Granite State Onsite Wastewater Association
35th Annual Conference and Exposition

Goat Cheese, Craft Wine, and Homemade Process Wastewater

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Goat Cheese, Craft Wine, and Homemade Process Wastewater

- Issue
  - Craft and homemade goods have always been popular, but there seems to be a resurgence in production
    - YouTube is full of "how to do" videos, and folks think they can make some extra money

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Homemade is Always Better, Right?

- It certainly can be
  - remember, there is a reason we pasteurize milk
  - if we make it ourselves, we have to deal with the leftovers
    - not just leftover food, but wasted ingredients
    - and we have to clean all the pots and pans
  - So,
    - we end up with homemade process wastewater

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Large Scale Production

- Even commercial facilities have a hard time with process wastewater
  - a fluid milk plant typically has its own wastewater treatment equipment
    - process wastewater is treated and then sent to the sewer
- Every pipe, vat, tank, container, conveyor, and surface has to be cleaned
  - and then sanitized
    - which is a whole different problem

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Craft Soap

- What are the ingredients?
  - some type of fat or oil that has lots of triglycerides
    - think lard
  - then a strong base – lye
    - sodium hydroxide
    - potassium hydroxide
- Can you think of the problems this could create?

https://thethingswellmake.com/making-a-basic-beginner-soap-and-then-making-it-fun/

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Goat Milk and Cheese

- What are the processes for cheese making?
  - use a lot of milk
  - use rennet and enzymes to coagulate the milk proteins
  - separate out the whey

https://www.castellocheese.com/en-us/cheese-types/goat-cheese/chevre/

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With Milk and Cheese Production

- You have a lot of pots to wash
  - if you don't get your sanitation correct, you can spoil a lot of milk and cheese
  - and sanitizers are rough on septic systems

https://www.cloroxpro.com/products/clorox/broad-spectrum-quaternary-disinfectant-cleaner/

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Do you want Wine with that Cheese?

- Wine Making
  - waste grape juice
  - yeast
  - sludge produced during clarification
  - high sugar content
  - low pH
  - stabilizers
- lots of pots and bottles to wash and sanitize

https://www.thespruceeats.com/muscadine-wine-recipe-3051579

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What about Deer Processing?

- There are many small meat processing operations that will convert your deer into venison
  - may or may not be USDA inspected
    - and USDA doesn't concern themselves about the wastewater
  - blood and visceral
  - wash water
  - sanitizers

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The Craft Industry

- These are just a few examples of kinds of activities that folks may be doing
  - in their spare time
  - or while trying to start a new business
- They are "under the radar"
  - no business license
  - they are working out of a barn or shed

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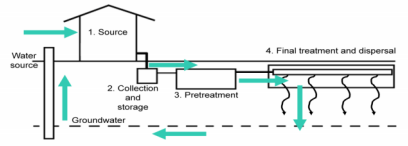
And....

- They don't have a clue as to their potential impact
  - on their septic system
  - or on the groundwater that might be their water source



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So,

- When their septic system fails
  - the owners need to understand that they need a system that can handle their process wastewater
- If the system is built for residential strength and volume
  - it can not handle the extra loading

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We are Working with High Strength Wastewater

- Focus
  - Onsite wastewater treatment systems that service
    - rural gift shops
    - residential kitchens that should be commercial
    - small wineries and craft food production
  - We have to understand
    - the flows into the system
    - what is in the water

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Milk Products and Oxygen Demand

Product	BOD_5 (mg/L)	COD (mg/L)
Whole Milk	114,000	183,000
Skim Milk	90,000	147,000
Buttermilk	61,000	134,000
Cream	400,000	750,000
Whey	42,000	65,000
Domestic Sewage	300	500

Source: Treatment of Dairy Processing Wastewaters, Britz, van Schallkwyk, and Hung, 2006, Taylor & Francis Group

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System Design

- We typically base the onsite system design on daily water volume - hydraulic flow
  - size of septic tank
  - size the soil treatment area
    - in combination with soil evaluation
- However, this assumes residential strength

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Primary Issue

- With high-strength wastewater
  - we have to protect the soil treatment area
- How
  - need to remove the high strength constituent before it damages the soil treatment area
  - need to increase the size of the soil treatment area in relation to the high-strength constituent
  - equalize the flow to reduce peak discharges

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You may Need to Design for High Strength Wastewater

- Wastewater stream with concentrations greater than residential
  - BOD_5 – 300 mg/L
  - TSS – 200 mg/L
  - FOG – 50 mg/L
  - other constituents

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Biochemical Oxygen Demand (BOD_5)

Range: 110 - 300 mg/L

Typical value: 140-170 mg/L (Effluent)

