

Things I learned during my years of work with Title 5.

WMPHA

October 2023

Roland (Joe) Dupuis

Things I learned

Gravity Flow

What is it?

Things I learned

Gravity Flow



It is a RATE of flow over a period of time



Produces a VOLUME



This rate of flow (gph) X its duration (hours)

Things I learned

Gravity Flow

- All onsite Title 5 systems have gravity flow
- The rates of flow and their respective duration vary over the day
- It also varies from day to day, weekends being even more varied

Things I learned

**Gravity
Flow**

What causes
these
variations?

Things I learned

Gravity Flow

A number of things site specific to the residence

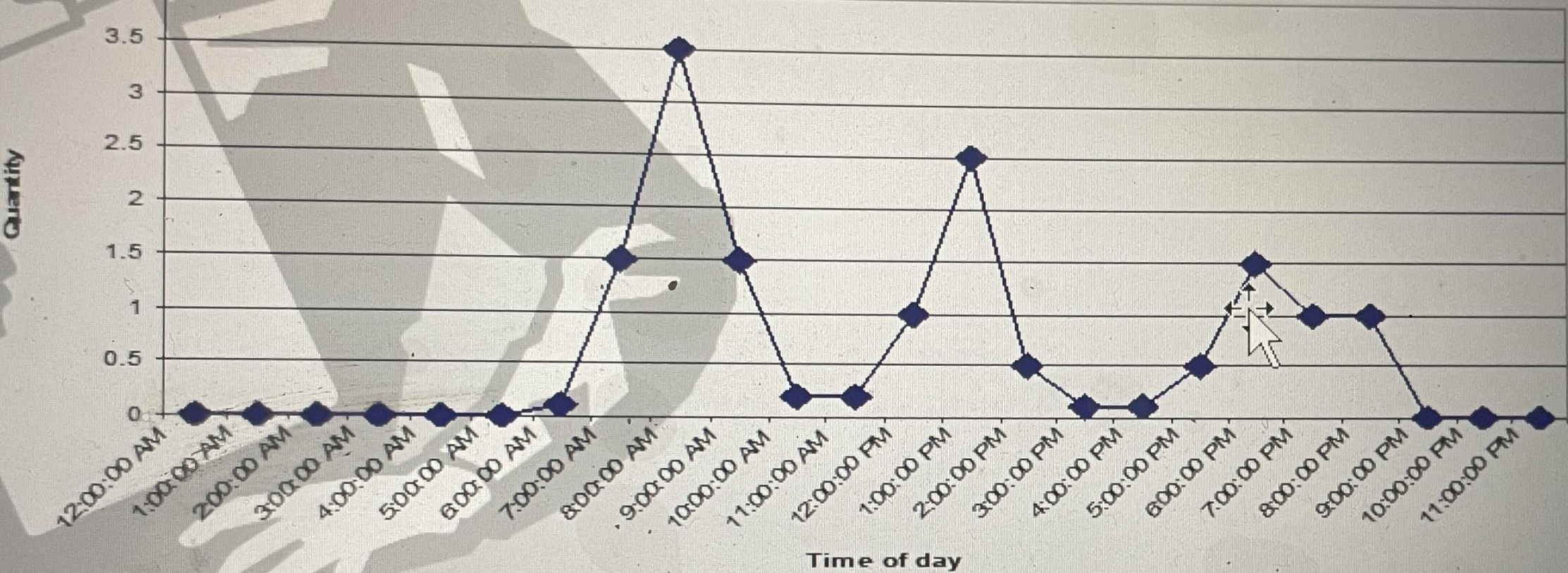
- Age and number of occupants
- Is house occupied during the day
 - Both adults working
 - Children at school
- Number of bathrooms

Things I learned

Gravity Flow

4. Number of showers taken and when
5. When is laundry done
6. Is more than one appliance run simultaneously
 - a) i.e. dish washer, washing machine, showers in more than one bathroom at same time





Things I learned

- **Gravity Flow**
 - Typical flow pattern for residence in a 24-hour time frame
 - Note times of no flow

Things I learned

Gravity Flow

- With these variable rates of flow with different durations of time and occurrences
- Makes designing them difficult
- However, there is guidance

310 CMR 15.0 (Title 5)

Things I learned

Gravity Flow

Values in 310 CMR 15.0 (Title 5) are not volumes

They are gravity peak rates of flow

Intended use is to properly size

Septic tanks

Leach fields

Things I learned



Gravity Flow



?

How many of you knew this or realized this before?

