

Food Service Establishments Wastewater Characterization

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Presentation Overview

- Background
- Study Design
- Procedures
- Data Obtained
- Design Interpretation

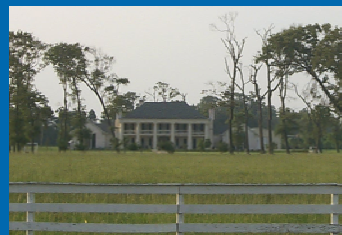
Background

- Onsite Wastewater Treatment is a permanent solution
- Need effective system
- Restaurant wastewater different from residential wastewater
- Scoping study was needed



Wastewater Loading

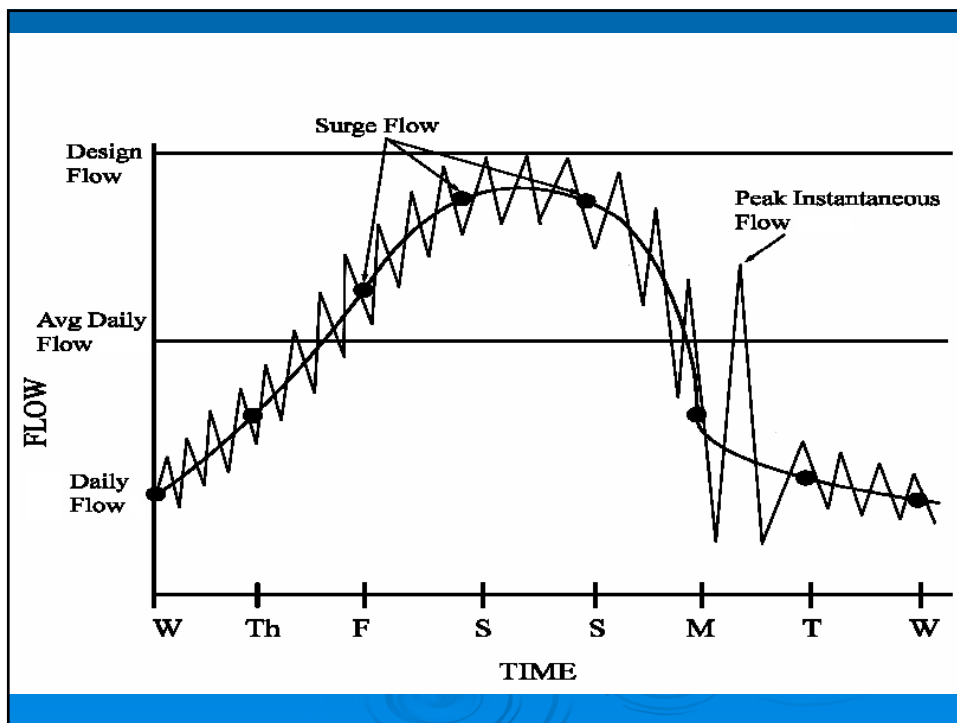
- Wastewater quantity
 - Hydraulic loading
 - Residential 100-150 gallons per bedroom
- Wastewater quality
 - Organic loading
 - Residential < 300 mg/L BOD₅
 - Oxygen demand
- Residential and commercial facilities

