REDUCED ABSORPTION AREA PERFORMANCE UTILIZING SECONDARY-TREATED EFFLUENT IN PROFILE-LIMITING SOILS

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PRESENTATION OUTLINE

- Introduction
- Justification
- Objective / Hypothesis
- Materials and Methods
- Results
- Conclusions

Site F - 3/2/2018

INTRODUCTION

- Background
  - Education
  - Work
- History
  - 500,000
- Onsite Wastewater in Arkansas
  - 1913 - Present

Site E - 3/2/2018

JUSTIFICATION

- Research an alternative way to dispose of secondary-treated effluent other than surface discharging
- Reduce regulatory burden
- Environmentally responsible

Surface Discharge – Round Mountain, Conway, Arkansas

OBJECTIVE AND HYPOTHESIS

- The objective of the study was to determine the feasibility of hydraulically loading limiting soils with secondary-treated effluent in a reduced absorption area.

- Soils hydraulically loaded at two times the loading rate for secondary-treated effluent will not exceed a ponding depth of 27 cm for a consecutive period greater than 14 days.

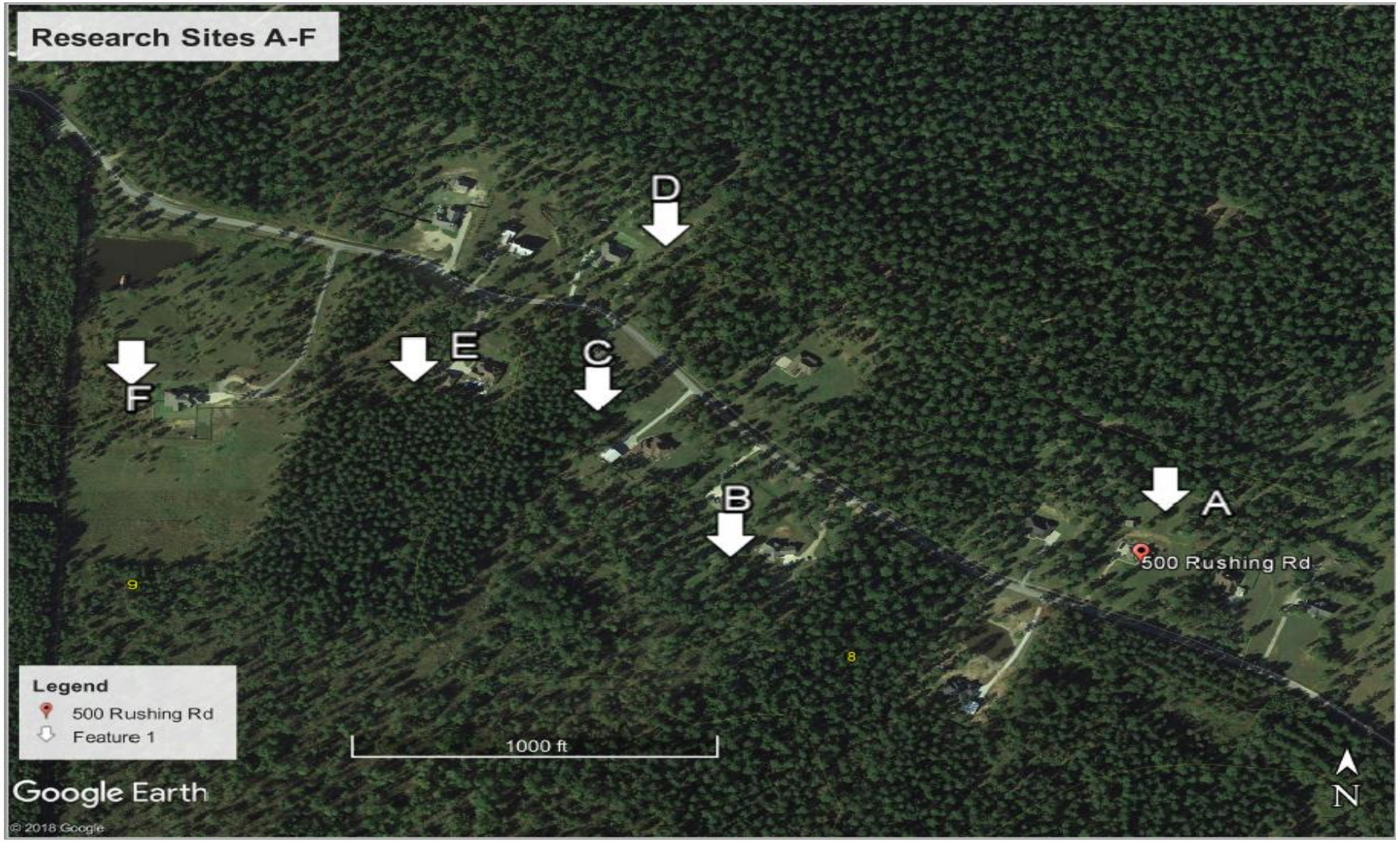
- Performance of hydraulically loading limiting soils with secondary-treated effluent in a reduced absorption area would differ over time between wet and dry seasons.

