RV Flow and Strength

Roger Hickman
Williamson County

WILLIAMSON COUNTY
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Presenter

- B.S. in Chemical Engineering Colorado State University
- M.E. in Environmental Engineering Texas Tech
- Texas Registered Professional Engineer
- Over 20 Years Engineering Experience with 5 Years in On-Site Sewage Treatment

RV PARK Overview

Types of RV Parks

- Campgrounds (few services)
- Vacation / Destination RV Parks
- Snowbird Resorts (<6 mo.)
- Full time RV Parks
- Man/Construction Camps

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RV Campgrounds

- Basics that you find in a Corp of Engineers, State or National Parks
- Wilderness areas without many creature comforts
- They can be as simple as a gravel RV pad and a fire pit
- Most of these sites will not have any service hookups like electric, water, and sewer
- Dump sites, fill stations, and facilities are usually available, just not on individual sites

Vacation / Destination Parks

- RV parks differ to campgrounds as they will always have the basic hook up, such as water and electric and may often have sewer as well.
- Facilities can vary in parks, there could be showers to laundry to swimming pools and dining facilities.

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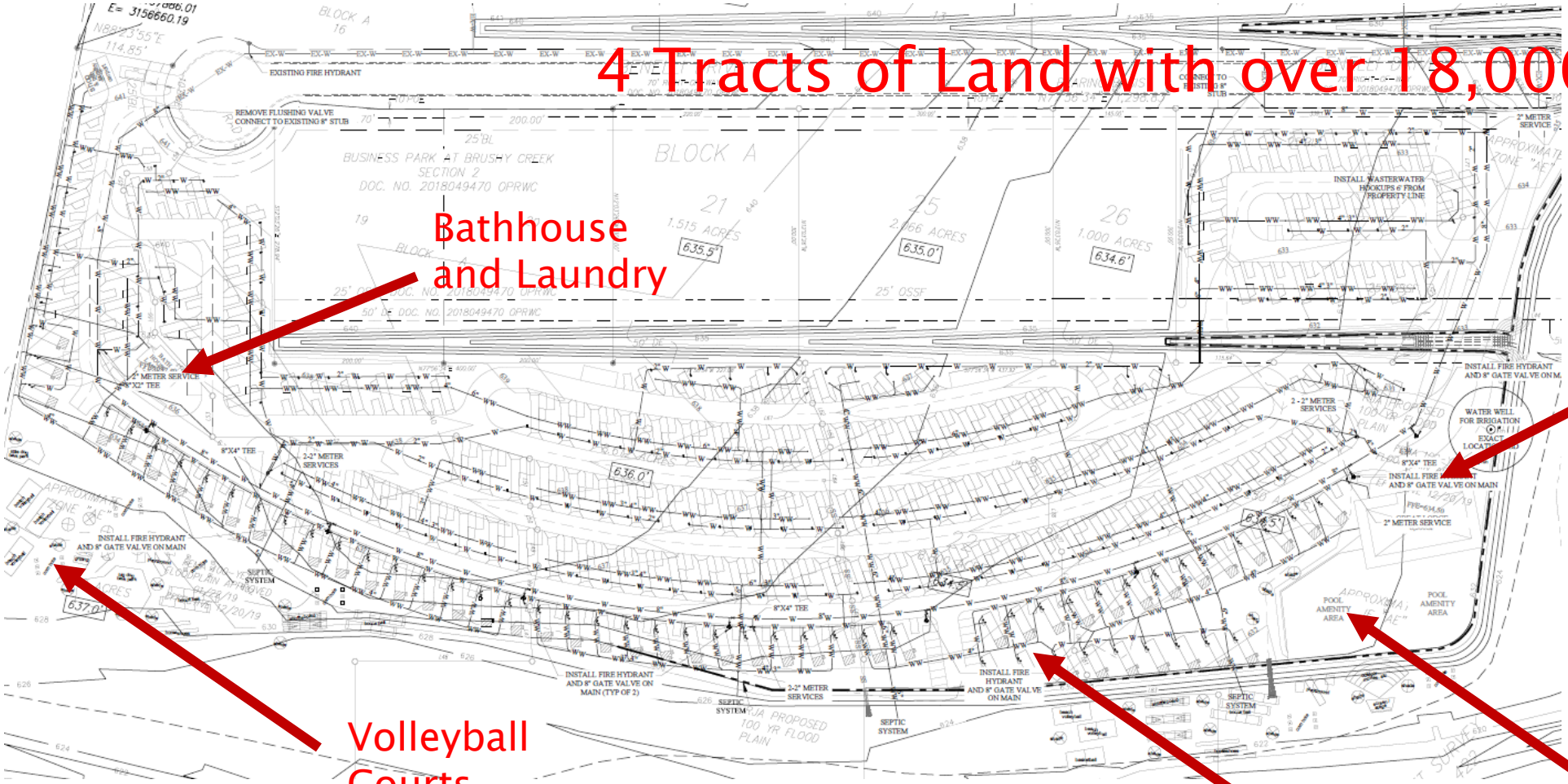
Proposed Williamson County RV Park No. 1



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Snowbird / Long Term RV Parks

- Long terms sites are designed to attract long term full-time RVers that could be there for months and even years. Some include full bath facilities, restaurants, clubhouses, recreation centers. You often sign a contract for resort spots guaranteeing month, three months or six-month stays.

- Many are designed, or even restricted, to senior RVers with classes, potlucks, and dances.

- Many attract transient workers such as construction workers, oil / gas workers or traveling nurses.