SHOW OF HANDS



Things I learned

Gravity Flow

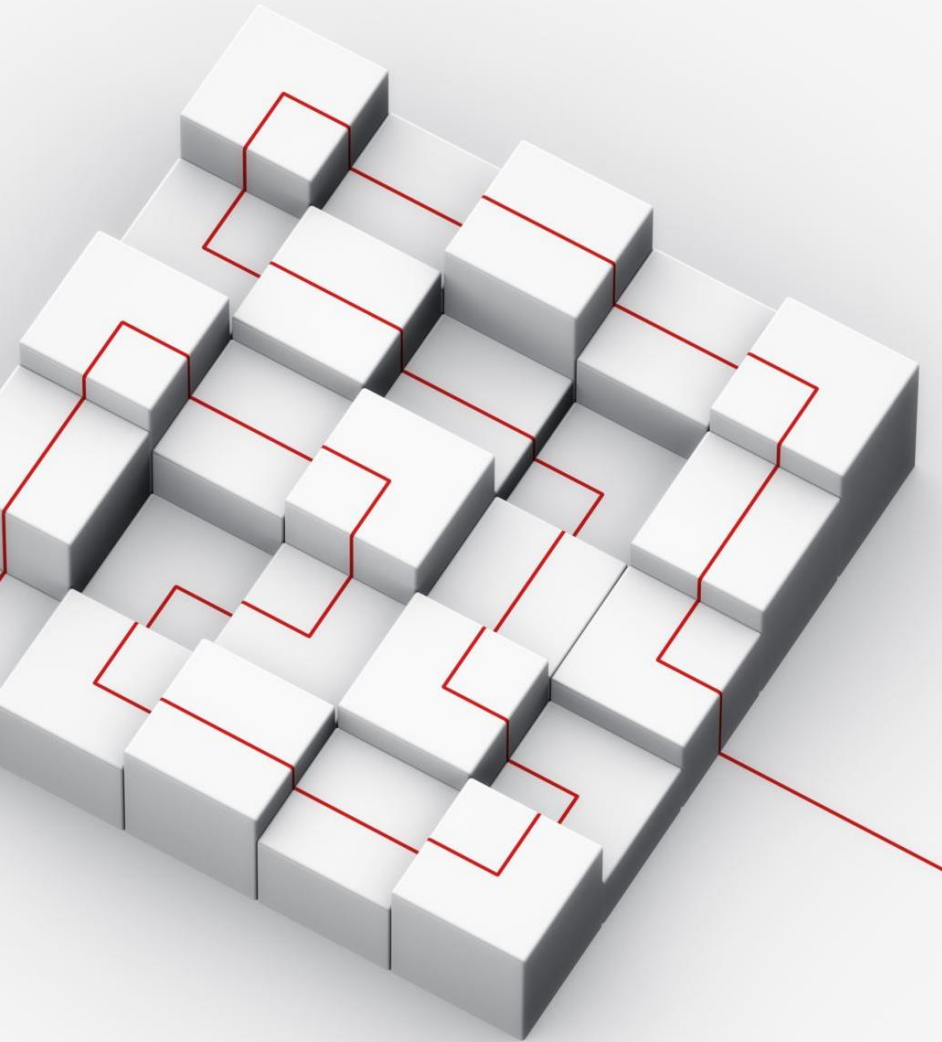
1. Onsite system design is not taught in schools
2. It is acquired through seminars such as this
3. It is acquired through your own personal encounters with your designs or review of other's designs

Things I learned

Gravity Flow

1. On overlooked aspect of gravity flow that is – slope!
2. Too steep of a slope of pipe for gravity flow can cause problems.

Where?



Things I learned

Potential Problem Areas

1. Entrances to D-Box
 - a) Straight in
 - b) With a 90-degree bend at entrance of box (Not recommended)
2. Entrance to septic tank

I know the code specifies what slope to use

But

Things I learned



Recently, I reviewed a design for a client of mine who had an abutter replacing a leach field.



This was around a lake, where all the systems were approved by Article XI of The Sanitary Code.



There is a shallow well which was 50 from the leach pit.



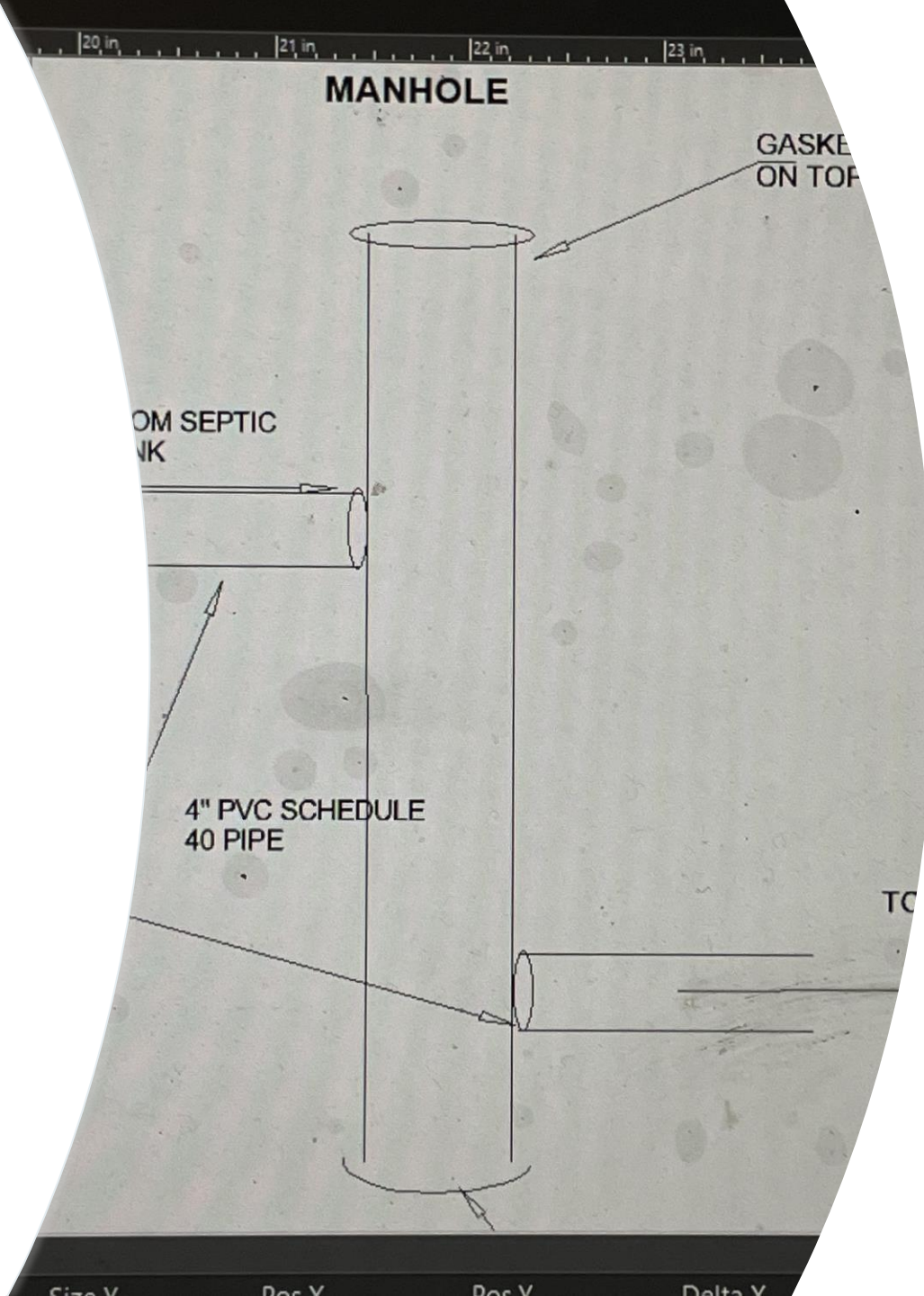
Replacing the leach pit with septic tank and field posed a problem.

