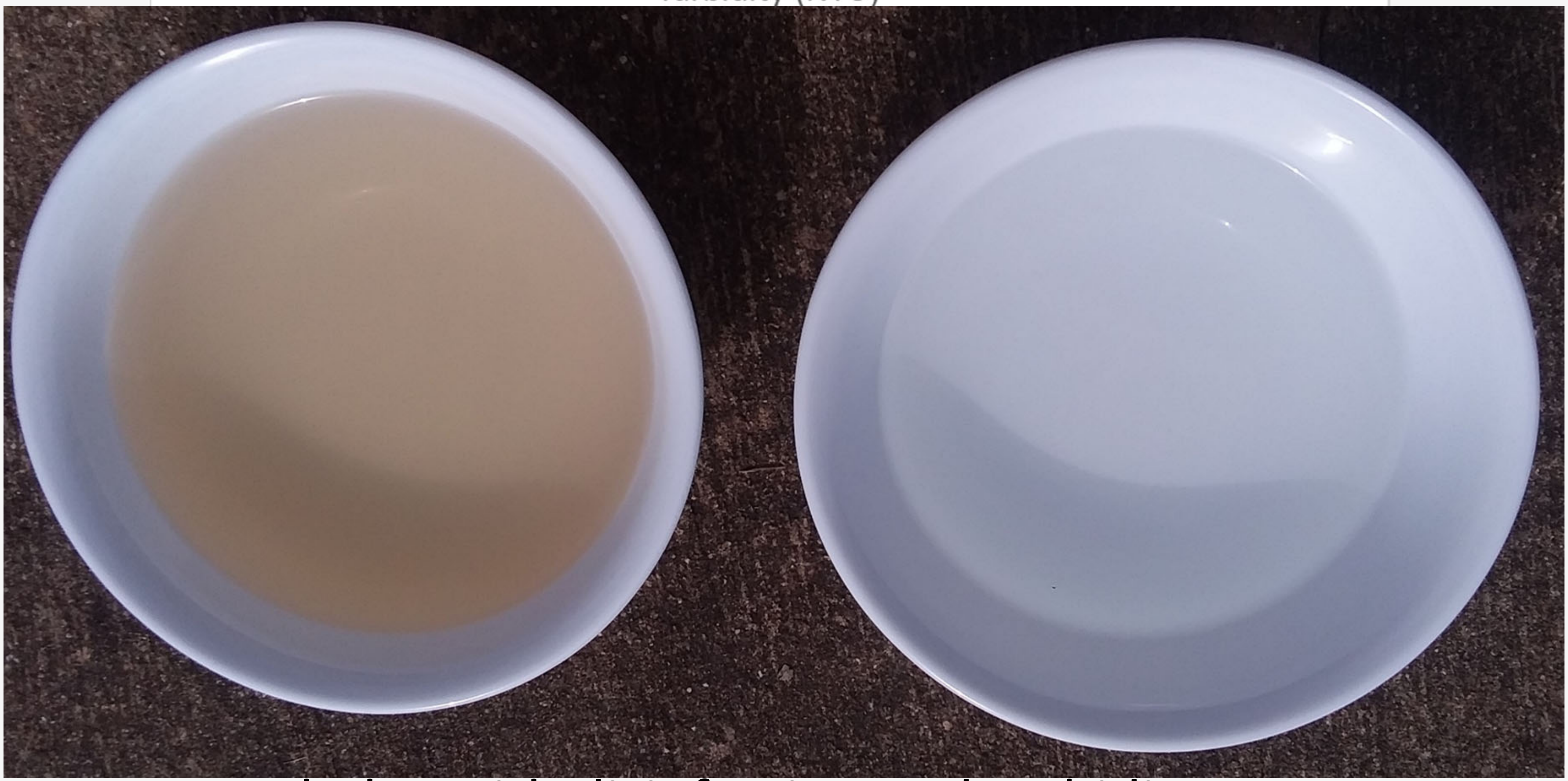
Why is *E. coli* count so high?



- Choice of COMPOSITE SAMPLING was a wrong one;
- Re-growth of E. coli in sampling tube is the reason;
- Few grab samples show much lower count,
- Re-sampling is planned if/when we get new funds!

What’s happening with Turbidity?

Turbidity (NTU)



- Ozone helps with disinfection and turbidity;
- Carbon filter may also be needed to meet reuse water quality standards.