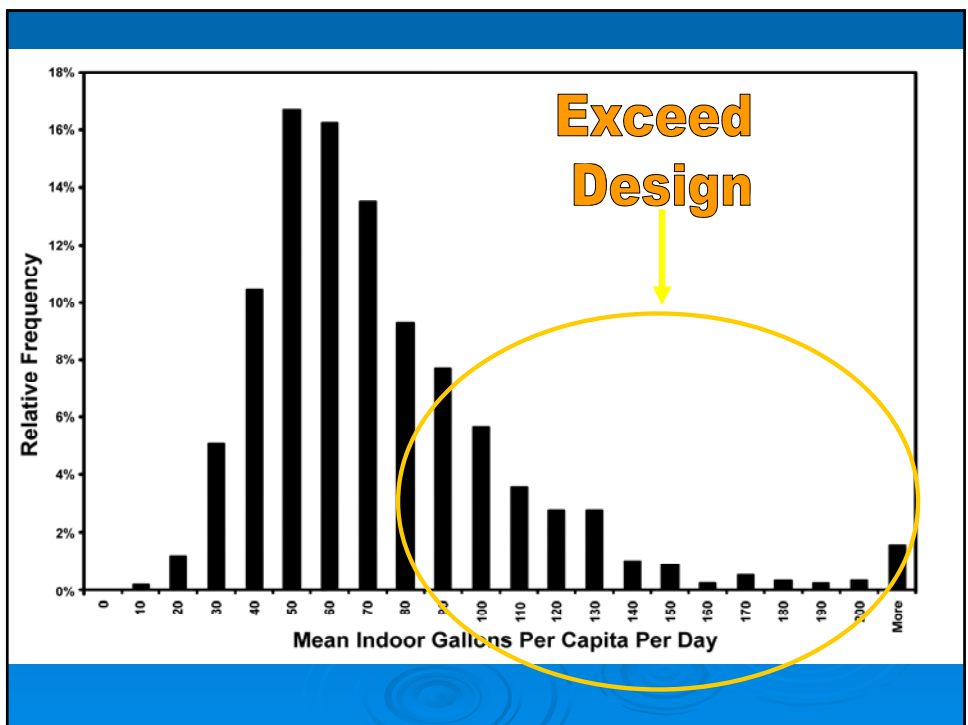
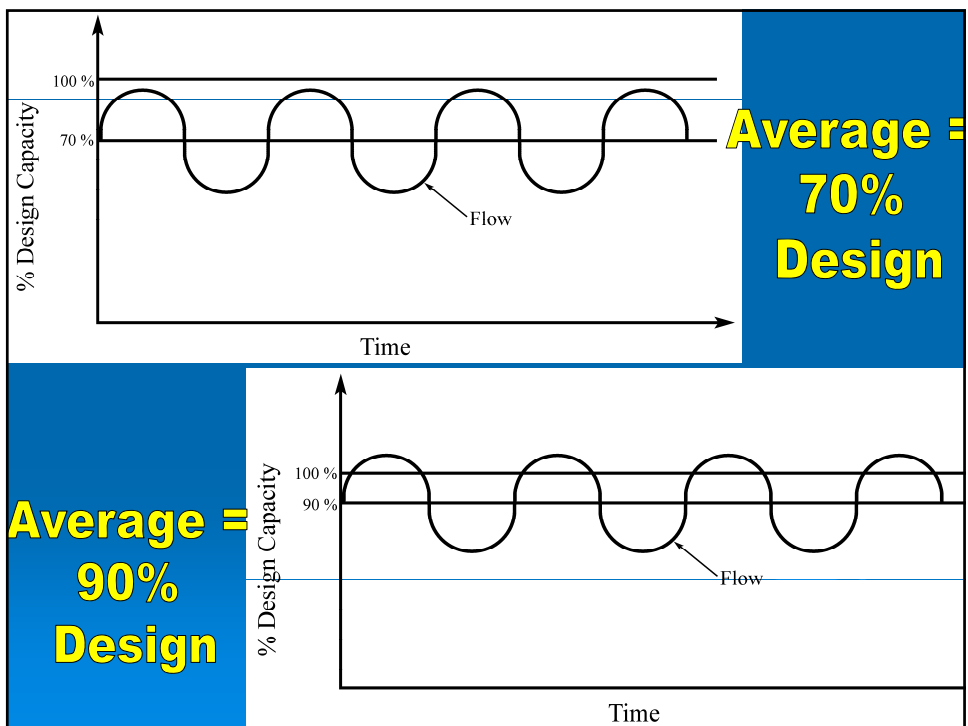


Wastewater Quantity

Types of Flow

- Residential
- Commercial
- Design
- Daily Flow
- Average
- Surge
- Peak
- Seasonal





Commercial Wastewater

- Strength
 - Usually greater than residential
 - Operation based
 - Food preparation
 - Restrooms
 - Laundry



WASTEWATER QUALITY

- BOD
 - Biochemical oxygen demand
- TSS
 - Total suspended solids
- FOG
 - Fats, oils & grease



High Strength Wastewater

1) Influent having

- BOD₅ > 300 mg/L,
- and/or TSS > 200 mg/L,
- and/or fats, oils, and grease (FOG) > 50 mg/L entering a pretreatment component

2) Effluent from a septic tank or other pretreatment component that has:

- BOD₅ > 140 mg/L,
- and/or TSS > 60 mg/L,
- and/or (FOG) > 25 mg/L and is applied to an infiltrative surface.

