IMPACT OF OPERATIONAL CHARACTERISTICS OF SHORT-TERM RENTALS AND RECREATIONAL VEHICLE PARKS ON LOADING TO AN OWTS

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Overview

- Defining a short-term rental facility and RV park?
- Location, location, location
- Key wastewater characterization considerations
- Performance considerations
- System considerations
  - Site specific designs - one size does not fit all sites

Define a “short term” rental facility

- How is facility managed?
  - Single family dwelling
  - Hotel equivalent activities – short term stays
- What is the turnover rate?
  - Weekend usage
  - Weekly usage
  - Monthly or greater
  - Seasonal versus year-around

Advertising for sleeping capacity

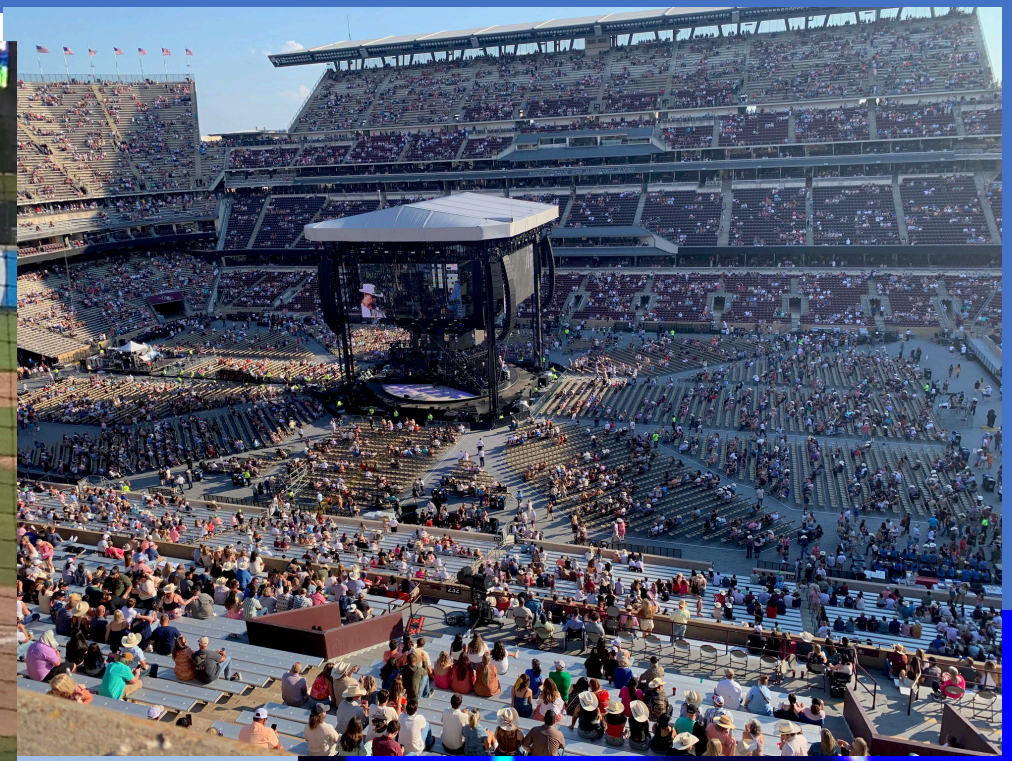
- Bedrooms – one bed per room
- Dormitory approach
  - Multiple beds
  - Bunk beds
  - Trundle beds
- Living areas
  - Sleeper sofa
  - Murphy bed
- All flat surfaces - Inflatable beds
- Cabins, RVs, tents, hammocks, etc.

What matters in real estate: location, location, location!!!

- Venues
- Outdoor activities
- Destinations

Venues

- Weddings
- Sporting events
- Concerts
- Racing
- Universities



Outdoor activities

- Water attractions: coastal beaches, lakes, rivers
- Outdoor recreational: hiking, snow skiing, snowmobile
- Outdoor sporting: fishing, golfing
- Tourism: State and National parks (Grand Canyon), wine country

Destinations

- Secluded areas
  - Mountain getaways
  - Rustic camping
- Islands

Short term rental - key considerations

- Turn rate
  - Length of stay
  - Seasonal versus year around
- Cleaning and sanitizing

- Occupancy
  - Normal
  - All their relatives and close friends

- Time spent at the facility: food and waste generation activities
  - Food preparation at site
  - Restaurants
- Showering and laundry activities
  - Normal activity
  - Double showering and guest laundry activities
  - Inorganics in waste stream (activities)
    - Salt, sand, etc.