Things I learned

Problem ?

- Slope of the land
- Too steep of a slope will create a higher velocity
- This in turn will leave solids behind causing a blockage

Things I learned



- Gravity Flow High Velocities
 - How to reduce high velocities between septic tank and D-Box
 - Install a drop box.
 - What is a drop box



Things I learned

Gravity Flow

As a result, from my experiences

I classify

“Gravity flow”

AS COMPRESSED

It occurs within certain time frames within a day

Things I learned

In my professional work
experiences of 54 years

My specialty is treatment plants

I have encountered the
“Clean Water Act of 1969”

I have encountered DEP
classifying **“All ground Water
Drinking Water”**

**Each of these posed problems for
the design and approval personnel
which required training**



Things I learned

- The IA treatment technologies approved by DEP work, or they would not be listed in the IA listing.
- However, how a designer locates and under what conditions the treatment technology is put in or exposed to is unknown.
- This lack of guidance can create condition that impact the desired treatment results.





Things I learned

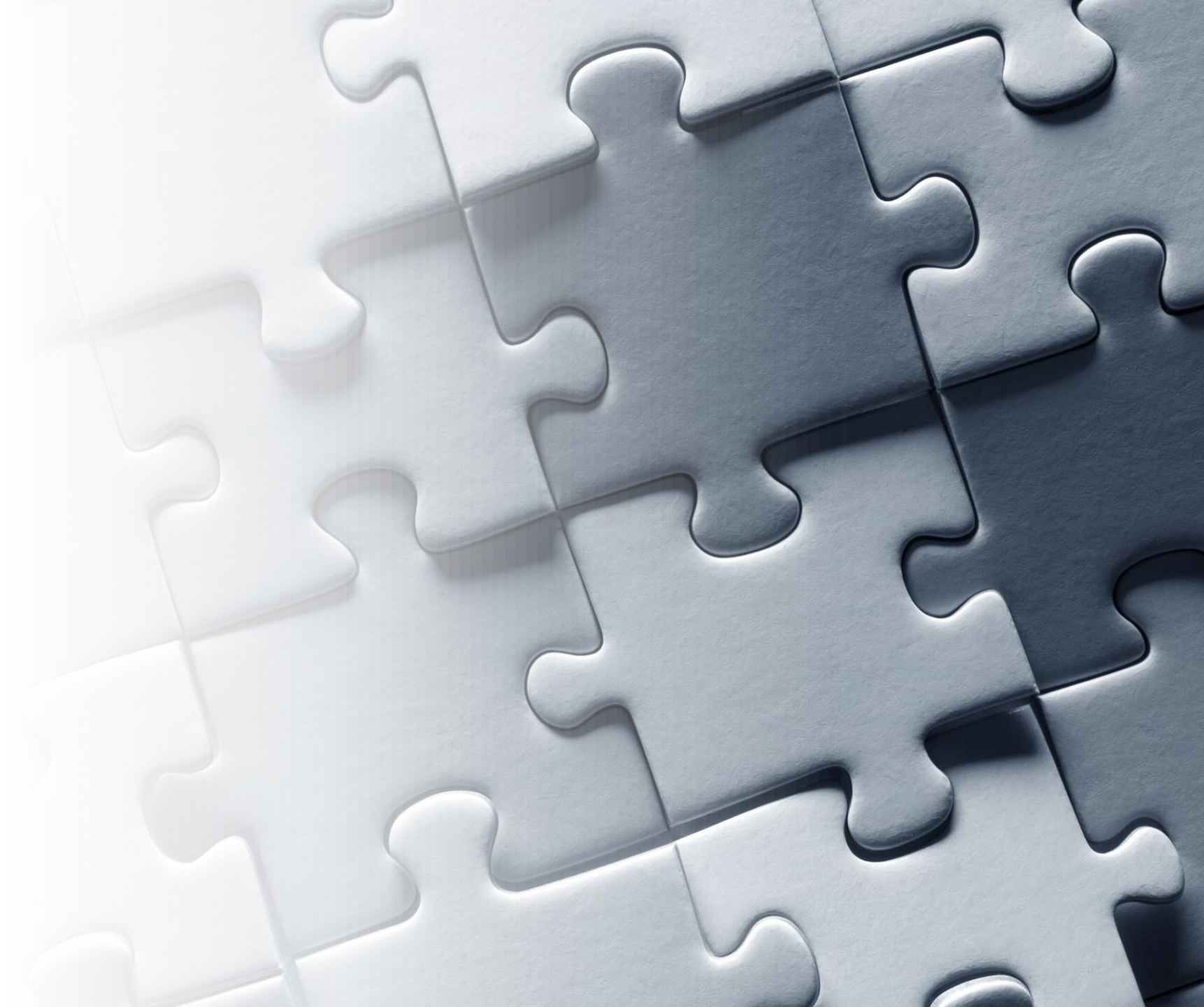
After transferring from the
Region in DEP

to

Technical Assistance in DEP

In addition to training and
trouble shooting municipal
plants

IA technology came within my
duties until my retirement





Things I learned

In 1995 DEP proposed that all flows to leach fields be pressure dosed.