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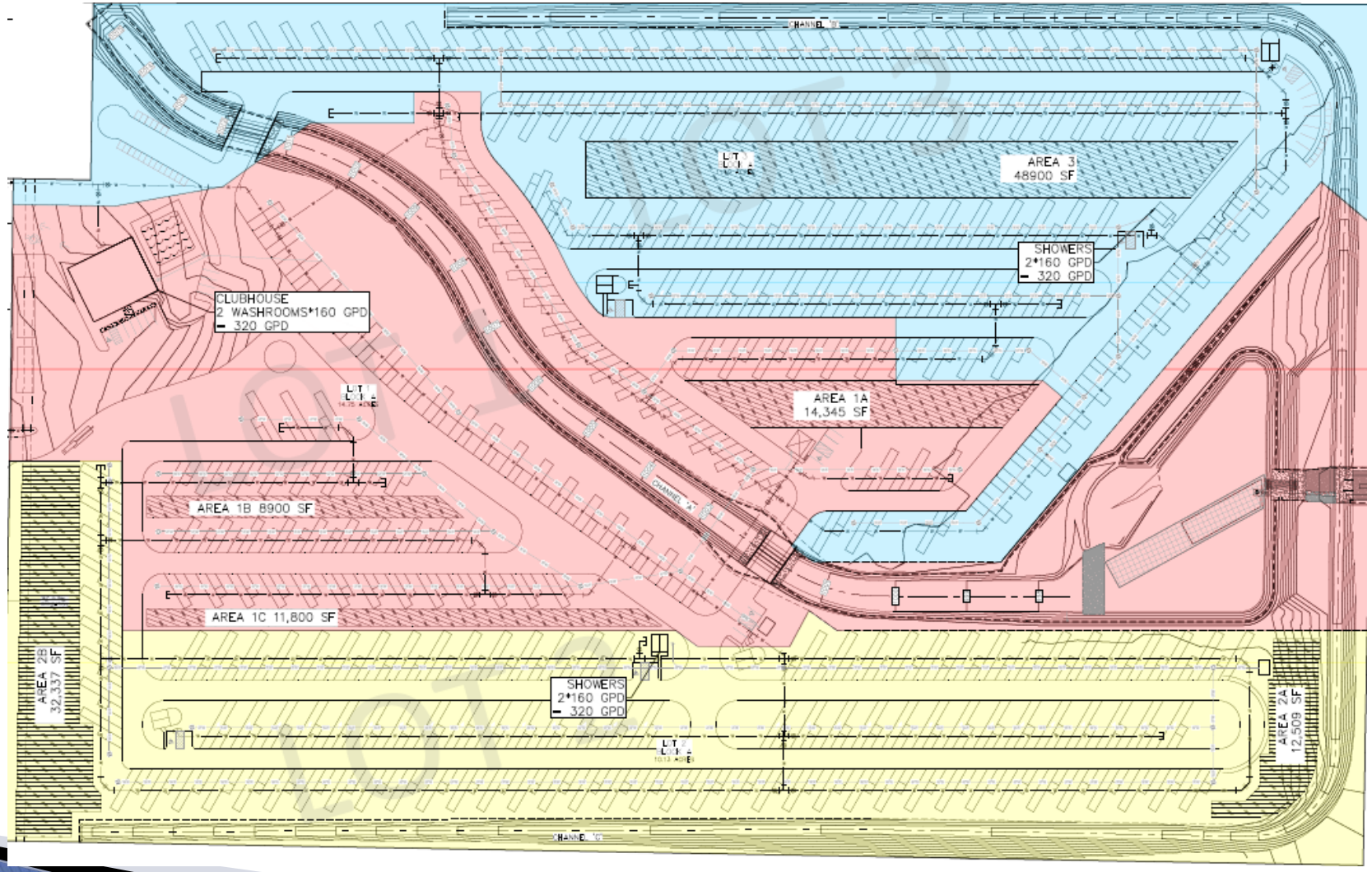
Proposed Williamson County RV Park No. 2



3 Tracts, 269 RV's and 13,000 GPD

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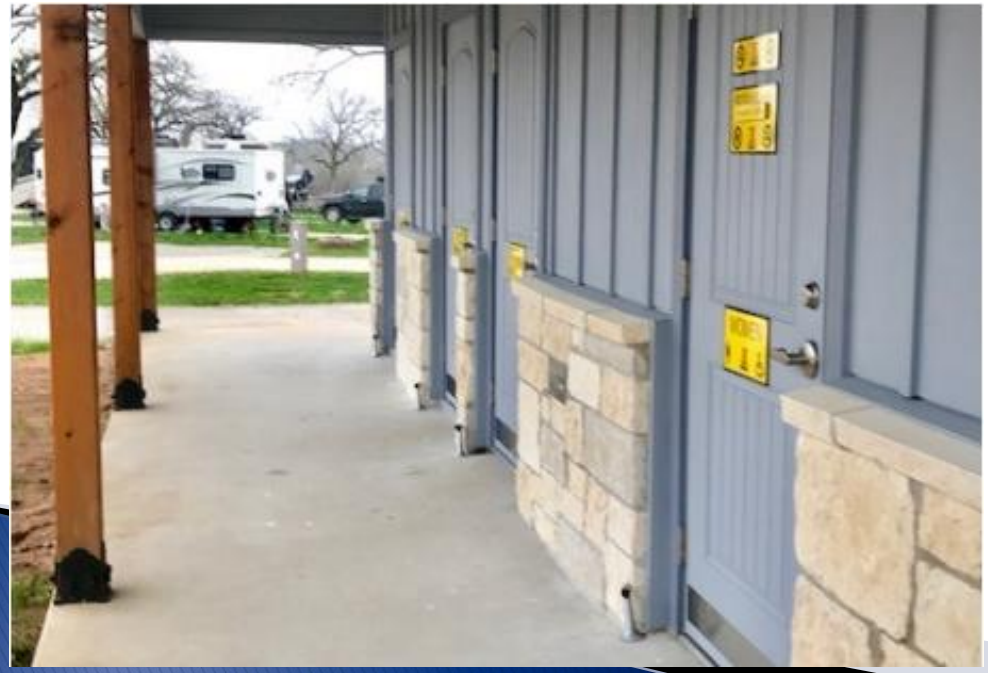

Man Camps

- Typically for oil field or construction projects
- Can include community shower facilities, dining halls, workout facilities
- Some (in demand areas) will share bunks (day and night shifts)

Man Camps

- Designed to keep people on the site due to remote location
  - Shared and Private Bathrooms
  - Kitchen & Dining Facility
  - Hot & Cold Meal Service
  - 24-Hour Snack & Beverage Service
  - Indoor Recreation Facility
  - Theater with Stadium-style Reclining Seating

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Park Models

- Typically cabins mounted on a single chassis with wheels and vehicle tag.
- Less than 400 SQ INTERIOR SPACE
- 12 feet in width and 36 feet long on chassis
  - (many have porches)
- Some have traditional low flow fixtures while others have specified “ultra low flow fixtures”.
- Designed to ANSI 119.5 standards
- Designed to NFPA 1192 standards

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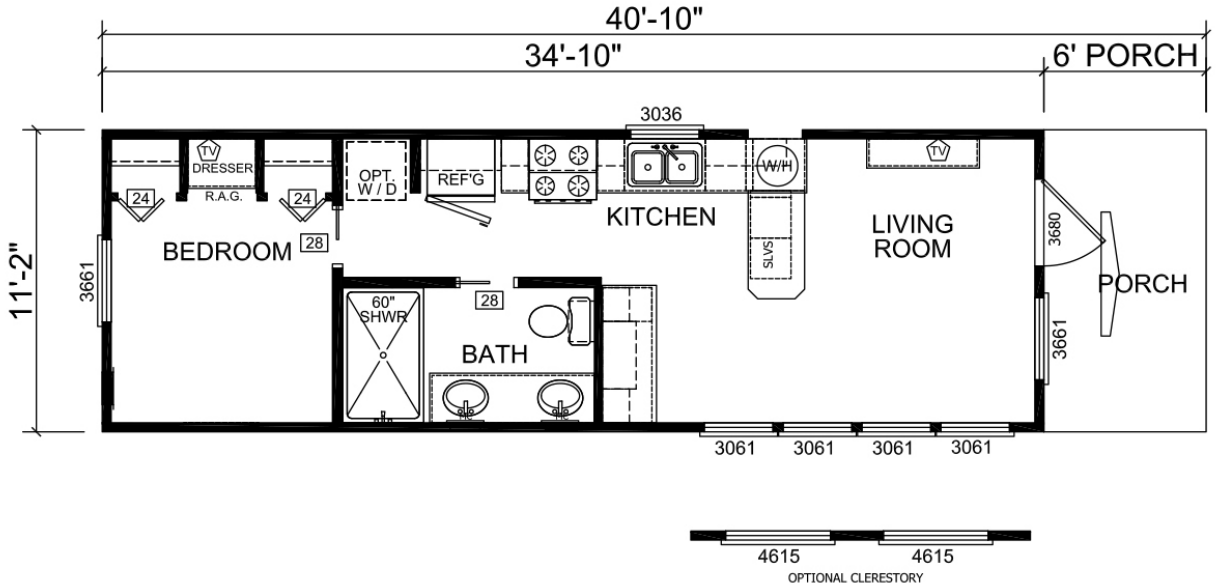
Park Model Interior