MATERIALS AND METHODS

- Site selection
- Design criteria
- Construction
- Data collection

Site A - 3/2/2018

SITE SELECTION - PARTICIPATION



Aerial image of research Sites A through F in Saline County, Arkansas. Google Earth image created on 2/26/2019 (Google Earth, 2018).

DESIGN CRITERIA - INFRASTRUCTURE

	Rated for 500 gpd
ORENCO SYSTEMS, INC. 800-348-9843	Advantex AX-20 & AX-20RT Synthetic media filter treats effluent from septic tank with effluent filter - Rated for 500 gpd
ACQUIRED WASTEWATER TECHNOLOGIES 318-746-5122	Alliance - Rated at 500, 600, 750, 1000 gpd Cajun Aire - Rated at 500, 750, 1000 gpd Mighty Mac - Rated at 500 gpd
AERO-TECH 574-935-0908	AT Models - Rated at 500, 600, 750, 1000, 1500 gpd
AQUAKLEAR 877-936-7711	Models - Rated at 500, 600, 750, 1000, 1500 gpd (concrete, fiberglass, polyethylene tanks)
BIO-MICROBICS 800-753-3278	Micro FAST 0.5, 0.625, 0.75, 0.9, 1.0, 1.5 - Rated at 500, 625, 750, 900, 1000, 1500 gpd