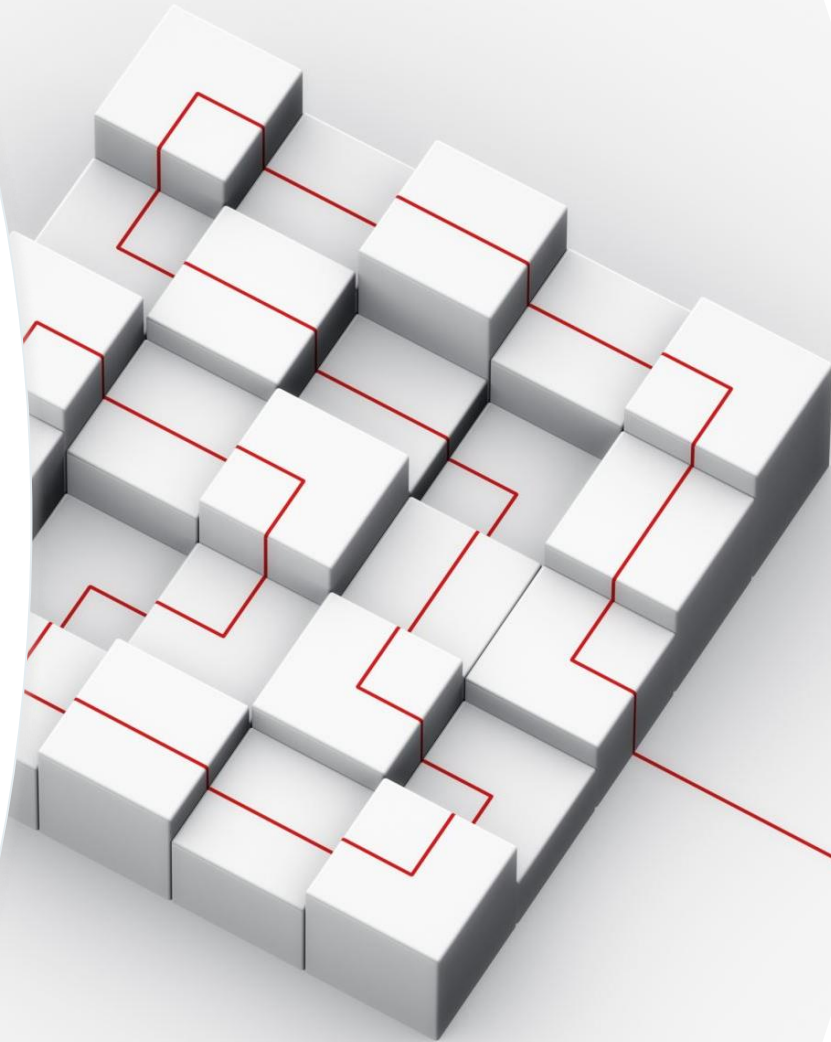


The out cry from boards of health was deafening – opposed!



I suspect it was because of the problems gravity flow could have on the yet to be designed and approved IA technology to come

Things I learned



As a result of my specialty (treatment Plants)