Non-potable Reuse at Public Facilities in Texas

Net-Zero Bathroom facility in Harris County, *(Carter Park) Rainwater harvesting for reuse; not wastewater*

TEXAS A&M AGRILIFE RESEARCH

BIOLOGICAL AND AGRICULTURAL ENGINEERING

TEXAS A&M AGRILIFE EXTENSION

Summary

- NSF/ANSI Standard 350 are adequate for performance testing of on-site reuse technologies and effluent quality under field conditions is comparable to Standard 350 test results.

- Both, MBR and non-MBR technologies have potential for producing non-potable reuse water that can be indoor for toilet flushing with adequate disinfection final filtration units.

- Ozone and granular charcoal are two effective means for disinfection and turbidity (color) removal at the final stage.

- Risks to public health can be mitigated by adding triple-disinfection (Ozone + UV + Chlorine) to treatment systems.

Lessons Learned & Recommendations….

- Do not use composite sampling method for coliform analysis, regrowth in the sampling tube will give higher values.

- Membrane bio-reactors (MBRs) are efficient in reducing BOD and TSS, however, membrane cleaning is labor intensive.

- Ozone and GAC filter are needed for both MBR and non-MBR systems to consistently produce highest quality reuse water to meet the current reuse water quality standards.

FINAL REPORTS ARE AVAILABLE ON OUR WEBSITE

https://ossf.tamu.edu/togp-research/

Final Report

For Texas On-Site Sewage Facility (OSSF) Res

Evaluation of Equalized Dosing and Hig

on the Performance of Aerobic T

Work Period: September 1, 2019 -

Report submitted t

Donna Cosper, P.E., Projec

Program Support and Texas OSSF Re

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(254) 774-6016

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Final Repor

Work Period: September 1

For Texas On-Site Sewage Facility (OS

Implementation of Low Pressu

Configu

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Report Sub

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November

TEXAS A

AGRI

RESEARCH | E

Final Report

Work Period: September 1, 2019 – August 31, 2021

For Texas On-Site Sewage Facility (OSSF) Research Contract #582-19-96829

Feasibility Study to Evaluate On-Site Treatment of Wastewater for Non-Potable Reuse

Report submitted to:

Donna Cosper, P.E., Project Manager

Program Support and Texas OSSF Research Grant Program

Texas Commission on Environmental Quality

P.O. Box 13087, MC - 235

Austin, Texas 78711-3087

Donna.Cosper@tceq.texas.gov

Report Submitted by:

Anish Jantrania, Associate Professor & Extension Specialist

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Temple, TX 76502

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February 8, 2022

TEXAS A&M

AGRILIFE

RESEARCH | EXTENSION

TOGP Round 2

TCEQ Solicitation: 582-21-10767

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Date: April 29, 2021

Type of Solicitation: Request for Grant Applications (RFGA)
Name of Solicitation: Texas On-Site Sewage Facility (OSSF) Research Grant

Solicitation Number: 582-21-10767

Class 918, Item 36
Class 925, Item 36
Class 925, Item 96

Pre-Proposal Conference: No physical location is scheduled. May 7, 2021 at 3:00p.m.

Texas On-Site Sewage Facility (OSSF) Research Grant
Solicitation Number: 582-21-10767

Contract addressing:

Wastewater Treatment Challenges at I

And

Aerobic Treatment Units in the Real W   d New Data)

Texas A&M C   Team

June W   Anish Jantrania

C   Ryan Gerlich

Was discussed yesterday!

TEXAS A&M AGRILIFE RESEARCH | EXTENSION

Project #2.3.2 - Proper Dosing Techniques and Application Rates for Drip Irrigation

Gabriele Bonaiti, Anish Jantrania, Ryan Gerlich – Texas A&M AgriLife Extension

June Wolfe III – Texas A&M AgriLife Research

TEXAS A&M AGRILIFE EXTENSION

Introduction and background

- Utilization of drip irrigation is expected to increase for subsurface dispersal of aerobic effluent on sites with limited soil depth;
- Current challenges with drip: poor design, improper installation, and mismanaged systems
- Research is needed to assist installers, maintenance providers, and designers by developing standard procedures for drip irrigation design, installation, and maintenance

Objectives

- Survey to query and interview regulators and license holders regarding the most common design, installation, operation, maintenance and troubleshooting procedures in Texas
- Literature review (local, state, and federal)
- Field experiments at the TAMU OSSF center:
  - Flushing and filtration performance
  - Irrigation line cleaning solutions
- Summarize designs, installation practices, maintenance schemes, and troubleshooting procedures
- Guidance document describing best practices