Airbnb's enhanced cleaning for turnover

Cleaning guidance

- Cleaning is removing dust and dirt from surfaces, such as floors and countertops. Make sure you:
  - Sweep, vacuum, dust, and/or mop areas before sanitizing
  - Wash dishes and laundry on the highest heat setting possible
  - Wipe down hard surfaces with soap and water

Sanitizing guidance

- Sanitizing is when you use chemicals to reduce bacteria on surfaces such as doorknobs and TV remotes. Be sure to:
  - Spray high-touch surfaces in each room with an approved disinfectant spray
  - Let the disinfectant stand for the length of time specified on the product label
  - Allow the surface to air-dry

Cleaning for turnover

- Time is money – clean as fast as possible
- All water using appliances operating at same time
  - Dishwasher
  - Laundry – multiple loads
    - Offsite as a time/water saver?
- Cleaning and disinfecting
  - Sinks
  - Toilets
  - Showers
  - Hard surfaces

Performance considerations

- Hydraulic
- Contaminant mass loading
- Microbial inhibition

Hydraulic impact

- Consistency of loading
  - Year around
  - Weekend venues
  - Seasonal use – extended periods of no use
- Outdoor activities
  - Multiple changes of clothing
  - Double showering and laundry
- Packed house
  - Lots of people –water using activities

Contaminant loading

- People
  - Limited people
    - Lesser organic loading
  - Many people
    - Greater organic loading
    - Greater urine loading

- Food preparation
  - Outdoor grilling
  - Breakfast – bacon grease
  - Garbage disposal
- Cleaning products
  - Greater nitrogen loading
  - 200 to 300 mg/L TN

Microbial inhibition

- Variable or limited food supply
  - Waste imbalance
  - Poo versus urine balance
- Cleaning products
  - Sanitizing
  - Excess nitrogen loading
- Water quality limited
  - Alkalinity

System considerations

- Site specific design
  - Location matters
  - Not one size fits all
  - Low impact area versus high impact site
- Robustness of design
  - Component's inherent ability to handle peaks
  - Safety factors in design values
  - Advanced treatment system
  - Flow equalization a bonus or requirement
- Performance requirements: concentration versus MASS loading basisI

OWTS sensitivity to hydraulic loading

- OWTS component: treatment and soil treatment area
- Considerations
  - Component response to peak hydraulic loading
    - Septic tank with effluent screen
    - Trench with storage space
    - Drip field with tubing in soil
  - Design – robust treatment capacity with safety factor
  - Flow equalization / dosing tank with timed dosing

OWTS sensitivity to mass loading

- OWTS component: treatment and soil treatment area
- Considerations
  - Component response to variable mass loading
    - Septic tank – effluent screen
    - Advanced treatment – suspended growth, biofilm growth
    - Trench with storage space
    - Drip field – filtration and tubing in soil
  - Biomass fluctuations and accumulation – food to microorganism ratio
  - Design – robust treatment capacity with safety factor
  - Excess nitrogen loading
  - Flow equalization / dosing tank with timed dosing

Microbial inhibition

- Less toxic alternatives for cleaning and disinfection
- Quaternary ammonium compounds (QACs)
- Deactivation chemicals:
- Commercially available
- Cyclodextrins, lecithin and Tween 80
- Alkalinity

Define an RV park

Travel trailers

Tiny homes

Short term versus long-term living quarters – amenities in RV impacts water loading