Most of my designs involved treatment

One of my design was in a pilot stage

This required testing and reports submittal

This led to the eventual approval of that technology

Things I learned



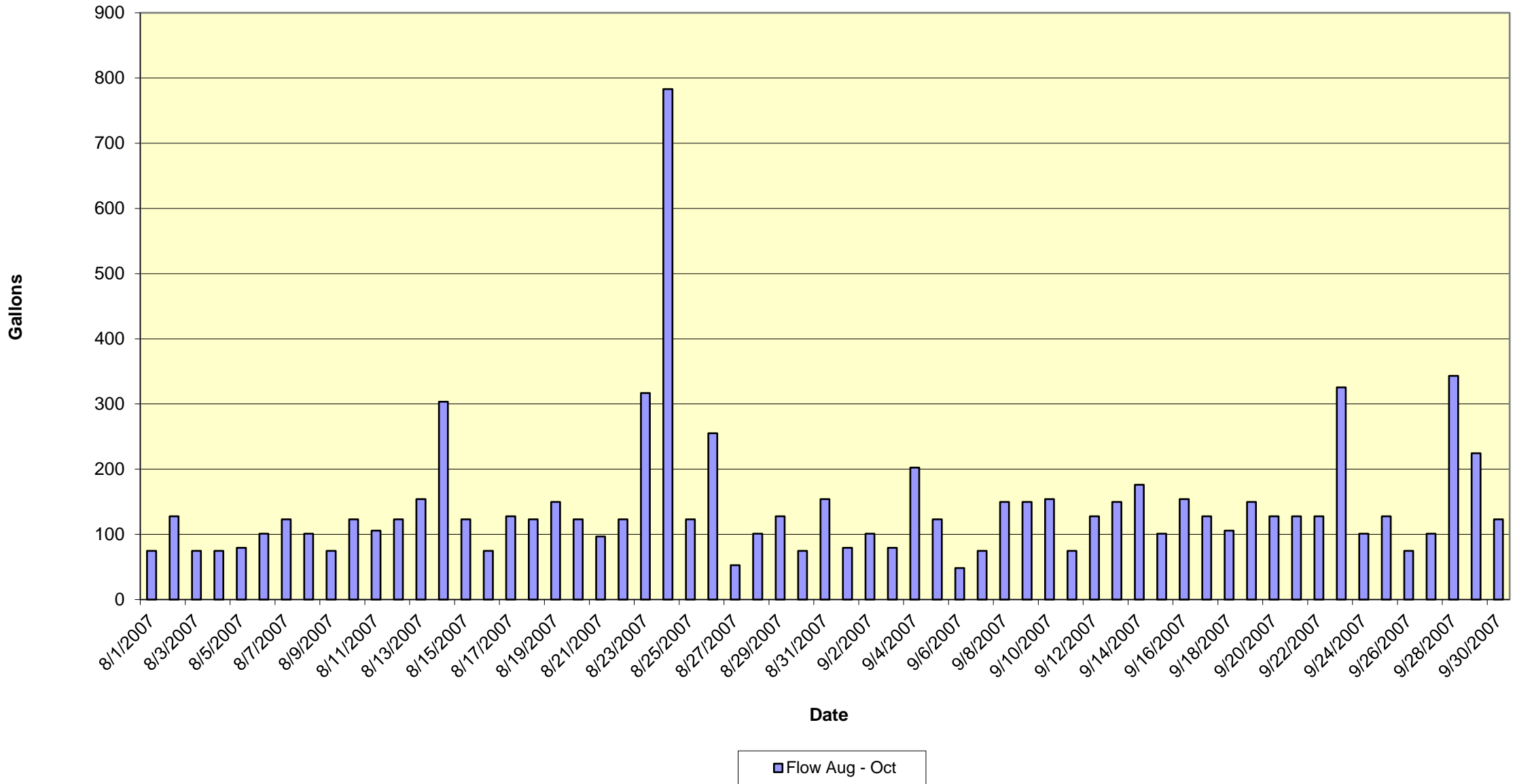
Gravity Flow

The following graphs that are shown are from a pilot design

In a 3-bedroom house with 2 bathrooms

4 adults and young child

Flow Aug - Oct

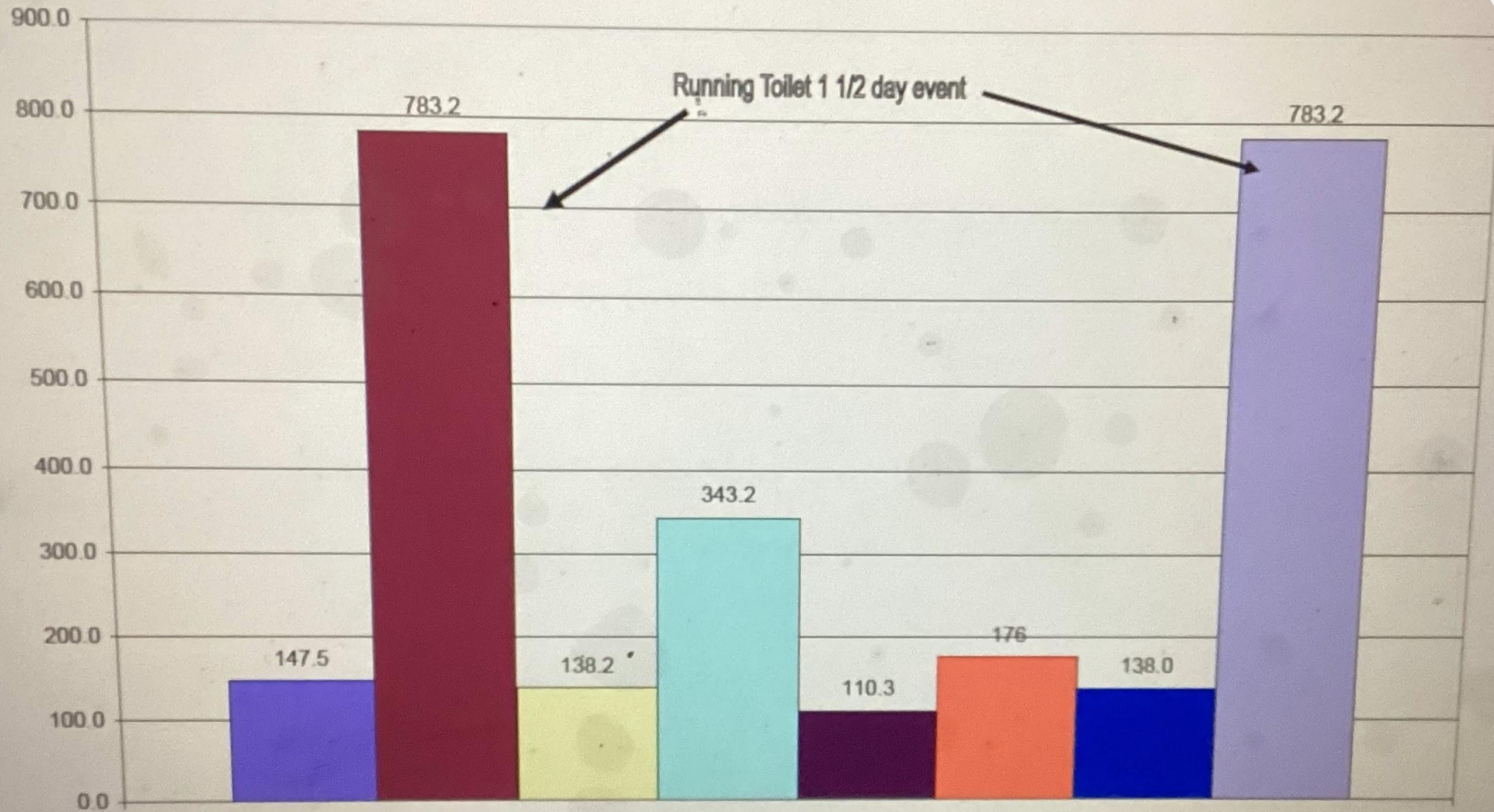




What caused that peak flow?