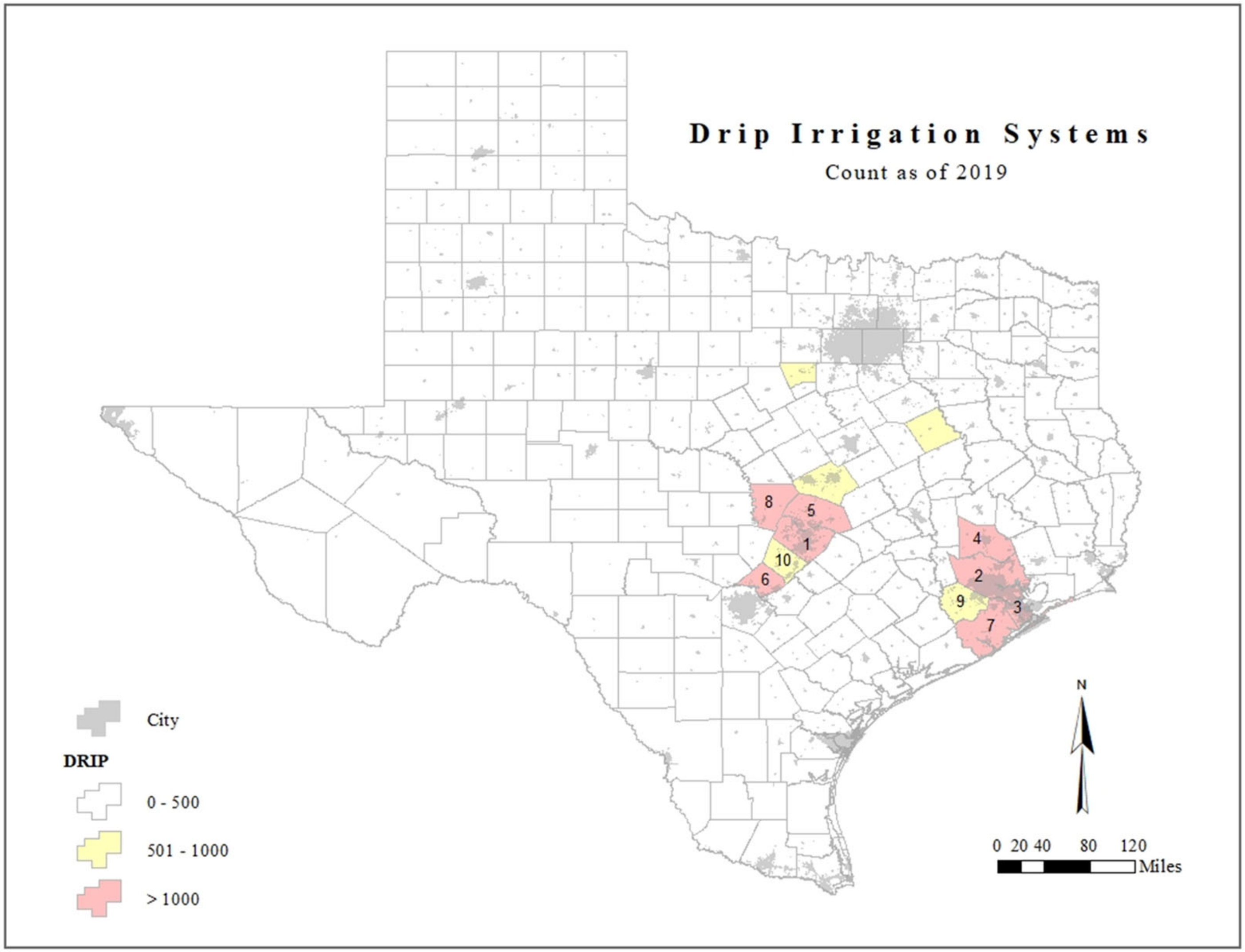


Figure 4. Number of drip irrigation permits issued in Texas between 1992 and 2019 (Source TAMU OSSF Inventory System). Labels indicate rank of top ten (10) counties, where 1 indicates the county with most permits

Final Report to Focus on...

- Practices that have proven successful for design, installation, and operation of drip system
- Develop guidance documents (standard operating procedures) for drip systems use in Texas.