Amenities

Washing machine designated for pet bedding

Animal hair in treatment system

Washing machines restricting pet bedding

Bathroom & shower facilities

Each unit offers shower, toilet, sink and bench

Four bathrooms

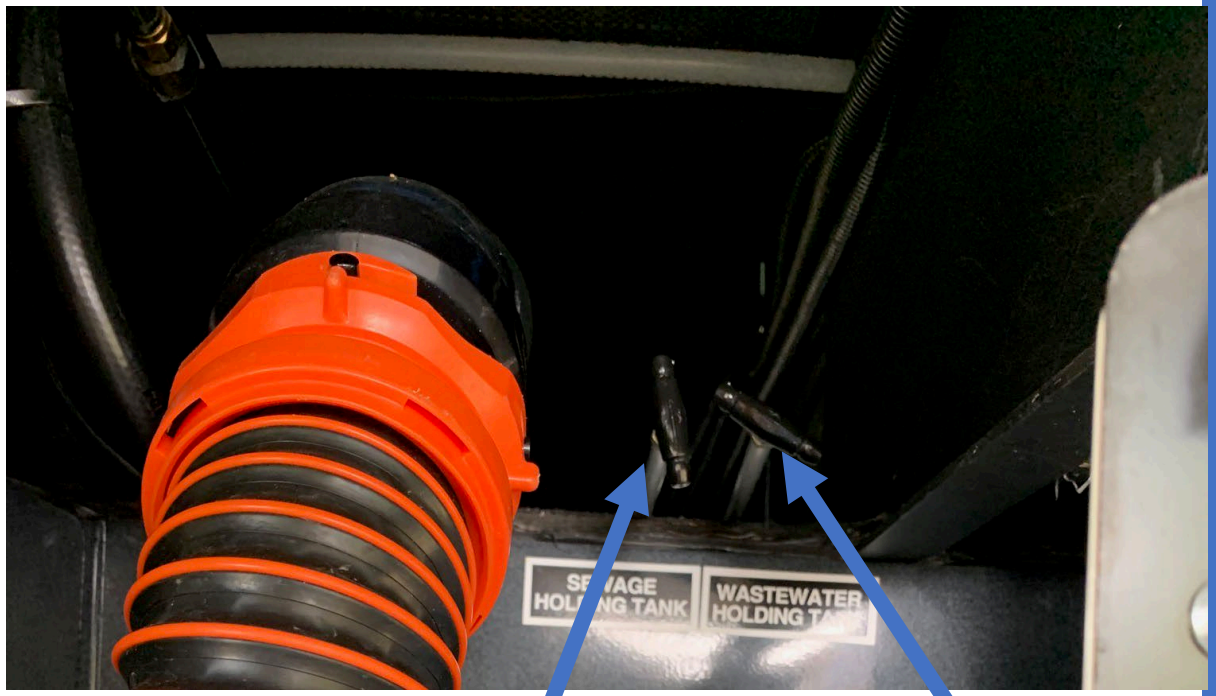
Amenities

Services building: office, kitchen, bathroom, showers, meeting room, clothes washing

Full kitchen: stove, sink, refrigerator, microwave oven

Holding tank management

- How many holding tanks?
  - Blackwater
  - Graywater
  - Capacity: 50 to 100 gallons each
- Control valves remain closed when filling holding tank: blackwater, graywater
- Empty blackwater first
- Graywater rinses blackwater from hose



Sewage control valve

Graywater control valve

RV Parks – wastewater characteristics

- Water usage activities define constituents
- Housing units;
  - Mobile units: short-term versus long-term
    - Holding tanks – slug flows of liquid waste
  - Stationary units: standard housing, tiny homes, park models
    - Fixtures in the housing units, garbage disposal, laundry, no holding tanks
- Amenities;
  - Food preparation areas & event facilities
  - Laundry facilities – pet hair?
  - Bathroom and shower facilities
  - Office buildings with employees
  - Swimming pools with bathhouse facilities

RV Research Data - Agrilife

- Long-term stay park
- Residents: seasonal and permanent
  - 85 RV spaces
- Comfort station
  - Two bath/showers
  - Three washing machines

Date (d-m-y)	Flow (gal/day)	BODs Conc. (mg/L)
5-Jun-2023	2234	623
8-Jun-2023	2234	936
9-Jun-2023	2234	849
12-Jun-2023	2234	573
13-Jun-2023	2234	587
15-Jun-2023	2234	765
16-Jun-2023	2234	622
19-Jun-2023	2234	568
20-Jun-2023	2234	510
22-Jun-2023	2234	574
23-Jun-2023	2234	606
26-Jun-2023	2234	747
27-Jun-2023	2234	635
28-Jun-2023	1977	611
29-Jun-2023	2129	608
30-Jun-2023	2188	522
Average	2209	646
Max	2234	936
Min	1977	510
Median	2234	607

RV Research Data - Agrilife

- Long-term stay park
- Residents: seasonal and permanent
  - 16 RV spaces
- No amenities

Date (d-m-y)	Flow (gal/day)	BOD_5 Conc. (mg/L)
13-Feb-2023	429	1580
14-Feb-2023	429	3110
16-Feb-2023	429	1600
17-Feb-2023	429	1610
20-Feb-2023	359	1480
21-Feb-2023	359	1660
23-Feb-2023	359	1580
24-Feb-2023	359	1420
27-Feb-2023	462	1840
28-Feb-2023	462	1870
2-Mar-2023	462	2350
3-Mar-2023	462	591
6-Mar-2023	424	1820
7-Mar-2023	424	2080
9-Mar-2023	424	2040
10-Mar-2023	424	1860
Average	419	1781
Max	462	3110
Min	359	591
Median	427	1740

RV Research Data - Agrilife

- Long-term stay park
- Residents: seasonal and permanent
  - 92 RV spaces
  - 9 Tiny homes
- Amenities
  - Office with 2 restrooms

Date (d-m-y)	Flow (gal/day)	BODs Conc. (mg/L)
6-Feb-2023	5088	304
7-Feb-2023	5088	458
9-Feb-2023	5088	519
10-Feb-2023	5088	545
13-Feb-2023	5498	596
14-Feb-2023	5498	78
16-Feb-2023	5498	702
17-Feb-2023	5498	924
20-Feb-2023	3509	526
21-Feb-2023	3509	535
23-Feb-2023	3509	654
24-Feb-2023	3509	NA
27-Feb-2023	3395	693
28-Feb-2023	3395	1000
2-Mar-2023	3395	1510
3-Mar-2023	3395	<15
Average	4372	646
Max	5498	1510
Min	3395	78
Median	4298	571