https://www.healthy.arkansas.gov/images/uploads/pdf/product_list_20180215.pdf

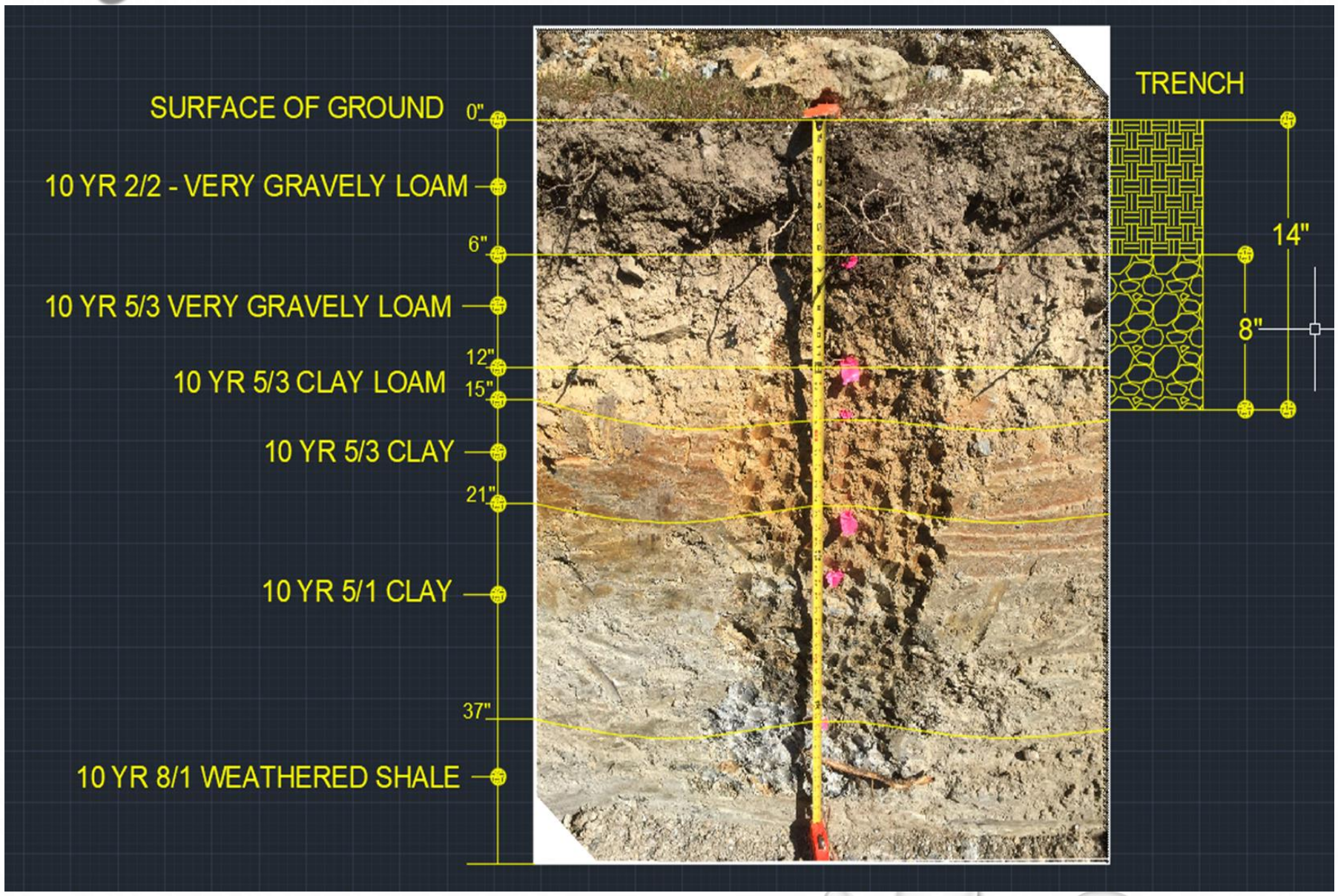
DESIGN CRITERIA – SOIL DESCRIPTION

Ap – 0 to 15 cm; very dark brown (10YR 2/2) very gravelly loam; weak fine granular and subangular blocky structure; very friable; many very fine and medium roots; 50% 2-10 mm sandstone fragments; clear smooth boundary.

E – 15 to 30 cm; brown (10YR 5/3) very gravelly loam; weak fine subangular blocky structure; friable; many very fine and medium roots; 60% 2-30 mm sandstone fragments; clear smooth boundary.

Bt1 – 30 to 38 cm; brown (10YR 5/3) silty clay loam; common fine yellowish red (5YR 4/6) redox concentrations; moderate medium subangular blocky structure; friable; few thin clay films; common fine roots; 8% 2-10 mm sandstone fragments; abrupt smooth boundary.

DESIGN CRITERIA – SOIL PROFILE



Site A

DESIGN CRITERIA – EFFLUENT QUALITY

Effluent Characteristics	**Discharge Limitations**		**Monitoring Requirements**	
	Concentration (mg/l, else specified)		Frequency	Sample Type
	Monthly Avg.	Daily Max.		
Flow (GPD)[1]	report	report	once/six months	estimate[2]
Biochemical Oxygen Demand (BOD_5)	10.0	15.0	once/six months	grab
Total Suspended Solids (TSS)	15.0	22.5	once/six months	grab
Dissolved Oxygen (DO)	6.0 (Inst. Min.)		once/six months	grab
Fecal Coliform Bacteria (FCB)	(colonies/100 ml)			
	200	400	once/six months	grab
pH[3]	Minimum 6.0 s.u.	Maximum 9.0 s.u.	once/six months	grab
If applicable:[4]				
Total Phosphorus (TP)	Report	Report	once/six months	grab
Total Nitrogen (TN)[5]	Report	Report	once/six months	grab

https://www.adeq.state.ar.us/water/permits/npdes/nonstormwater/pdfs/arg550000/2014_final_permit.pdf