120 mg/L and 10 mg/L

Over 600 mg/L

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Measuring Oxygen Demand

- Biochemical Oxygen Demand – BOD_5
  - dissolved oxygen consumed by microbes during 5-day test
- Chemical Oxygen Demand – COD
  - oxygen needed to break down organic matter using strong oxidizing agents
    - approximation of BOD
    - quicker test than BOD
    - measure of biological inhibitors

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I mentioned "Sanitizers"

- This is why you need both BOD_5 and COD tests
  - BOD_5 is based on a microbial response, organic matter is bio-oxidized over a 5-day period
  - if sanitizers prevent microbes from doing their job,
    - the BOD_5 test is faulty
  - sanitizers can also kill your wastewater treatment system

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What about Total Suspended Solids (TSS)

- Range: 44 - 200 mg/L
- Typical value: 80 mg/L

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TSS impacts on treatment

- High levels lead to clogging
- Reduce efficiency of treatment system
- Block or plug distribution pipes
- Seal off and plug voids in soil and filters
- Neutral buoyancy solids do not settle
  - stay in suspension in the tank "clear zone"
  - may carry over to next treatment step

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Fats, Oils, and Greases (FOG)

Range: 10 - 50 mg/L
Typical value: 15 mg/L

Assumes residential strength wastewater

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Fats

- Origin:
  - animal fats
  - lard, meat fat, butter
- State:
  - solid at room temperature
- Treatment:
  - separate into scum, microbial degradation, non-toxic, sticks to components in the tank

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Oils

- Origin:
  - vegetable or plant
- State:
  - liquid or solid at room temperature
- Treatment:
  - separate into scum, microbial degradation, non-toxic, stays in liquid area in tank

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Grease

- Origin:
  - petroleum product
- Example:
  - sun tan lotion, petroleum jelly, bath & body oils.
- State:
  - solid or liquid at room temperature
- Treatment:
  - separate into scum, toxic to microbial activity

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System Impacts

- Fats, oil, and grease
  - Add to septic tank scum layer
  - Clog pipes, treatment systems, soil treatment areas
  - Coats media
  - Collect and harden on surface, entraps organic matter and other materials
  - Cause foul odors and attract insect pests
  - Creates a high oxygen demand

FOG

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pH

Range: 6.5 – 8.0 Typical value: 7.0
Biological life: 4.5-9

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What will effect pH?

- Low pH: acids (sour odor indicator)
  - Milk products, sugars, flour, canning
  - Acid cleaners
- High pH: basic (chemical odor indicator)
  - Ammonia
  - Cleaners
- Both low and high readings cause lethargic microorganisms

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Temperature (˚F)

Range: 37 – 81˚ F Typical value: 60˚ F
Optimal for biological activity: 77-95˚ F

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What Influences Temperature?

- Source water temperature
  - (well vs. surface vs. utility)
- Wastewater exiting facility
- Holding/detention time
- Air temperature
- Soil temperature
- Commercial – hot water

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Working with High Strength Wastewater

Protecting the Soil Treatment Area

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Design Considerations

- Pre-Treatment
  - reduce the high-strength constituent
- Sizing the soil treatment area for the load
  - spreading the constituent out over a greater area
- Flow equalization
  - optimize the treatment system
  - protect the infiltration area

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Pre-Treatment

- Liquid/solid separation
  - grease trap/interceptor
  - septic tank
  - effluent screen
- Oxygen demand removal
  - advanced treatment with aerobic systems
- Chemical amendments
  - acid/base

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Fats and Oils

- Watch the temperature
  - flow from commercial dishwashers can raise temperature in liquid/solid separation tanks
  - prevents oils from rising to scum layer
- Watch detergents
  - emulsifiers – maintain fats & oils in suspension
- Use garbage cans for food scraps
  - before the pre-wash

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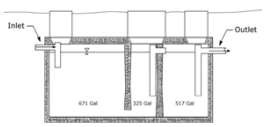
Grease Trap/Interceptor

- Different from a septic tank
  - longer baffles
  - typically, traffic rated
  - usually based on two days of hydraulic retention time



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Separate the Flows

- Commercial kitchen or butcher shop wastewater
  - grease trap/interceptor
  - then septic tank
- Commercial laundry wastewater
  - lint screen
  - then septic tank
- Restrooms
  - straight to septic tank

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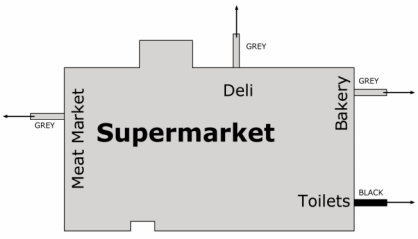
Diversity of flows from a Rural Supermarket



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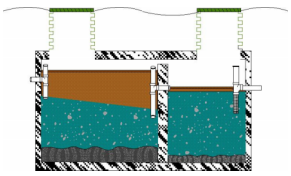
Septic Tank

- Sized for two days of hydraulic detention
  - Keep fats and oils out of septic tank
  - two section with baffles
  - effluent screen
  - risers



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Sludge levels

- Indicates amount of settling in tank
  - Use sampling probe (sludge judge or dip stick)
  - Should be three distinct layers if functioning properly
  - Heavy accumulation means excess inputs (garbage disposal?)