Can Sleep 4 Comfortability

PARK MODEL RV



MODEL: **APH 536**

12 x 34 399 Sq.Ft

1 Bedroom 1 Bathroom

Ultra Low Flow

- There is no AWWA or ANSI standard for ultra low flow.
- Shower heads are sometimes advertised to flow at 0.625 GPD

Wastewater Quantity Flows

- Design Parameter No .1
  - Published Data
  - Flow Study

Published Hydraulic Flows

Source	Flows
TAC 285.91 Table 3	40 GPD with low flow fixtures
EPA Onsite Treatment Manual (2002)	75 GPD to 150 GPD (125 GPD typical) per trailer
Forrest Service Design Manual	20 to 30 GPD per trailer
North Carolina Department of Health	120 GPD traditional RV's and 175 GPD for Park
Wastewater Engineering (Metcalf and Eddy)	75 GPD per vehicle or (34 GPD with comfort station)

Licensed RV Park Study Results

- Located in Hays County

- 2 Systems
  - One for 70 campsites
  - Second for 52 campsites and Community Showers, Laundry and Store

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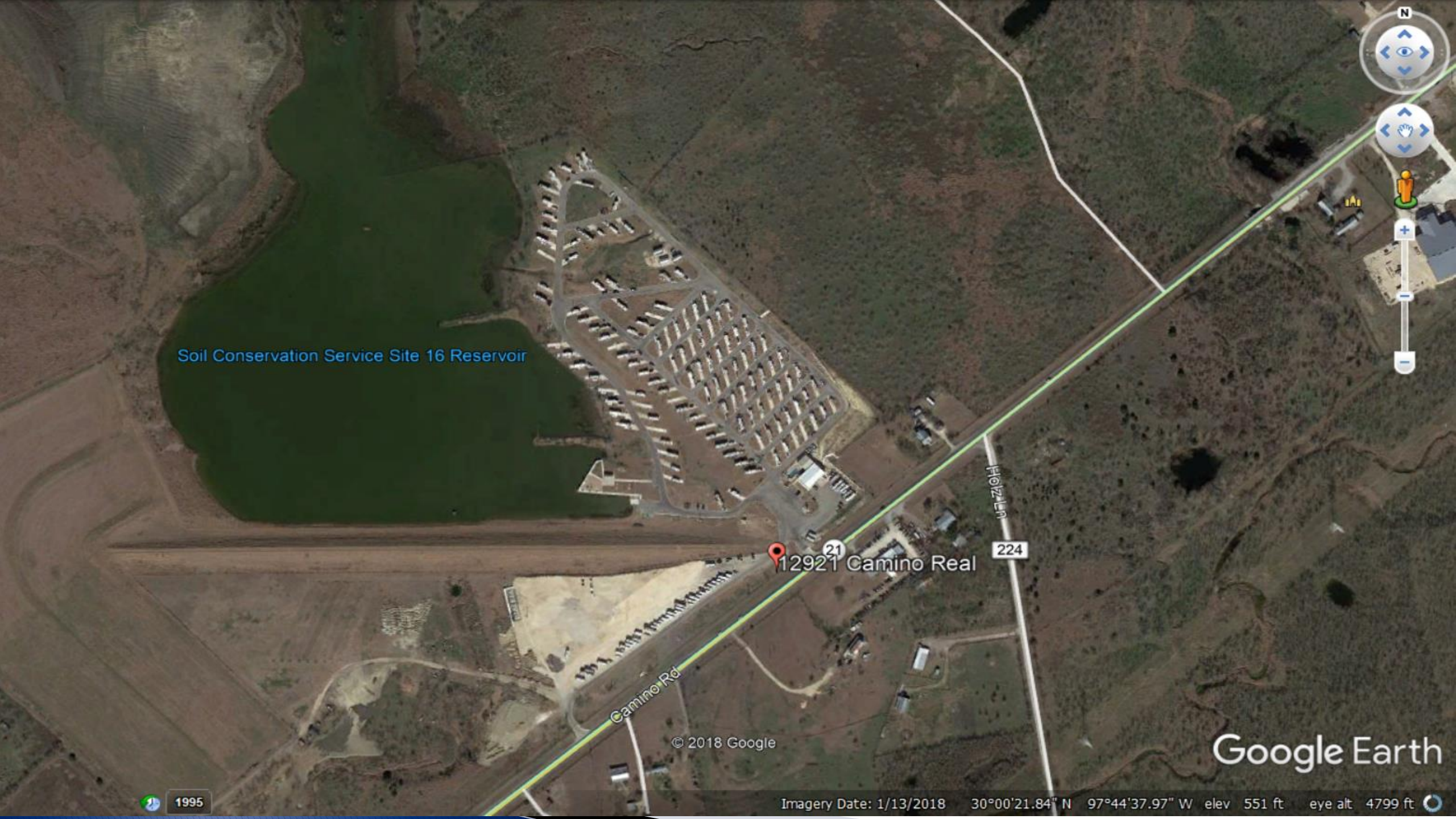
Licensed RV Park

- 90% Full Time Sites
- 10% short term and rentals
- Office with Convenience Store
- Onsite Pizza (Hunt Brothers)
- Club House
- Laundry & Showers
- Pool & Dog Park
- Fishing Dock & Fire Pits
- RV Maintenance & Repair Services
- Rentals (for Family visits)


Soil Conservation Service Site 16 Reservoir
12921 Camino Real
21
224
Holz Ln
Camino Rd
© 2018 Google
Google Earth
1995
Imagery Date: 1/13/2018 30°00'21.84" N 97°44'37.97" W elev 551 ft eye alt 4799 ft

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RV Park Study Results

- Date Range – 10/3/2016 to 2/17/2020
  - Approximately 3 years and 4 months
  - Readings were taken weekly
- 2 Systems
  - One for 70 campsites – 25 GPD
  - Second for 52 campsites and Showers, Laundry and Store – 57 GPD
- Entire RV park residents had access to the shower, laundry and store.

Maximum Flows per Tract

- Per TAC 285.2(44) – An OSSF cannot treat more than 5,000 GPD
- Developer may track out land by meets and bounds to put multiple systems on one lot.
- Remember to take into account the locations of showers, stores, and other convenience structures that will be used by the whole community.
  - Person on Tract A will use the laundry on Tract B.