RV Research Data - Agrilife

- Short-term stay park
- Residents: vacationing and seasonal visitors
  - 25 RV spaces
  - Office with single restroom
- No amenities

Date (d-m-y)	Flow (gal/day)	BOD_5 Conc. (mg/L)
6-Feb-2023	583	275
7-Feb-2023	583	256
9-Feb-2023	583	178
10-Feb-2023	583	229
13-Feb-2023	680	268
14-Feb-2023	680	565
16-Feb-2023	680	726
17-Feb-2023	680	594
20-Feb-2023	537	353
21-Feb-2023	537	529
23-Feb-2023	537	639
24-Feb-2023	537	620
27-Feb-2023	504	855
28-Feb-2023	504	960
2-Mar-2023	504	849
3-Mar-2023	504	864
Average	576	588
Max	680	960
Min	504	178
Median	560	580

Mass Loading Values – per person

Item	Range (lb/cap/day)	Typical without ground up Kitchen waste (lb/cap/day)	Typical with ground up Kitchen waste (lb/cap/day)	Common Value (lb/cap/day)
BOD	0.11 - 0.26	0.18	0.22	0.25
TSS	0.13 - 0.33	0.2	0.25	0.25
NH^3 as N	0.011 - 0.026	0.017	0.019	0.03
Flow (GPD/ Person)	20 - 200			75

Metcalf and Eddy, 4th Edition, Table 3-12

Relationships – ten marble example

Scenario	10 Marbles in a 2-liter bottle	10 Marbles in a 1-liter bottle
Hydraulic loading	2-liters	1-liter
Concentration	5 marbles per liter	10 marbles per liter
Organic loading	10 marbles	10 marbles
Sizing of OWTS	10 marbles	10 marbles
Controlling loading	Organic	Organic

Water conservation removes liquid, not waste

BOD: Concentration vs Mass Loading - RVs

- Blackwater with gray water removed – 600 mg/L BOD_5
- Residential wastewater – 300 mg/L BOD_5
- Research data for RV parks – averages: 434 mg/L to 1,781 mg/L;
- Median avg. value 588 mg/L; Sample value range 78 mg/L to 3,110 mg/L, (Texas Agrilife Research)

- Mass (lb) = C (mg/l) x Q (gpd) x 8.34 / 1,000,000
- Mass (lb)= 1,781 mg/l x 500 gpd x 8.34 / 1,000,000 = 7.43 lbs/day
- Mass (lb)= 600 mg/l x 500 gpd x 8.34 / 1,000,000 = 2.5 lbs/day
- Mass (lb)= 300 mg/l x 500 gpd x 8.34 / 1,000,000 = 1.25 lbs/day

Required advanced treatment unit size/capacity based upon organic loading rate

High strength waste considerations

- Organic loading typically controls system sizing.
- Building a treatment train with growth potential
- Flexibility
- Multiple treatment units – parallel configuration
- Safety factors
- Maintenance such as pumping should be planned during the design phase
- Equalization of both liquid and organic loading

Flexibility

- Difficult to determine exact wastewater quality and quantity of a new system
- Design the system for potential expansion
  - Piping between components
  - Space between components
- Leave room for treatment component expansion
  - Dedicate space for future treatment – reserve on site drawing
- Potential addition of amenities to attract and retain customers
- Anaerobic tanks are relatively in expensive to install initially
- Repurpose tanks if system modification required

Multiple treatment units

- Split flow between components
  - Sequential versus parallel loading
- Uniformity of splitting – required accuracy
- Accuracy/efficiency is directly related to loading rate
- Permitted rate = Design rate
  - Accuracy/efficiency = 100%
- Permitted rate = 70% of design rate
  - Accuracy/efficiency = 70%

Safety factors

- Safety factors are critical when sizing high strength wastewater treatment systems.
- Loading at 100% of design operates system at maximum O&M
- Buffer capacity for treatment units.
- Accuracy of flow splitting operations; maintenance required
- Facilitates performance during extreme circumstances
- Calculating safety factors:
  - Flow: 1,500 GPD
  - Safety factor: 30% [(100-SF)/100]; (100-30)/100 = 0.70
  - Design: 1,500 GPD /0.70 = 2,143 GPD

Summary

- Defining a short-term rental facility and RV park?
- Location, location, location
- Key wastewater characterization considerations
- Performance considerations
- System considerations
  - Site specific designs - one size does not fit all sites