Leaking toilet

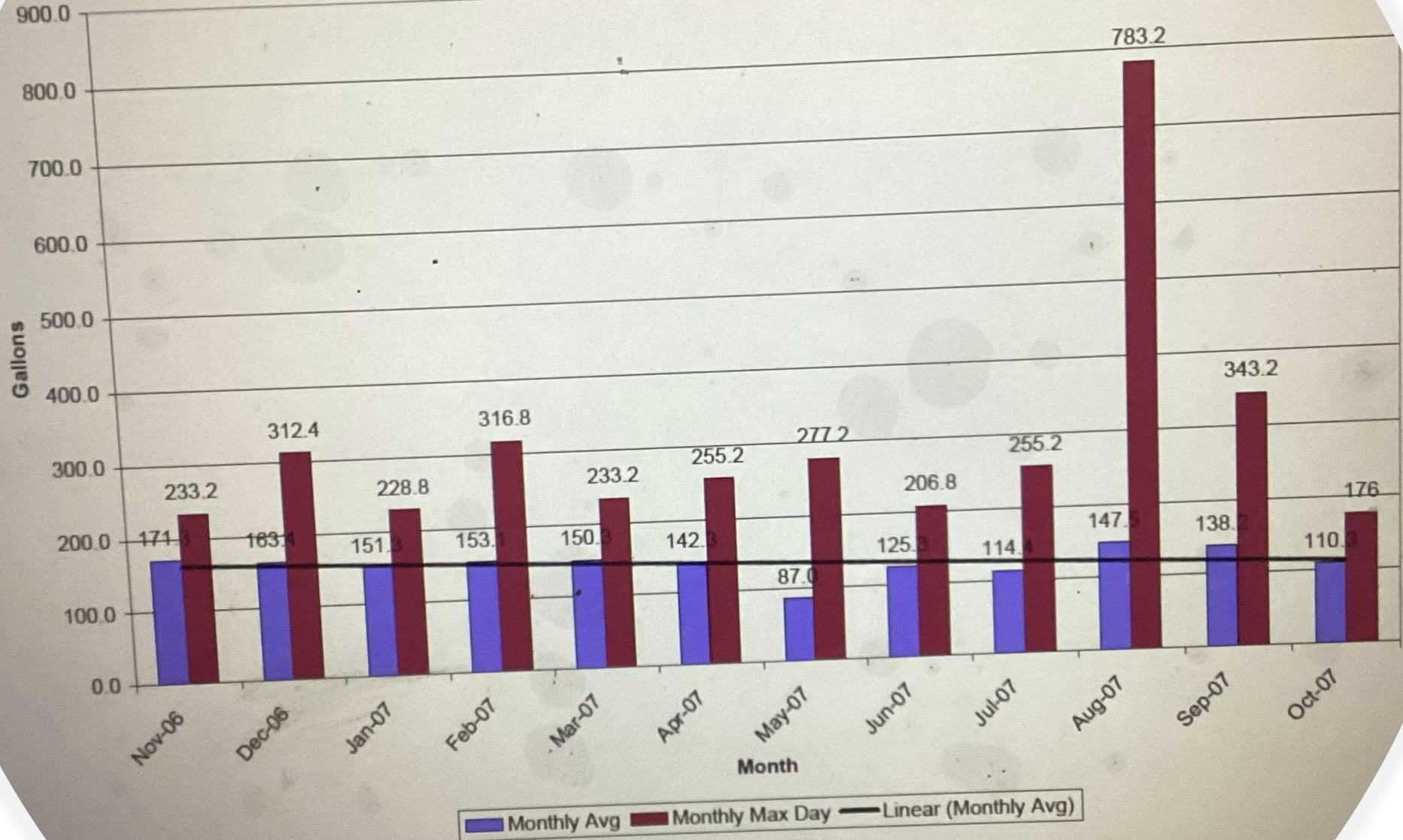
Forth Quarter Values

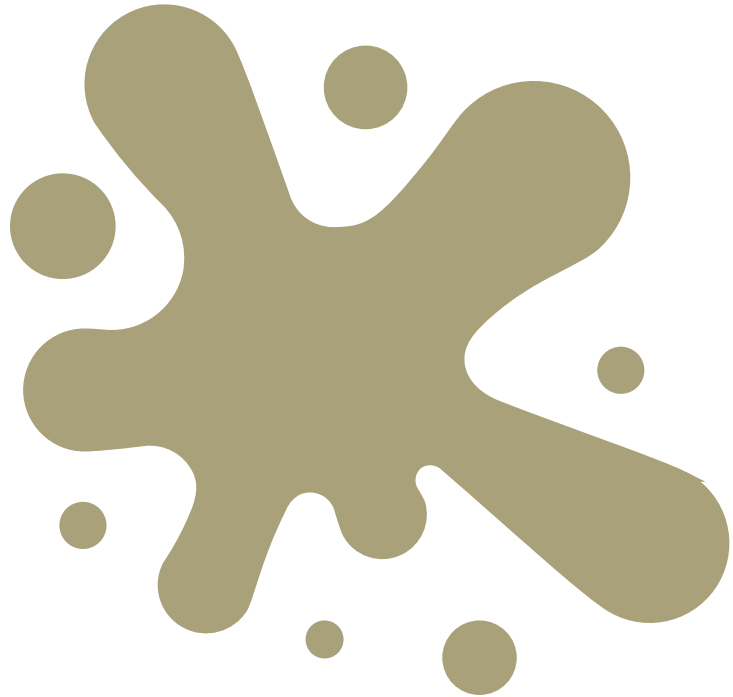


Months Aug, Sept & Oct

■ Aug Avg ■ Aug Max Day ■ Sept Avg ■ Sept Max Day ■ Oct AVG ■ Oct Max Day ■ Qtr Avg ■ Qtr Max Day

Monthly Avg & Max Day





Things I learned

Grease Tanks

I classify

“Gravity flow”

AS COMPRESS

Things I learned

Grease Tanks

1. All tanks should be viewed to be in a compressed flow mode for design purposes
2. These required for kitchen waste discharges
3. Very few restaurants / cafeterias are open greater than 12 hours
4. The Title 5 size of a 1000 gallons is inadequate
5. The Mass Plumbing code has an excellent instructions to size a grease tank



Things I learned

Grease Ranks

1. All grease tanks must be inspected monthly for depth of grease in the tank
2. Once depth is 1.5 feet in a 4-foot tank it must be pumped
 - Rule of thumb for tanks deeper than 4 feet - once depth of grease is 37.3 % of tank depth pump it
3. Tank must be pumped every 3 months, regardless of grease depth