DESIGN CRITERIA – HYDRAULIC LOADING RATE

Table 4.2
Soil Loading Rates for Infiltrative Surfaces

SOIL TEXTURE	SOIL STRUCTURE		HYDRAULIC LOADING RATE (gpd/ft2)		LINEAR LOADING RATE (gpd/ft)
	SHAPE	GRADE	BOD>30 mg/L and < 140 mg/l*	BOD<30 mg/L	
Coarse sand, Sand, Loamy coarse sand, Loamy sand	Single grain	Structureless	0.8	1.6	6
Fine sand, Very fine sand, Loamy fine sand, Loamy very fine sand	Single grain	Structureless	0.4	1.0	5
Coarse sandy loam, Sandy loam	Massive	Structureless	0.2	0.6	4
	Platy	Weak	0.2	0.5	
		Moderate, Strong			
	Prismatic , Blocky, Granular	Weak	0.4	0.7	
		Moderate, Strong	06	1.0	
Fine sandy loam, Very fine sandy loam	Massive	Structureless	02	0.5	3
	Platy	Weak, Moderate, Strong			
	Prismatic , Blocky, Granular	Weak	0.2	0.6	
		Moderate, Strong	0.4	0.8	
Loam	Massive	Structureless	0.2	0.5	3
	Platy	Weak, Moderate, Strong			
	Prismatic , Blocky, Granular	Weak	0.4	0.6	
		Moderate, Strong	0.6	0.8	
Silt Loam	Massive	Structureless		0.2	3
	Platy	Weak, Moderate, Strong			
	Prismatic , Blocky, Granular	Weak	0.4	0.6	
		Moderate, Strong	0.6	0.8	
Sandy clay loam, Clay loam, Silty clay loam	Massive	Structureless			2.5
	Platy	Weak, Moderate, Strong			
	Prismatic , Blocky, Granular	Weak	0.2	0.3	
		Moderate, Strong	0.4	0.6	
Sandy clay, Clay, Silty clay	Massive	Structureless			2.5
	Platy	Weak, Moderate, Strong			
	Prismatic , Blocky, Granular	Weak			
		Moderate, Strong	0.2	0.3	

Source: Adapted from Tyler, 2000 – USEPA Onsite Wastewater Treatment Systems Manual
* For BOD_5>140 mg/l, see Chapter 5

CONSTRUCTION

- Flow meters
- Gate valves
- Trenches
- Inspection ports

Site B – 12/29/2016

DATA COLLECTION

- Interval
- Trench ponding
- Seasonal water table
- Flow
- Rainfall
- Observations

Site	Flow ($L\ d^{-1}$)	Disposal area (m^2)	Design ($L\ m^2\ d^{-1}$)	Actual ($L\ m^2\ d^{-1}$)	Multiplier
A	1749	37.6	12.2	46.5	3.8
B	863	7.0	32.5	123.3	3.8
C	458	5.6	32.5	81.5	2.5
D	488	9.8	12.2	49.7	2.0
E	697	29.3	12.2	23.8	2.0
F	772	29.3	12.2	26.3	2.2

Summary of average daily flow and loading rates among the six research sites.