Mass Loading Calculation

Residential strength

- Calculate mass loading to a system
 - Concentration in wastewater
 - Volume of wastewater
- Mass (lb) = 140 (mg/L) x 200 (gpd) x 0.00000834
- Mass (lb) = 0.23 lbs per day

Commercial strength

- Mass (lb) = C (mg/L) x Q (gpd) x 0.00000834
- Mass (lb) = 600 (mg/L) x 500 (gpd) x 0.00000834
- Mass (lb) = 2.5 lbs per day

Mass Loading

- Calculate mass loading to a system
 - Number of people (capita) & Organic loading rate
- **Mass (lb) = P (# of people) x O_L (lbs per capita- day)**
- **Mass (lb) = 5 (# of people) x 0.17 (lbs per capita- day)**
- Mass (lb) = 0.85 lbs per day
- **Mass (lb) = 5 (# of people) x 0.25 (lbs per capita- day)**
- Mass (lb) = 1.25 lbs per day

Class	Persons Per Unit	gal/cap/day	lbs BOD ₅ /cap/day	
			Average	with Garbage Grinder
Subdivisions, Higher Cost	3.5	100	0.17	0.25
Subdivisions, Average	3.5	90	0.17	0.23
Subdivisions, Low Cost	3.5	70	0.17	0.20

(Goldstein and Moberg, 1973)

Study Participants

- Study conducted by Texas Onsite Wastewater Treatment Research Council
- Contracted with three laboratories to collect samples, analyze samples and report data
- Texas A&M University System Analyzed Data

Restaurants Sampled

- 28 Restaurants
- Types of Restaurants
 - Single service
 - Full service
 - Buffet
- Cuisine types

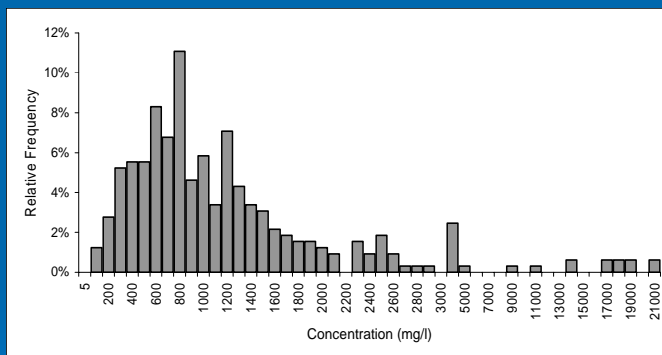


Wastewater Collection

- Three different laboratories
 - Lab A – 10 restaurants
 - Lab B – 9 restaurants
 - Lab C – 9 restaurants
- Sampling program
 - Grab sample (noon to 3 p.m.)
 - Sampling for 6 consecutive days
 - Two sampling events
 - 6 days x 2 events x 28 restaurants = 336 samples
 - Samples collected after grease trap