Chart 1

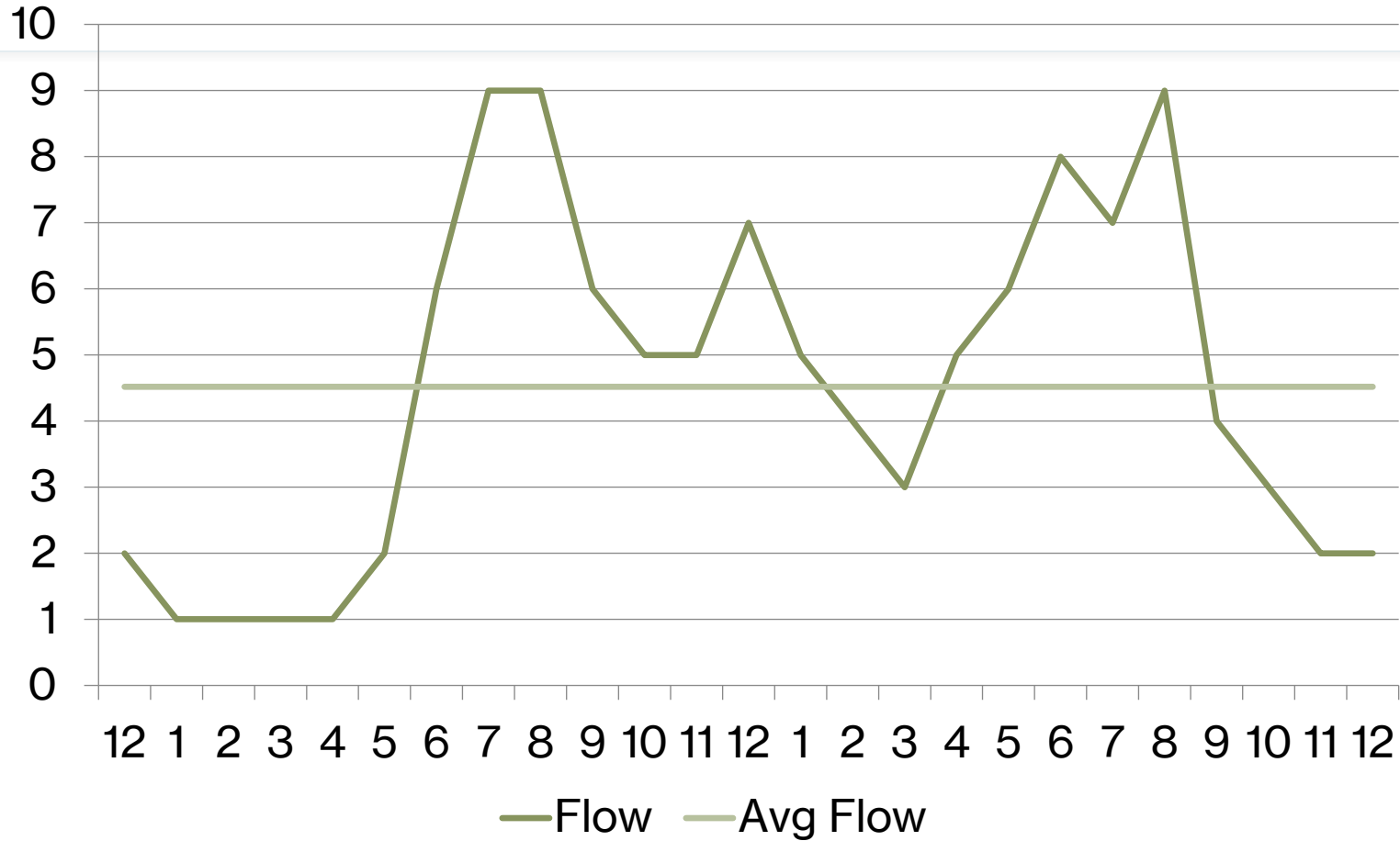
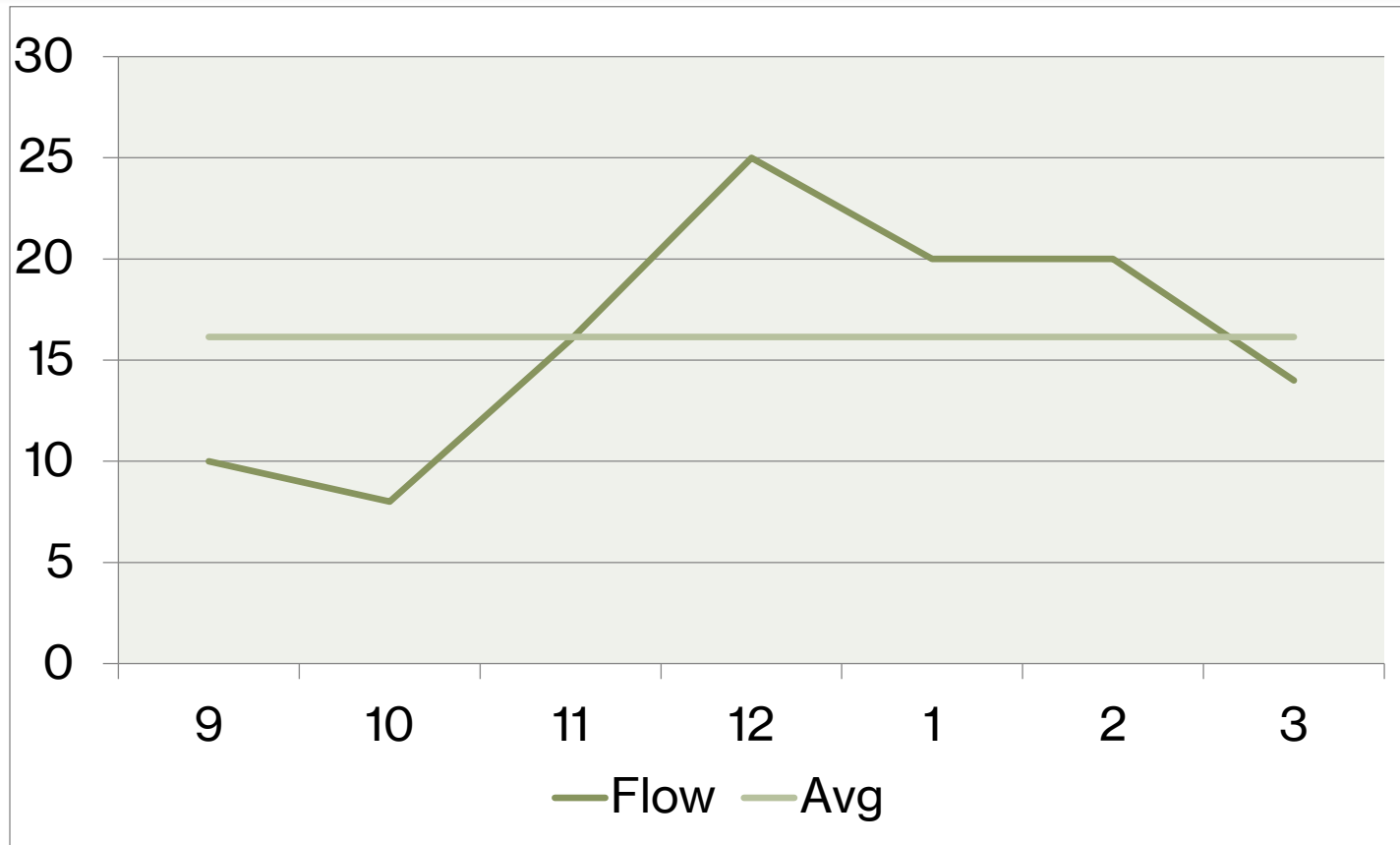
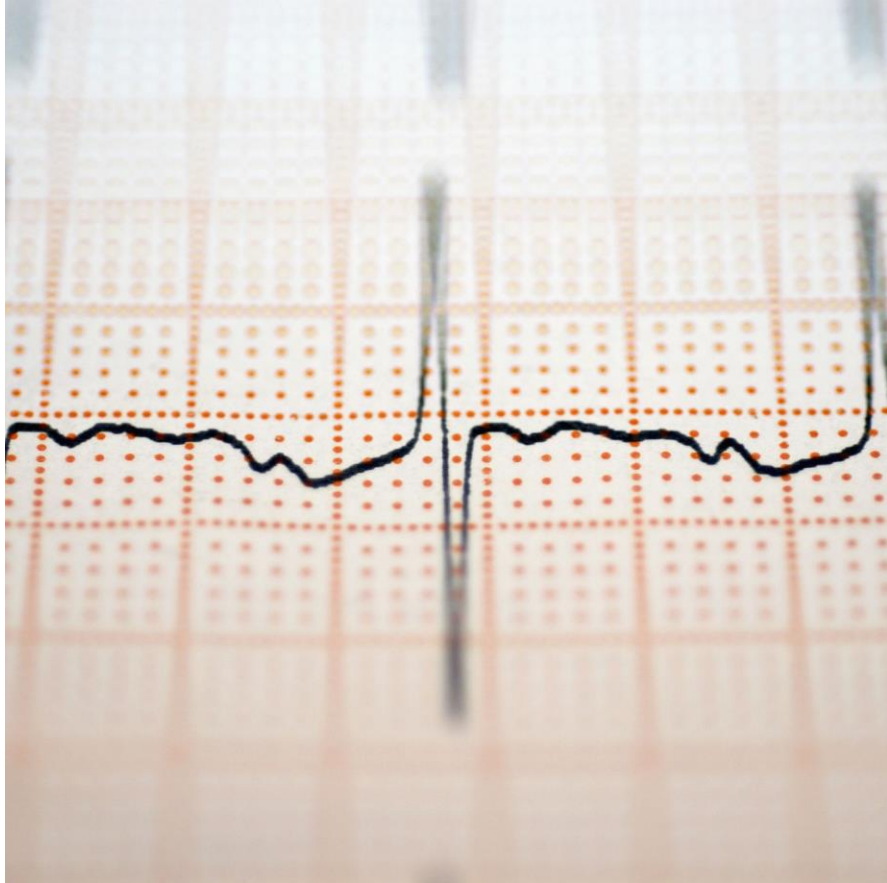