Wastewater Quality Data

- Design Parameter No. 2
  - Theoretical Calculations
  - Sampling Studdies

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Theoretical Math Calcs – House

- In a house:
  - 0.15 lbs per person **without in-sink disposal**
    (Wastewater Engineering, Metcalf and Eddy, 5th Ed.)
  - 2 people in the house (0.30 lbs.)
  - 154 gallons of flow
    (Wastewater Engineering, Metcalf and Eddy, 5th Ed.)
  - 8.34×10^{-6} x lbs of BOD/ Gallons of flow = mg/l
  - 0.30/(154 gallons * 0.0000834)
  - Wastewater strength is 234 mg/L
  - 25% Reduction in a septic tank = 175 mg/L

Theoretical Math Calcs – RV

- In an RV
  - 0.15 lbs per person
  - 2 people in the TV (0.30 lbs)
  - 40 gallons of flow
  - $8.34x10^{-6}$ x lbs of BOD/ Gallons of flow= mg/L
  - 0.30/(40 gallons * 0.000834)
  - Wastewater strength is 899 mg/L
  - 25% Reduction in a septic tank = 674 mg/L

Composite WW Strength Calculation

- $BOD_{comp} = \frac{Flow_1(BOD_1) + Flow_2(BOD_2) + Flow_3(BOD_3)\ldots..}{Flow_1 + Flow_2 + Flow_3}$

- Example – RV Park
  - 55 RV's 40 GPD per trailer and 800 mg/L of strength,
  - Shower Station – 1000 GPD at 5 mg/L,
  - Laundry –400 GPD at 30 mg/L

- $BOD_{comp} = \frac{55*40(800)+1000(5)+400(30)}{55*40 +1000+40} = 493$ mg/L

- BOD Load/Day = 493 mg/L*3600 GPD * 8.34 x 10^{-6} = 14.8 lbs/day

Considerations:

- Often less than 2 persons per RV
- People do not cook full meals but instead eat take out or fast cook convenience meals
- Limited dilution water comes from showers and laundry
- Even a site that is 100% occupied only has 80-85% of the people there at peak times.

Williamson County's two BOD Sampling Events

- Day 1 –Six Systems at two RV parks – July 2, 2019
  - RV Park No. 1 has only RVs
  - RV Park No. 2 has 3 OSSFs that served only RV systems and one system that combined RV's with showers and a clubhouse
- Day 2 – Four Systems at one RV park – Jan 8, 2020
  - RV No. 2 park has 3 OSSFs that served only RV systems and one system that combined RV's, restrooms, showers and a clubhouse
- Samples were analyzed for BOD and CBOD

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Day One – July 2, 2019

- Used a Sludge Judge to sample the entire tank top to bottom of a septic tank

- Analytical Results
  - BOD Values between 1700 to 9900 mg/l
  - CBOD Values between 1420 to 3660 mg/l
  - MDL = 3000 mg/L

- **FAILED – the sludge and scum layer fouled the sampling results**

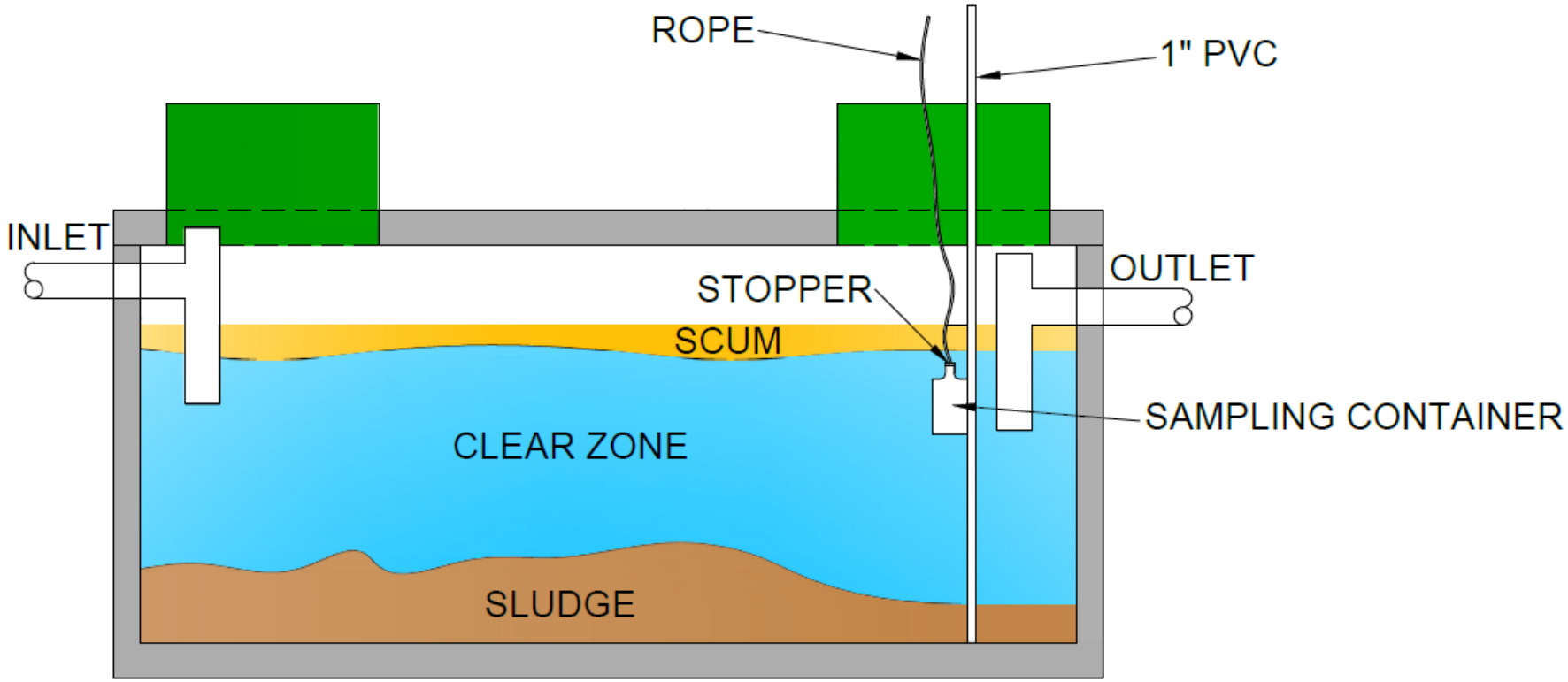
Day Two – Jan 8, 2020

- Used a sampling “milk jug” to capture sample at the septic tank outlet

- Analytical Results
  - BOD Values between 135 to 696 mg/l
  - CBOD Values between 183 to 1240 mg/l
  - BOD values in line with expectations. CBOD value of 1240 mg/L may be erroneous.

- **Partial Success**

Septic Tank Sampling Schematics



Septic tanks typically reduce 25 to 50 percent of incoming BOD.

500 mg/L BOD at outlet is 667 mg/L to 1000 mg/L influent

RV Park No. 3

- 60% Full Time Sites
- 40% Weekly or less (Corp Req)
- Office with Convenience Store
- Club House
- Laundry & Showers
- Lift Station and Septic Tank Sampled

CORPORATE OFFICE
635 Phil Gramm Boulevard
Bryan, TX 77807
Phone: (979) 778-3707
Fax: (979) 778-3103

AQUA-TECH LABORATORIES, INC.