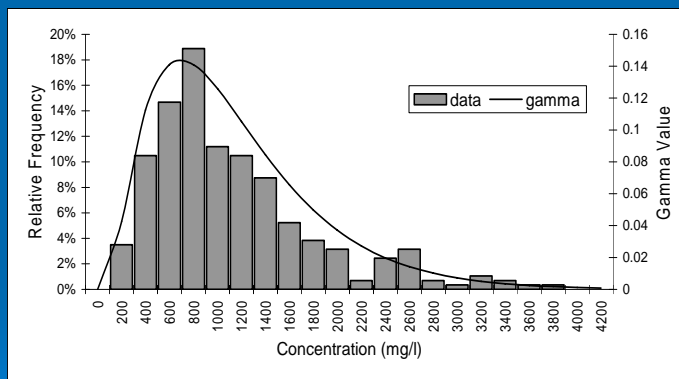
Raw BOD Data

- N= 304
- Max = 20,100 mg/l
- Skewed to right



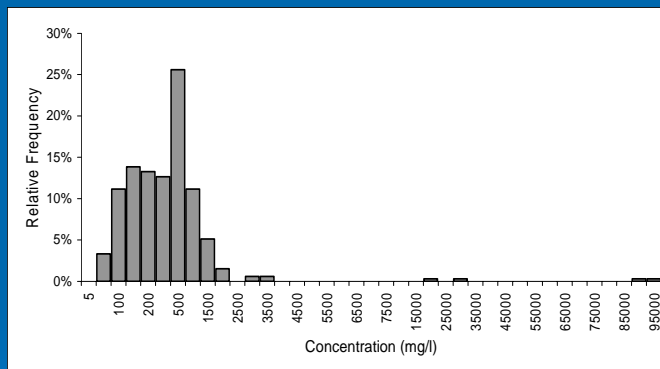
Trimmed BOD Data

- N= 284
- Removed 11 values between 4,100 and 20,100 mg/l
- 9 values TSS/FOG



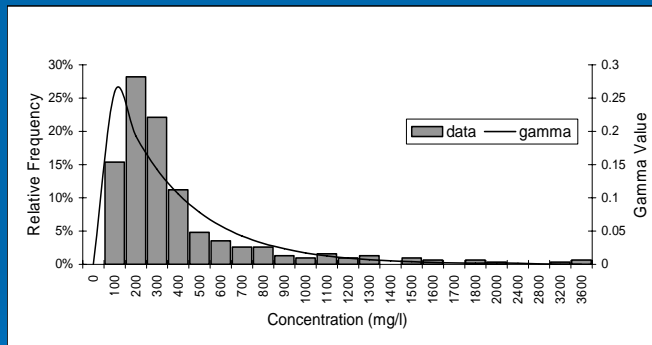
Raw TSS Data

- N= 332
- Max = 91,800 mg/l
- Skewed to right



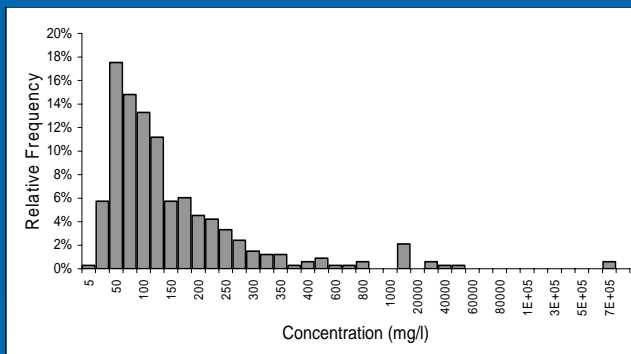
Trimmed TSS Data

- N = 312
- Removed 4 values between 15,100 and 91,800 mg/l
- 16 values BOD₅/FOG



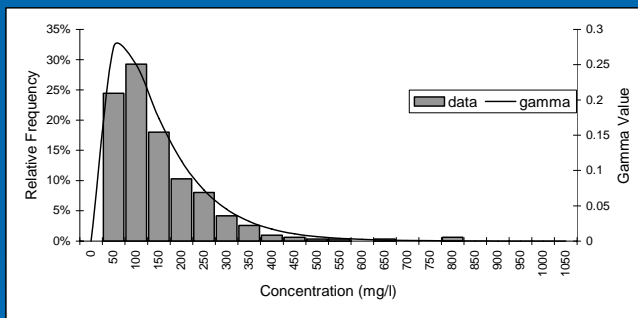
Raw FOG Data

- N = 331
- Max = 700,000 mg/l
- Skewed to right



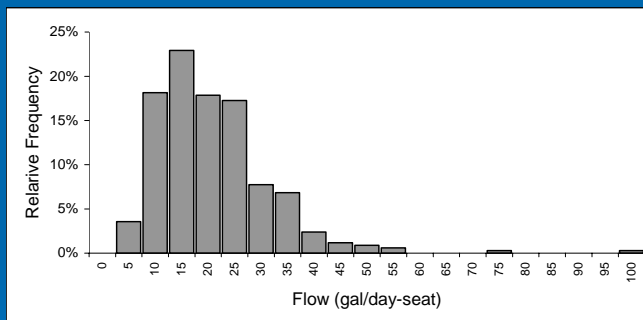
Trimmed FOG Data

- N = 311
- Removed 13 values between 1,129 and 700,000 mg/l
- 7 values BOD₅/TSS



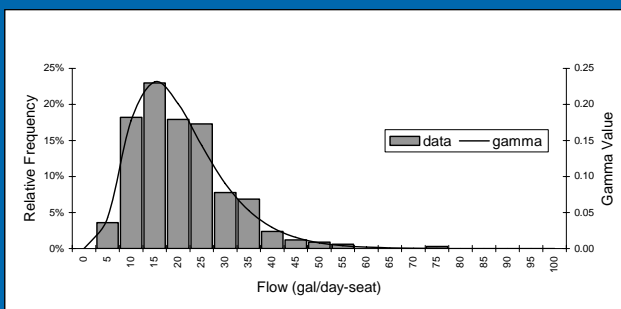
Raw Flow Data

- N = 336
- Max = 97 gal/day-seat
- Skewed to right



Trimmed Flow Data

- N = 335
- Removed 1 value of 97 gallons/seat-day



Summary Statistics

		Raw Data	Trimmed Data
BOD ₅ (mg/l)	Mean	1,584	1,040
	Std. Dev.	2,902	690
	Geometric Mean	932	833
	Geo. Mean + Std Dev.	3,834	1,523
TSS (mg/l)	Mean	1,030	358
	Std. Dev.	7,113	430
	Geometric Mean	257	234
	Geo. Mean + Std Dev.	7,370	664
FOG (mg/l)	Mean	4,520	123
	Std. Dev.	51,400	107
	Geometric Mean	108	90
	Geo. Mean + Std Dev.	51,508	197

Percent of Data Captured (Geometric Mean plus One Std. Dev.)

Parameter	% Data Covered
BOD ₅	82
TSS	87
FOG	81

Design Guidelines

	Burk & Minnis (1994)		Tchobanoglous (1991)			Goldstein & Moberg (1973)	This Study	
	Range	Typical	Weak	Med	Strong		Mean	Mean +Dev
BOD ₅ (mg/l)	100- 400	250	110	220	400	450	1045	1523
TSS (mg/l)	100- 400	220	100	220	350	N.A.	358	664