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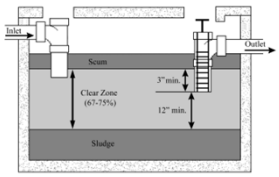
When to pump tank

- 25 – 33 % of operating volume of tank
- High risk pump more often



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Effluent Screen

- Placed in outlet of septic tank for additional filtration
  - screens solids
  - requires periodic cleaning
  - need for frequent cleaning is an indicates organic overloading

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Oxygen Demand Removal

- Advanced treatment
  - make a happy home for microbes to digest organic matter
- Aerobic treatment
  - fixed film
  - suspended growth

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Fixed Film Process

- Microbes are attached to the media
  - Microbes have a home and tend to store food
- Greater mixing to bring food/oxygen to microbes
- FOG control is very important
  - fats, oils, & grease will coat the media
  - difficult to digest

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Media Filters

- Effluent percolates through the media to an underdrain system where it is collected for further treatment.
- Media is never saturated; the presence of air promotes establishment of favorable microorganisms.

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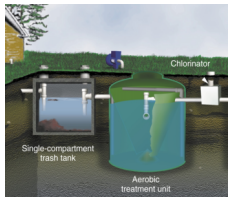
Suspended Growth Unit

- Microbes are suspended in water
- Free swimming
- Mixing brings microbes in contact with food



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Remember the Goal

- To protect the soil treatment area from being clogged by excessive organic matter
  - size advanced treatment system for the organic loading
- Undersized:
  - organic matter will move through undigested
- Oversized:
  - insufficient bacteria population available for treatment

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Sizing the Soil Treatment Area to Handle the Organic Load

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How Much Organic Matter can the Soil Handle?

- Depends on the soil
- We evaluate the soil for hydraulic loading with the assumption of residential strength
- Again
  - what if we don't have residential strength?

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Mass loading

- Calculate mass loading to a system
  - Concentration of constituent in the wastewater
- Mass (lb) = $\frac{C\ (mg/L) \times Q\ (gpd) \times 8.34}{1{,}000{,}000}$
- Mass (lb) = C (mg/L) x Q (gpd) x 0.00000834

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How to Calculate Soil Mass Loading

200 (GPD) x 140 (BOD_5)(mg/L) x 0.00000834 = 0.23 lb/day

For soil loading

0.23 lb/day ÷ absorption area square feet = lb/square foot/day

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Example Soil Loading Chart

Soil classification	Hydraulic loading (gal/ft²-d) R_a	Organic loading rate lb/ft²-d R_{OL}
Sandy	0.38	0.00044
Sandy Loams	0.25	0.00029
Loamy Silt	0.20	0.00023
Clayey	0.10	0.00012

- Organic loading rate based on the assumption of BOD_5 =140 mg/L before entering soil treatment area

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Example

- Daily volume is 600 gpd
- Soil rated for 0.25 gpd/ft2
  - hydraulic loading rate
- Effluent BOD_5 is 200 mg/L
  - higher than 140 mg/L
- How much bigger does the soil treatment area need to be?

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Infiltrative Surface Area (A_{OL})

$$A_{OL} = [(BOD_{Eff} / 140) \times (Q / R_a)] / 0.70$$

- Where:
  - A_{OL} =Infiltrative surface area (ft²)
  - BOD_{Eff} = Facility BOD (mg/L)
  - Q = Flow (gpd)
  - R_a = hydraulic acceptance rate (gpd/ ft²)
  - 0.70 = Safety factor

Note: This equation uses an example assumed value for septic tank effluent of 140. If the local code R_a values are based on an assumed BOD_5 other than 140 mg/L, use that value instead.

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Calculation

$A_{OL} = [(BOD_{Eff} / 140) \times (Q / R_a)] / 0.70$

$A_{OL} = [(200 / 140) \times (600 / 0.25)] / 0.70$

$A_{OL} = 4{,}900\ ft^2$

If wastewater had been residential strength

$A_{OL} = (600 / 0.25) / 0.70 = 3{,}430\ ft^2$

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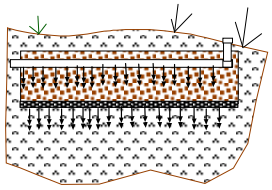
For High Strength Wastewater

- Use pressurized distribution
  - Distributes effluent in space and time
  - Facilitates unsaturated zone below infiltrative surface
- Biozone
  - Effluent treatment
  - Biofilm development on particles
  - Time for soil treatment



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Flow Equalization

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Wastewater loading

- Wastewater quantity
  - total daily volume
    - 600 gpd
- Would it change the design
  - if all that water was produced in two hours?