AUSTIN OFFICE
7500 Hwy 71 W, Suite 105
Austin, TX 78735
Phone: (512) 301-0550
Fax: (512) 301-0552

Analytical Report

Report Printed: 5/24/19 11:18

C016317

RV EFFLUENT

Lab ID# C016317-01

Collected: 05/15/19 10:00 by CLIENT
Received: 05/15/19 12:30 by Kelly Kukowski

Type: Grab
Matrix: Non Potable
C-O-C #: 292582

	Result	Units	Notes	MDL	Adj MDL	SQL	Lab	Analyzed	Method	Batch	
General Chemistry											
BOD (5 day)	26	mg/L		1	1	1	*Austin*	05/16/19 07:40 SKH	SM5210 B 2011	M098477	NEL

TRASH TANK

Lab ID# C016317-02

Collected: 05/15/19 10:10 by CLIENT
Received: 05/15/19 12:30 by Kelly Kukowski

Type: Grab
Matrix: Non Potable
C-O-C #: 292582

	Result	Units	Notes	MDL	Adj MDL	SQL	Lab	Analyzed	Method	Batch	
General Chemistry											
BOD (5 day)	852	mg/L		1	1	1	*Austin*	05/16/19 07:40 SKH	SM5210 B 2011	M098478	NEL

LIFT STATION

Lab ID# C016317-03

Collected: 05/15/19 10:20 by CLIENT
Received: 05/15/19 12:30 by Kelly Kukowski

Type: Grab
Matrix: Non Potable
C-O-C #: 292582

	Result	Units	Notes	MDL	Adj MDL	SQL	Lab	Analyzed	Method	Batch	
General Chemistry											
BOD (5 day)	633	mg/L		1	1	1	*Austin*	05/16/19 07:40 SKH	SM5210 B 2011	M098479	NEL

General Chemistry - Quality Control

	Result	Units	Notes	MDL	SQL	Analyzed	Spike Amount	Source Result	%R	%R Limits	RPD	RPD Limit	Batch	
BOD (5 day) - SM5210 B 2011														*Austin*
Diln Water Blk	<0.20	mg/L		1	1	05/16/19 07:40 SKH		0.0		< or = 0.2 mg/L			1905149	
GGA	189	mg/L		1	1	05/16/19 07:40 SKH	198		95.5	84.6 - 115.4			1905149	
GGA	197	mg/L		1	1	05/16/19 07:40 SKH	198		99.5	84.6 - 115.4			1905149	
GGA	211	mg/L		1	1	05/16/19 07:40 SKH	198		107	84.6 - 115.4			1905149	
Seed Blank	<1	mg/L		1	1	05/16/19 07:40 SKH							1905149	
Seed Blank	<1	mg/L		1	1	05/16/19 07:40 SKH							1905149	
Seed Blank	<1	mg/L		1	1	05/16/19 07:40 SKH							1905149	
Duplicate	1	mg/L		1	1	05/16/19 07:40 SKH		1			0.00	36.2	M098477	
Duplicate	<1	mg/L		1	1	05/16/19 07:40 SKH		<1				36.2	M098478	
Duplicate	1	mg/L		1	1	05/16/19 07:40 SKH		1			0.00	36.2	M098479	

OSSF Design for RV parks

- It is the presenter's opinion that OSSF for RV Parks should be considered high strength waste (above 300 mg/L for BOD).
- PER TAC 285.32(f), high strength waste is defined as BOD above 140 after the septic tank (primary treatment).
- For high strength waste, there are two design parameters
  - Hydraulic loading
  - BOD loading
  - Contact the ATU manufacturer for BOD treatment parameters above 300 mg/l

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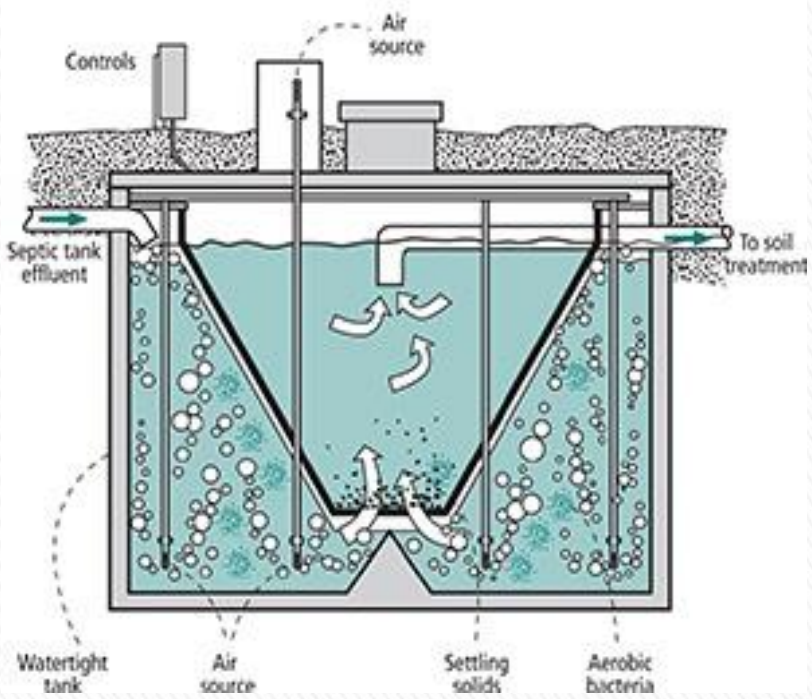
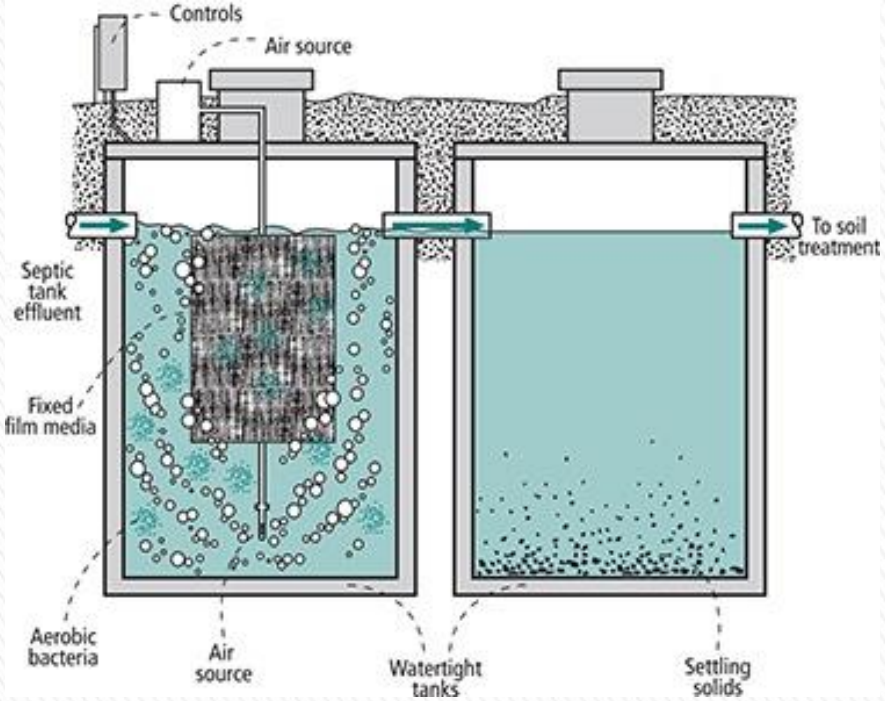
Types of Aerobic Treatment Units.