FOG (mg/)	50-150	100	50	100	150	N.A.	123	197

Management Practices

- After hours cleanup (AHC)
- AHC chemicals used
- Automatic flush fixtures
- Buffet style facility
- Cuisine type
- Food defrosting
- Full service alcohol bar
- Garbage disposal us
- Ice cream/Yogurt machines
- Kitchen laundry
- Lawn Irrigation system
- Low flow fixtures
- Cooking oil type (liquid)
- Cooking oil type (solid)
- Salad Bar (self serve)
- Service type (Full or single)
- Self serve fountain drink
- Number of seats
- Square footage
- Meals served
- Hours of operation

Significant Facility Management Practices (This Data Set)

- Cuisine type
- Salad bar (self service)
- Number of seats

- Note: Self reported data.. Further review of all practices with future studies

Influences of Cuisine Type and Management Practices

Possible Indicator	Final Parameter Estimate
Cuisine Type	--
Primarily Mexican	0.235
Primarily Asian	0.159
Seafood	0.000
Single Service- primarily American	-0.395
Full Service – primarily American	-0.446
Self Serve Salad Bar	0.574
Number of Seats	-0.002
Note: Seafood was arbitrarily set as baseline for the Cuisine type category	

Selecting a design number ?

- Current guidance underestimates waste strength
- What estimate
 - Average
 - Average plus 1 Standard Deviation
- Outliers
 - Poor decisions
 - Management



Summary

- Scoping Study
- Grab samples from 28 restaurants
- BOD₅ Data 2 to 8 times greater than design values
- TSS and FOG are greater than design values
- What design value to choose?
 - Average
 - Average + Std Deviation
- Wastewater strength is still tied to facility practices