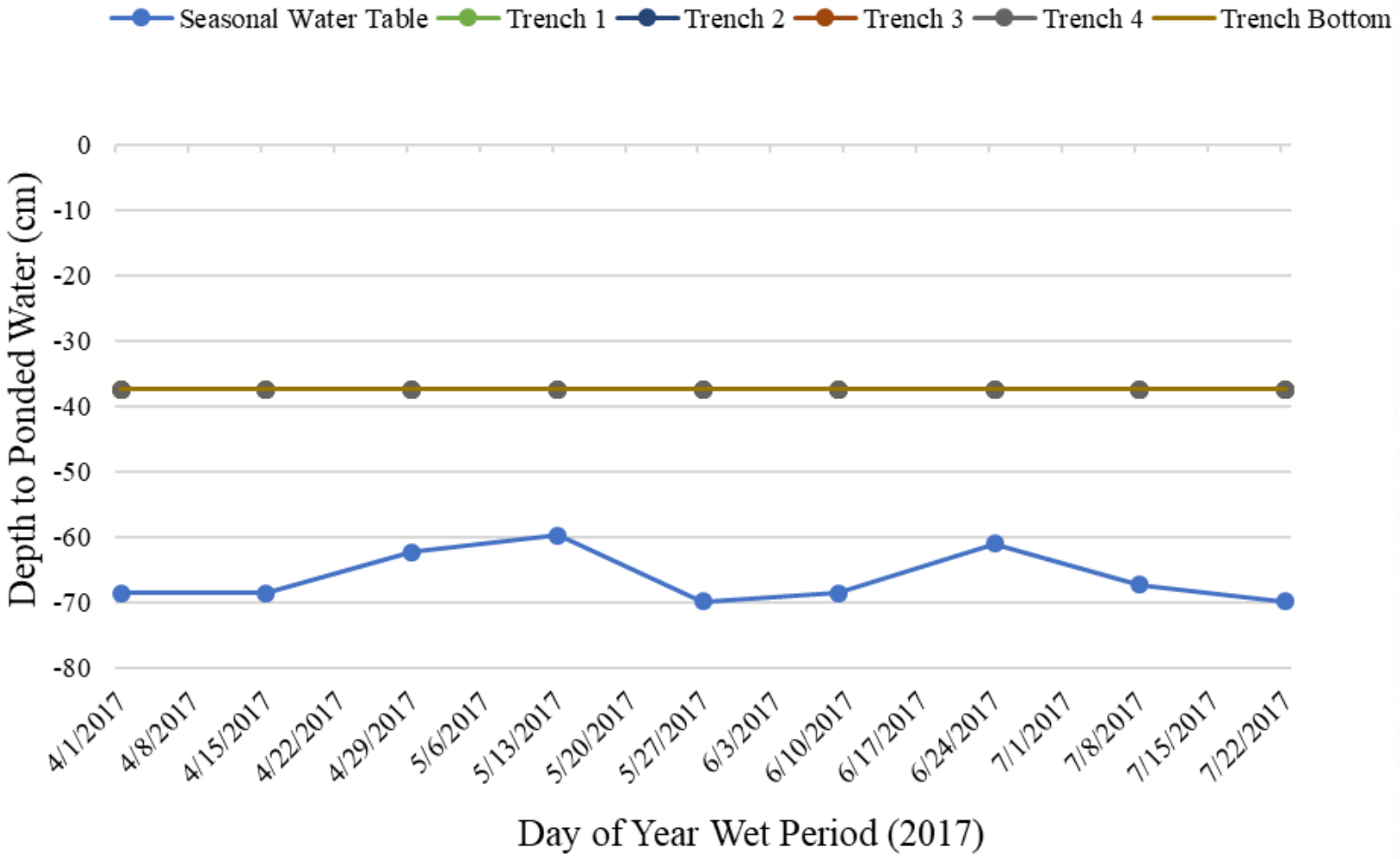
Seasonal water table fluctuations from April 2017 to May 2018 from the up-slope observation port of research sites A, D, E, and F. The soil surface is the 0-cm line on the y-axis. The bottom of the observation well is at the -80-cm line depth.

Site D – 12/10/2018

Monthly rainfall data, both actual and 30-year (1981-2010) average amounts associated within the study area.