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Hourly Variation in Wastewater Flow

- Restaurants
  - dishwashing & food prep
- Schools
  - lunch time & ballgames
- Grocery Stores
  - nighttime cleaning activities, monthly floor stripping and cleaning activities

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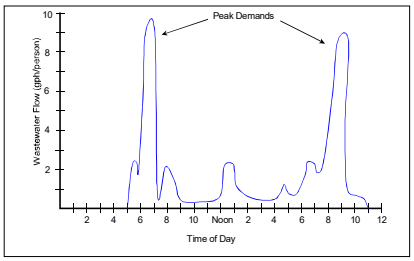
Hourly Variation in Wastewater Flow



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Inflow Rate

- Inflow rate can change the effectiveness of
  - grease traps/interceptors
  - septic tanks
  - aerobic treatment units
- Basically
  - flow in equals flow out
  - disrupt settling
  - water moves through components too quickly

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Peak flows

- Estimating peaks
  - Home - 16 hours
  - Commercial - hours of operation
    - 24 hour
    - Dinner only (4-5 hours)
  - Runoff period
    - Open hours + prep & cleanup
    - May need to check more closely on hourly basis

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Managing Hydraulic Loads

- Need to determine the length, timing and volume of peak flow.
  - Residential typically diurnal pattern
  - Restaurants typically about 2 hours after lunch and dinner.
    - Clean up time
  - But you need to consider that the water use habits may not be "typical"

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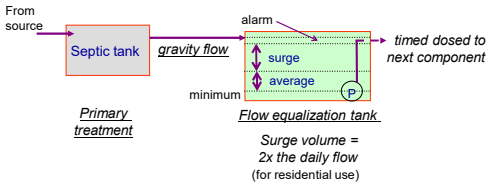
Equalization Tank

- Presence indicates time dosing
- Typically sized to hold 2 X daily flow



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Do not Totally Rely on Published Design Criteria

- Getting real values for
  - daily wastewater volume
  - peak wastewater flow rates
  - organic loading
  - temperatures
- Is critical for successful design and installation
  - find similar facility

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Data Required

- Flow characteristics:
- Average daily flow
- Peak flow
  - Regular highs
  - Weekly
  - Monthly
- Special occasions
  - How often: annually/ bi-annual, monthly?
  - can we get porta-potties for special occasions?

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Flow Equalization Systems

- Makes the flow introduced to the treatment system more consistent.
- Flow equalization is important if:
  - Water use habits or facility operations are variable-
    - Example: church only open on Sun.
  - Frequent peaks exceed system capacity
    - Wash day: cleaning service

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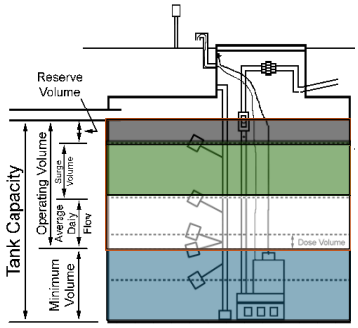
Required Volumes



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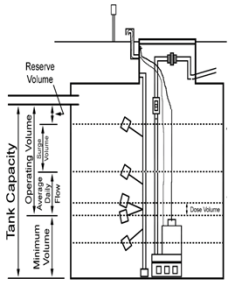
Calculating Tank Storage for Equalization

- Measure the flow
  - Read meter
  - Calculate flow
- Calculate volume in tank
  - Daily flow - timed dose



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Calculating Tank Storage for Equalization (cont)

- Necessary storage
  - Surge volume
  - Storage volume [surge volume + avg.]
- Operating volume
  - Storage volume + reserve volume
- Tank capacity
  - Sum all necessary volumes [min.+ operating]

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Summary

- Most all of the regulations are based on what we have learned about residential strength wastewater
  - however, if some component of the wastewater is greater than residential strength
  - then it must be treated as high strength
- We have to protect the infiltrative surface within the soil treatment area
  - or wastewater will rise to the ground and the system will fail

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Summary

- Three ways to work with high strength wastewater
  - remove the high-strength component before it reaches the soil treatment area
  - increase the size of the soil treatment area in proportion to the high-strength component
  - equalize the flow to the treatment system and to the soil treatment area

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Thank You


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