Suspended Aeration

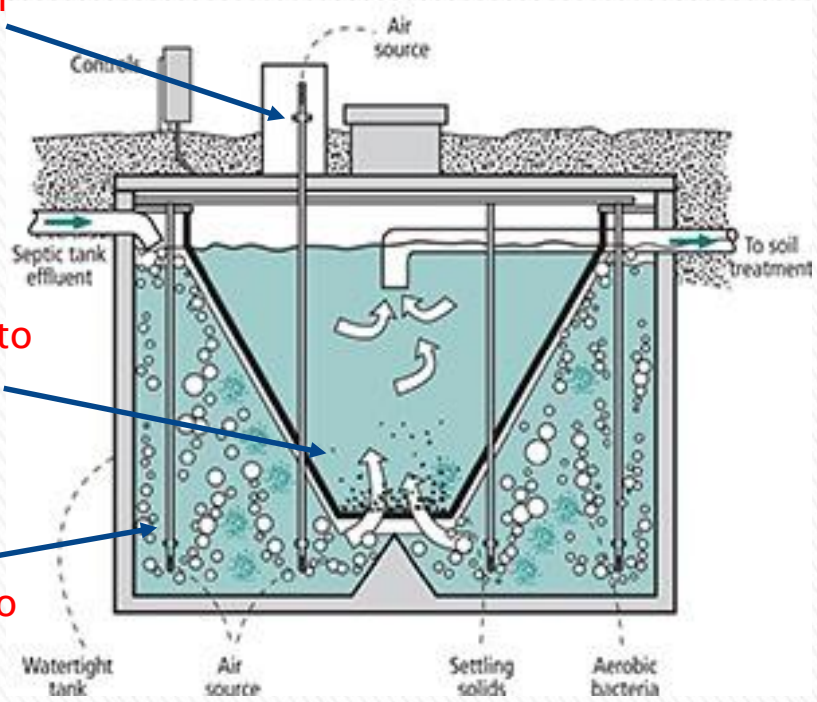
Attached Media

BOD Overloading of an Aerobic Treatment Unit

Not Enough Air

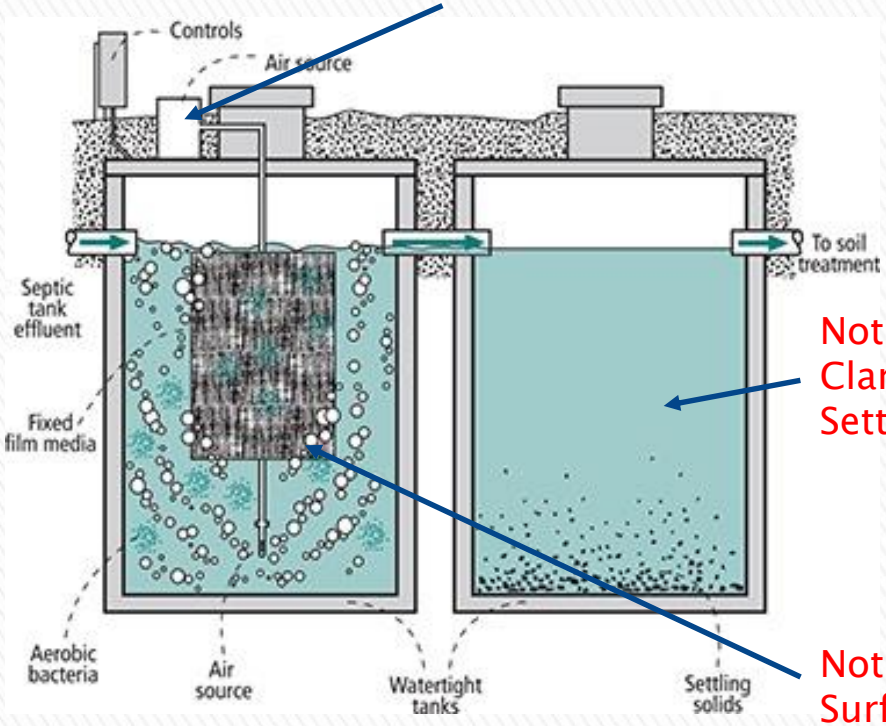
Not Enough Clarifier Volume to Settle Solids

Not Enough Aeration Volume to Support MLSS



Suspended Aeration

Not Enough Air



Not Enough Clarifier Volume to Settle Solids

Not Enough Media Surface Area

Attached Media

NSF Standard 40

NSF International Standard / American National Standard

NSF/ANSI 40 - 2019

Residential Wastewater Treatment Systems

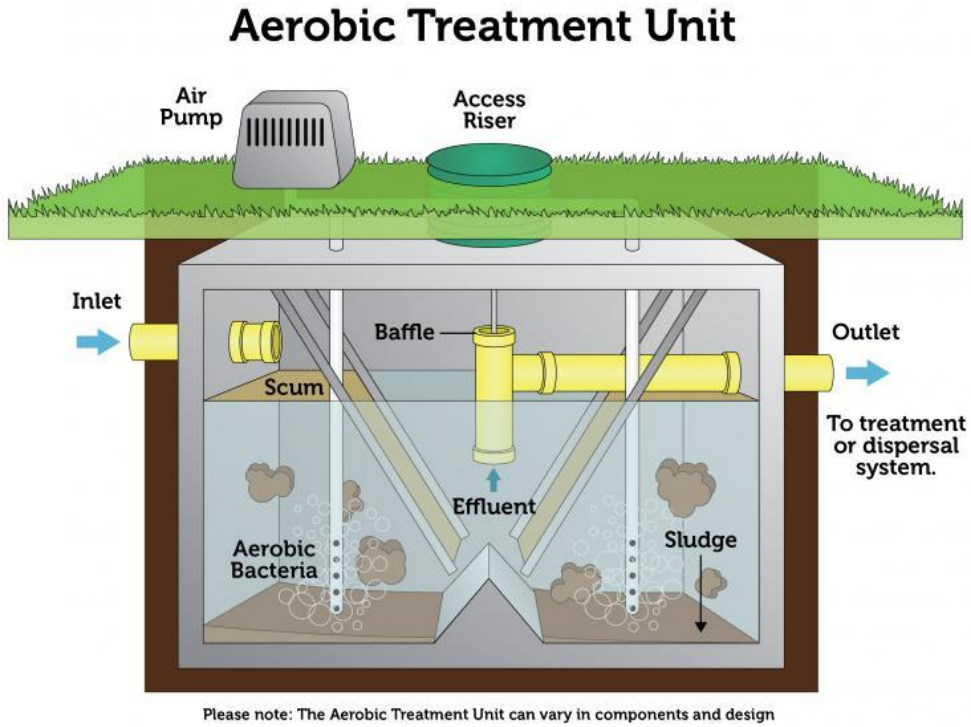
The purpose of this Standard is to establish minimum materials, design and construction, and performance testing and evaluation requirements for residential wastewater treatment systems. This Standard specifies minimum literature requirements to be supplied by manufacturers to authorized representatives and owners. This Standard does not establish nor demonstrate the appropriateness of utilizing certified equipment for treating nonresidential wastewater. Special considerations should be made with regard to anticipated wastewater strength, characteristics, and flows when utilizing certified equipment outside of its evaluated purpose. Additional consideration should also be taken when utilizing multiple applications of these technologies, whether in series or parallel, to create systems with a combined treatment capacity that exceed the 5,678 L per day (1,500 gal per day) GPD or 3.8 lb per day BOD_5 limitations of the equipment.