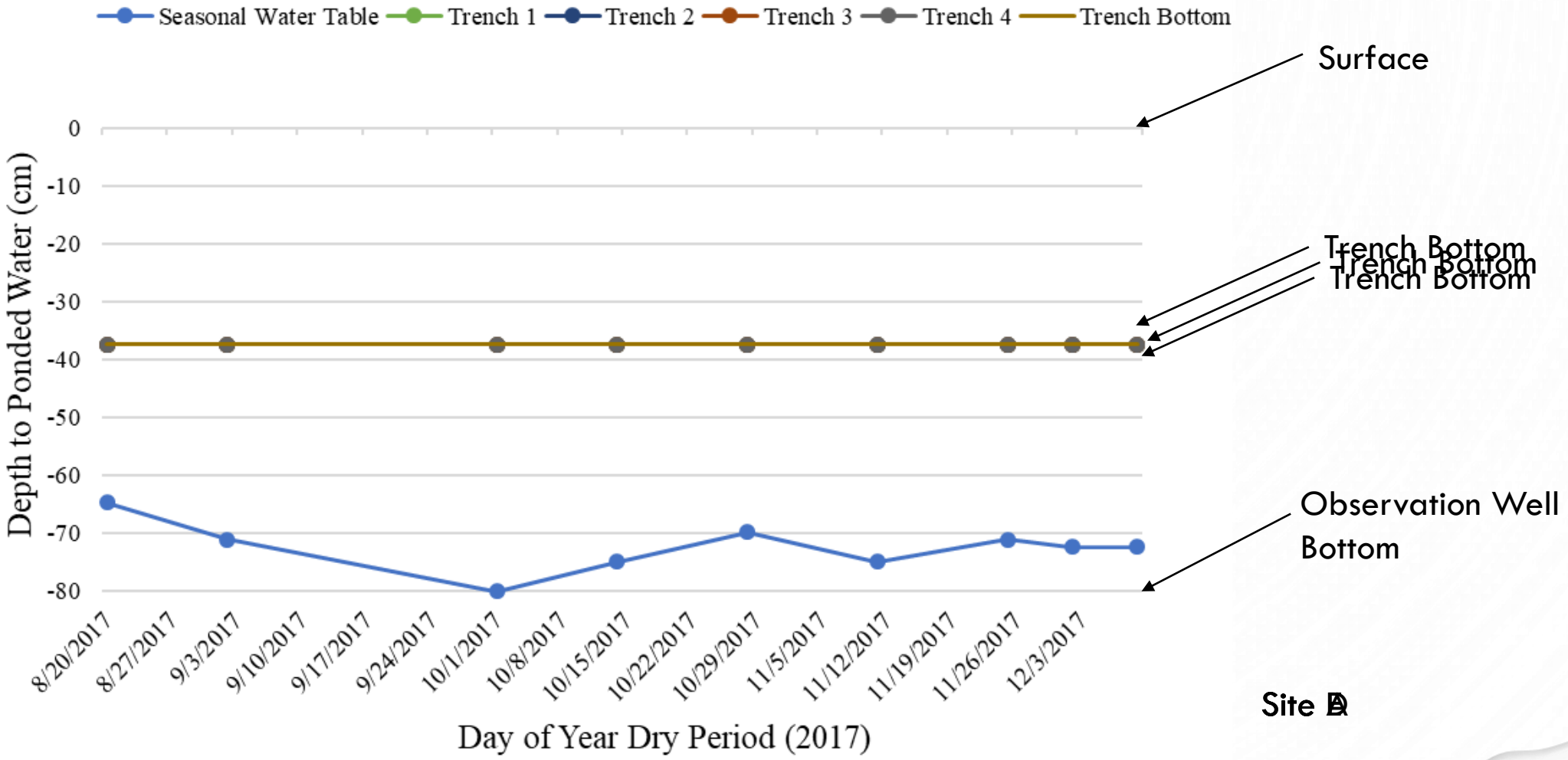
Flows were recorded at the flow meters entering the disposal site at 14-day intervals throughout the study. Average flows are reported. Flows were also compared to home water meter reading to verify accuracy.