2.3.4 Reduction of Wastewater Effluent from On-Site Sewage Facilities

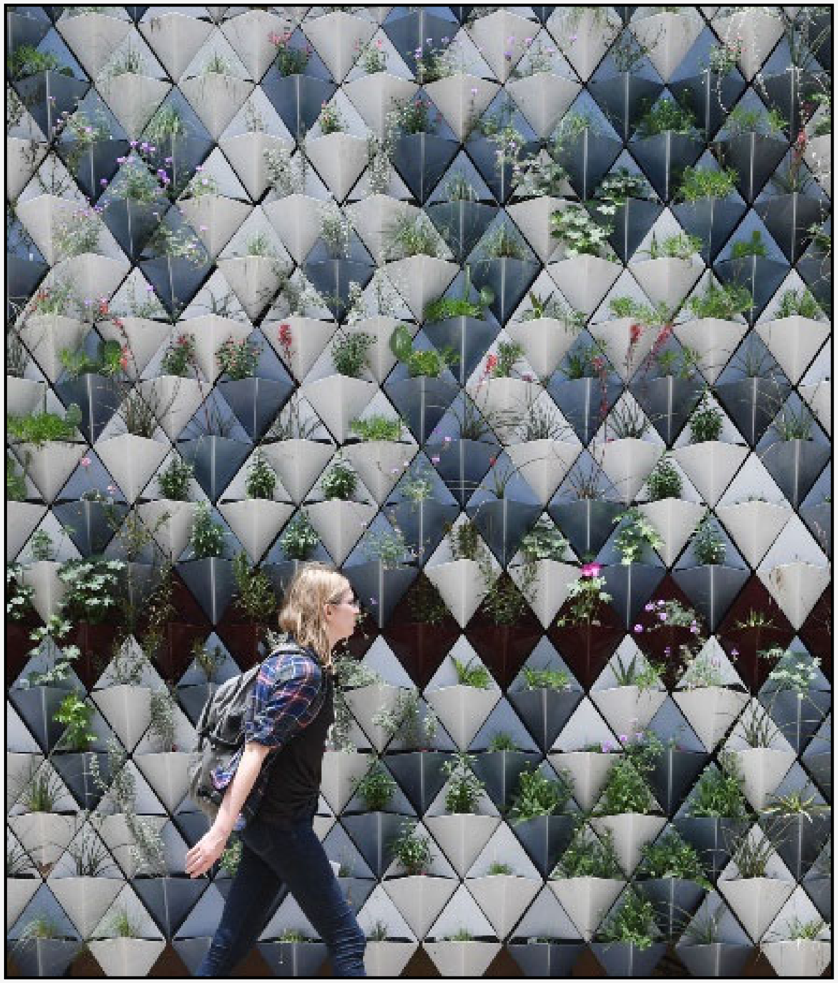
Under current rules, adequate and suitable disposal area will continue to be a challenge for properties served by OSSFs. Residential and commercial properties are constantly faced with choosing between on-site disposal and the use/enjoyment of valuable real estate.

Research is needed to identify technologies and applications that can be:

1. Utilized to eliminate liquid water discharge from on-site sewage facilities; and
2. Coupled with on-site sewage facilities to utilize roof and/or wall space for disposal area.

…….. *The goal is to develop solutions for alternate disposal areas.*

TAMU Main Campus Activities



Examples of Green Roof Green Wall

TAMU Main Campus Activities

Examples of Greenhouses on the roof

Texas A&M AgriLife Research

BIOLOGICAL AND AGRICULTURAL ENGINEERING

Texas A&M AgriLife Extension

Old Project in VA Done Specifically to Reduce Discharge

- Masonic Lodge Project (long story…)

Effluent discharge reduced by reuse and ET losses!

Converting wetland cell into a Greenhouse Facility?

Proposed Plan

- Use aerobically treated effluent (~100 GPD) to dosed into the climate control greenhouse… monitored the flow rate accurately for water-balance;
- Measured the GPD out of the Greenhouse accurately to determine reduction in discharge….
- Determine GPD reduced per SqFt and CuFt of the Greenhouse and the COST.

Sustained Funding Needed

- TAMU OSSF Research and Extension Capacity has come a long way since FY2015.....

Sustained Funding Needed

- There is still need for improvement, which requires sustainable financial support…
- TAMU-OSSF Team has been selected for the first two rounds of TOGP funding…
- We need your support <u>to build a sustained funding mechanism starting FY2024.</u>

QUESTIONS / COMMENTS?

QUESTIONS / COMMENTS?

THANK YOU

TAMU OSSF/OSSRF TEAM

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