Correct Sizing of Aerobic Treatment

ATU's need to be designed based on Hydraulic Loading and WW Strength

Example –

For the discussed 55 Unit RV Park with a 3600 GPD flow and 14.8 lbs of BOD per day. Choose a 3 Unit ATU configuration



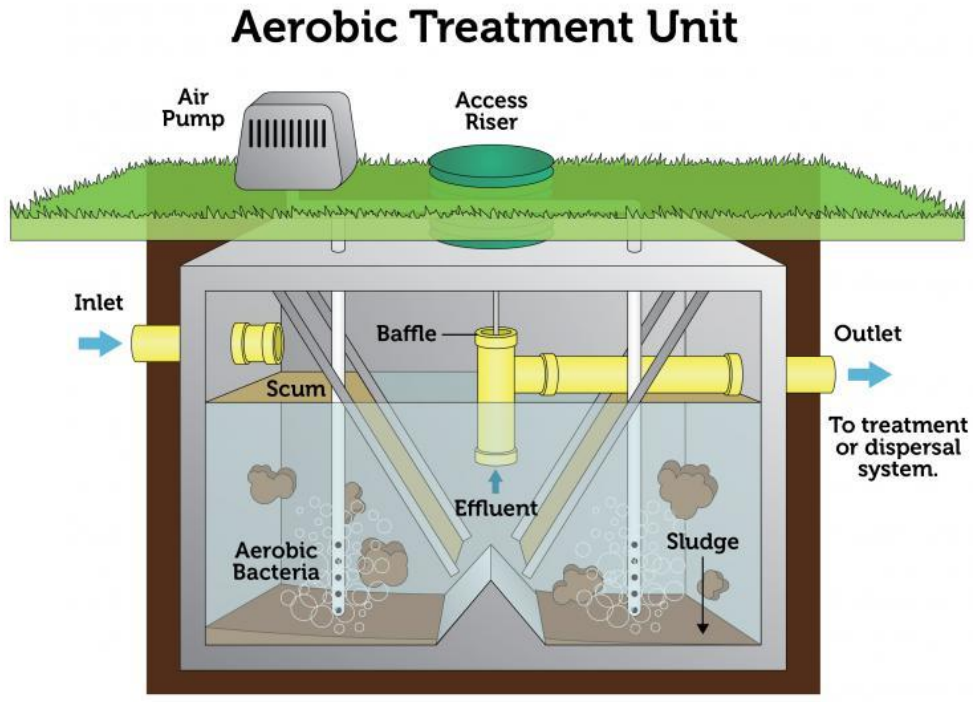
ATU A	ATU B
1200 GPD Flow	1500 GPD Flow
3.0 lbs of BOD Treatment	5.0 lbs of BOD Treatment

Correct Sizing of Aerobic Treatment with DRIP

Result – Choose 3 ATU B Systems

3 – ATU A	ATU B
3600 GPD of Flow	4500 GPD Flow
9 lbs of BOD Treatment	15 lbs of BOD Treatment

Parameters
55 Unit RV Park
3600 GPD flow
14.8 lbs of BOD per day.



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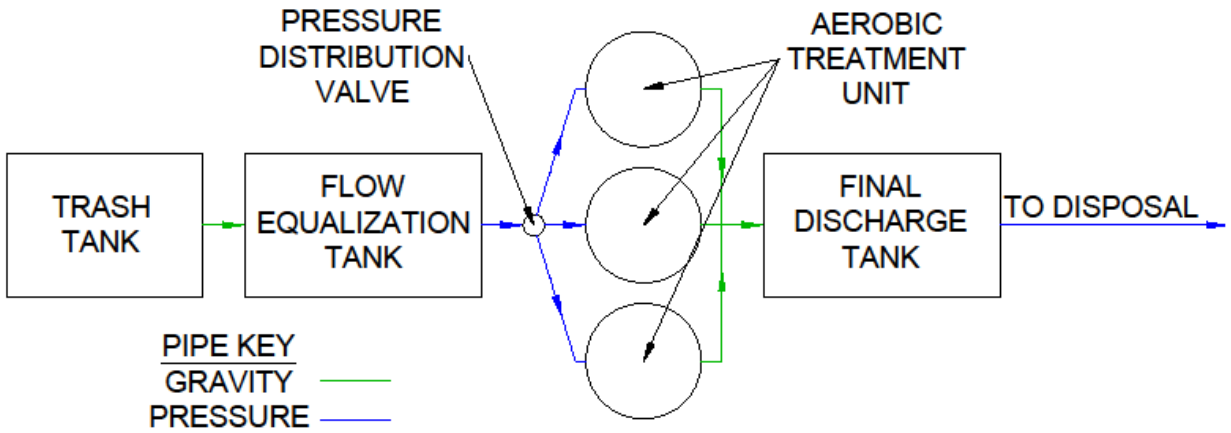
System Layout



High Strength with Spray Application

- Per TAC 285.32(d) and TAC 285.91(Table 9)
  - A Professional Engineer must design (or specify) a system for BOD strengths above 300 mg/l using spray system.
  - An Registered Sanitarian can specify a system that treats strengths below 300 mg/L.

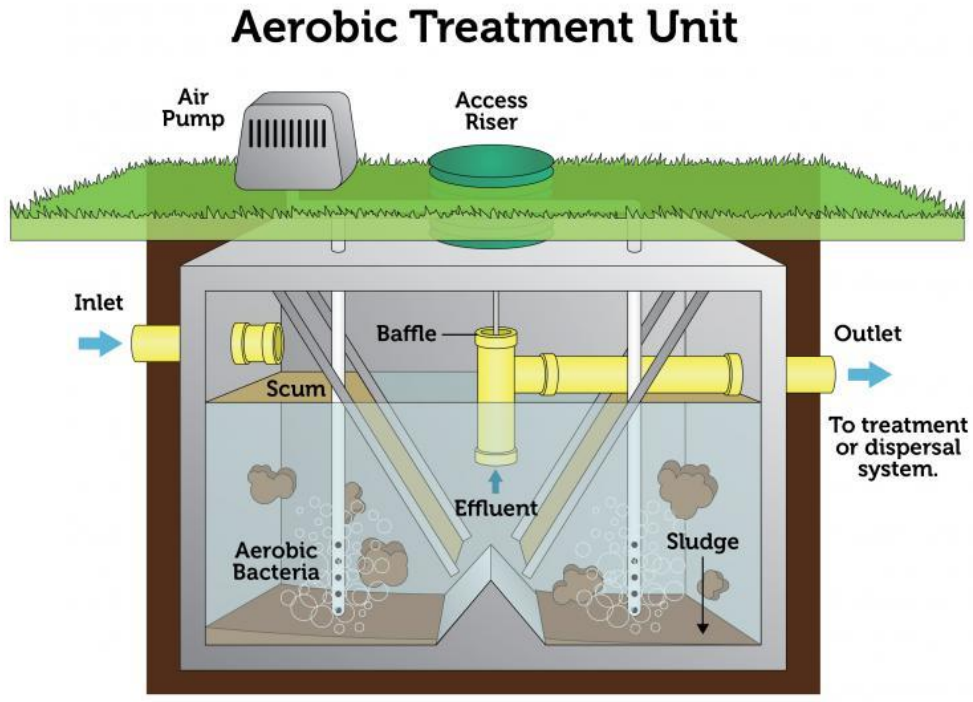
Correct Sizing of Aerobic Treatment with Spray

Sanitarian vs. Engineer

ATU A – Residental Strenght	ATU B – High Strenght
1200 GPD Flow	1500 GPD Flow
3.0 lbs of BOD Treatment	5.0 lbs of BOD Treatment

5 – ATU A	3 – ATU B
6,000 of Flow	4,500 GPD Flow
15 lbs of BOD Treatment	15 lbs of BOD Treatment

Parameters
55 Unit RV Park
3600 GPD flow
14.8 lbs of BOD per day.