RESULTS - WET



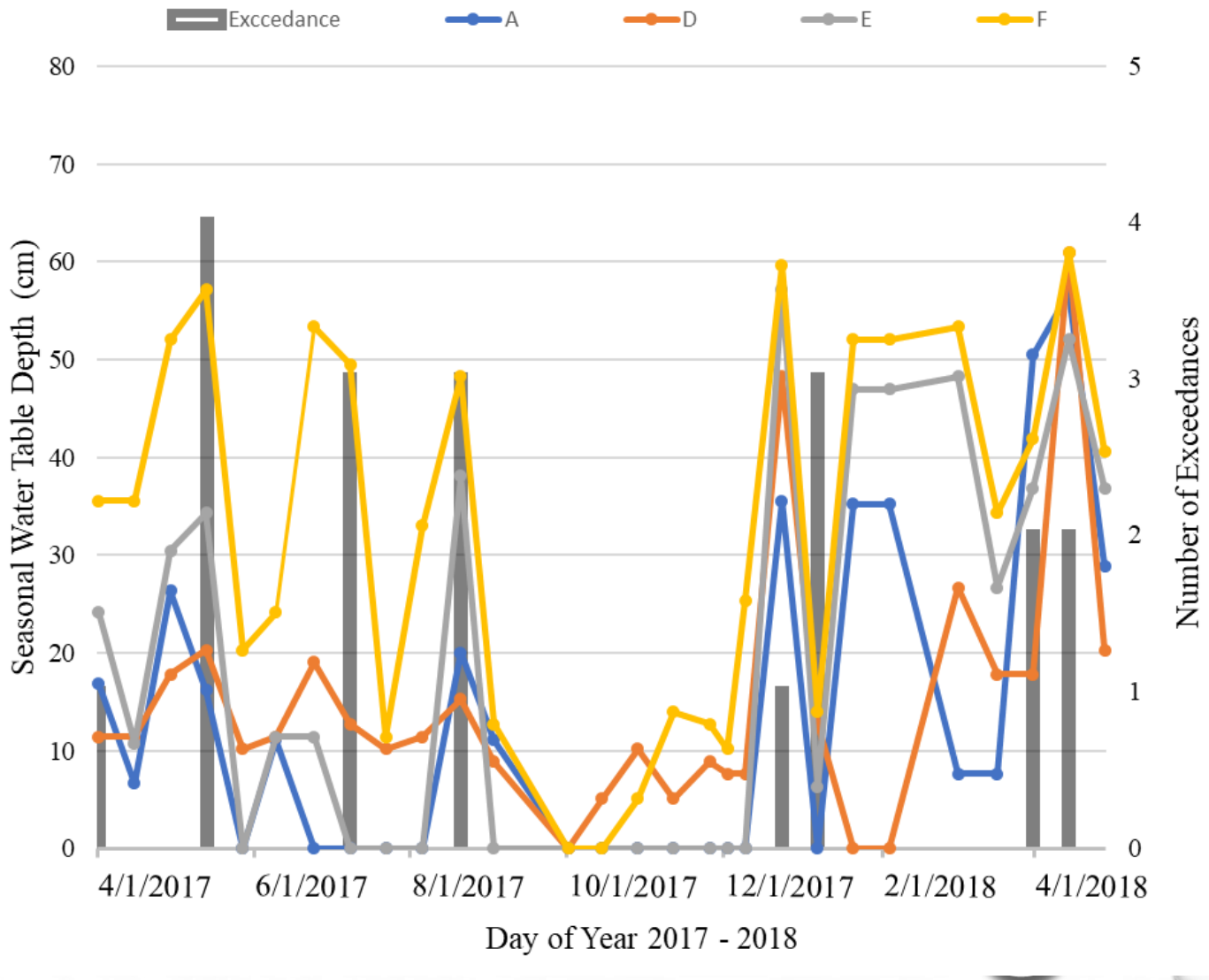
Depth to ponded secondary-treated effluent during the wet period from April to July 2017 for only the up-slope trenches at the Site D. The soil surface is the 0-cm depth mark on the y-axis. The trench bottom is the 30-cm depth mark. The seasonal water table was present throughout this period.

RESULTS - DRY



Site B

RESULTS – EXCEEDANCES



DISCUSSION

- Seasonal water table
- Textural change
- Equalization
- Lateral movement

Site B – 4/28/2018

CONCLUSIONS

- Based on the absence of appreciable secondary-treated effluent ponding at sites B, C, and D during the study and the minimal exceedances in site A, E, and F, which was linked directly to fluctuating seasonal water tables, it is reasonable to consider hydraulically loading secondary-treated effluent at a rate Tyler (2001) established based on soil textures and structure. Consideration must be given to hydraulically loading secondary-treated effluent in unsuitable soils or suitable soils with a reduced disposal area.

QUESTIONS?