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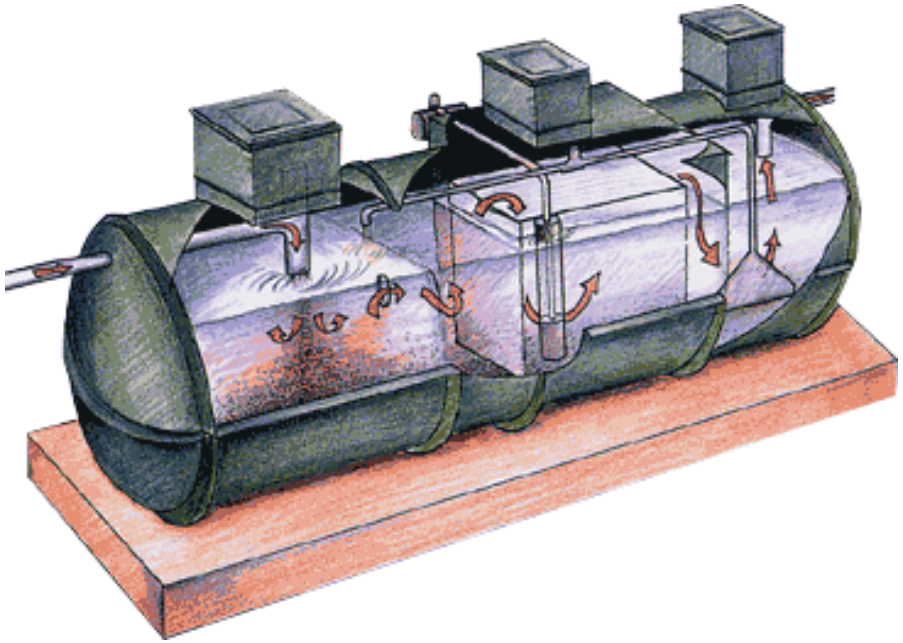
Package Plants

- The TCEQ approves systems with flows below 1,500 GPD based on NSF certification.
- Many manufacturers offer systems that treat high strength waste above 1,500 GPD.
- Per TAC 285.32(d) and 285.91(Table 9) systems that treat flows above 1,500 must be designed by a Professional Engineer.



What we are looking into:

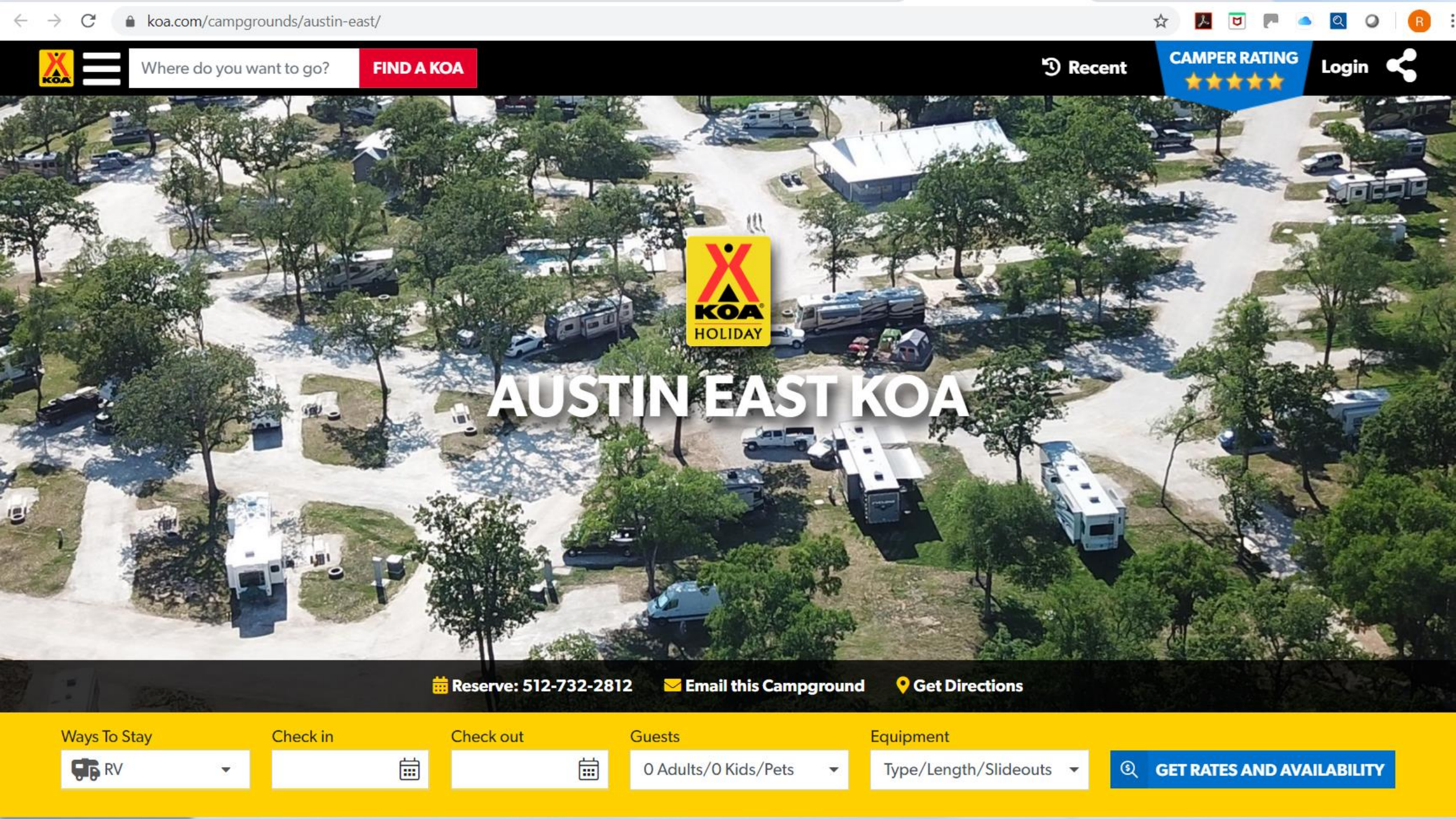
- Study RV Flow and Waste Strength to determine sizing
  - More sampling events and flow monitoring
- Goal is not to just increase flows (limiting park size) but determining true organic strength
- Account for other items like showers, laundry, c-store (especially food prep)

END

Questions?????

RV Resorts Can Be different too

Extra Slides


koa.com/campgrounds/austin-east/
Where do you want to go?
FIND A KOA
Recent
CAMPER RATING
Login
KOA HOLIDAY
AUSTIN EAST KOA
Reserve: 512-732-2812
Email this Campground
Get Directions
Ways To Stay
RV
Check in
Check out
Guests
0 Adults/0 Kids/Pets
Equipment
Type/Length/Slideouts
GET RATES AND AVAILABILITY

What all of these have in common:

- Have Tanks
- Typically Gray and Blackwater
- Graywater is set up to gravity drain, Black cannot
- Blackwater is dumped and rinsed when ¾ (or more).
  - For 2 people this can be every week or 2
- All RV Parks, whether they have dumps stations or not need Flow Equalization for mixing and metering into treatment equipment.


Lazydays RV Holding Tank Maintenance Tips
Black Water Tank / Video 3 of 3

Tiny House Rentals

- Limited to short term stays
- Same square footage as RV's
- No laundry or dishwasher
- Smaller showers

So what is Williamson County Doing?

Lab Results