Chart 2





Compressed Flows Have Higher Rate Values

Chart 1

- Average flow 4.52, High rate of 9

Chart 2

- Average 16, High rate of 25



Compressed Flows Have Higher Values

1. For a grease tank to function properly
2. The rate of flow needs to be reduced or
3. Increase the size of the tank (Length especially)
4. It must allow time for the grease to rise to the top
5. This will only happen if there is enough detention time within the tank to create this condition
6. Compressed flows generally will not provide the proper condition unless proactive action taken

Things I learned

248 CMR 10.09 *Table 2:*
SIZING FORMULAS FOR LARGE CAPACITY
GREASE INTERCEPTORS (INSIDE OR OUTSIDE BUILDINGS)

For Restaurants:	Other Establishments with Commercial Kitchens:
$(S) \times (GS) \times (HR/12) \times (LF)$ = Effective Capacity of Grease Traps and Interceptors in Gallons	$(M) \times (GM) \times (LF)$ = Effective Capacity of Grease Traps and Interceptors in Gallons
WHERE:	WHERE:
S = Number of Seats in Dining Area GS = Gallons of Waste Water per Seat: HR = Number of Hours Restaurant Is Open. LF = Loading Factor Use 25 Gallons for Restaurants with China Dishes and/or automatic dishwashers Use 10 Gallons for Restaurants with Paper or Baskets and no dishwashers.	M = Meals Prepared per Day GM = Gallons of Waste Water per Meal (Use 5 Gallons) LF = Loading Factor Use 1.00 with dishwashing machines and 0.75 without dishwashing machine.
Loading Factors:	
Use 2.00 Interstate Highway, Use 1.00 Main Highway, Use 0.75 Other Highways Use 1.50 Other Roadways Use 1.25 Recreational Areas	

The Plumbing code has a chart that takes into consideration items / situations that Title 5 does not

Things I learned

Strength of waste from septic tank?

Title 5 assumes BOD of +/- 250 mg/L

Non-residential values > 250



Things I learned

Strength of waste from septic tank

Caution when designing food establishments

Should one size the leach field for hydraulic or organic loading

WHY?



— Things I learned

Strength of waste from septic tank

Milk has a strength in terms of BOD is 20,000 mg/L

1 gallon of milk put in a 1000-gallon septic tank filled with clean water will generate a BOD of 500 mg/L

Most restaurants produce a COMPRESSED FLOW and have flows > 2000 gallons/day

Gravity flow or non-time dosed pumping from them will organically overload the leach field.

This will cause premature leach field failure

Things I learned

Strength of waste from septic tank

Gravity flow or **on demand** pressure dosing

1. Is not good for leach field with high strength waste
2. Will create organic overload and cause premature leach field failure
3. The flow from restaurants is a Compressed flow

Things I learned

Strength of waste from septic tank

Compressed Flow

It is best to do 24 Hour-timed dose pressure pumping

Dose tank must be large enough to hold flow generated

Size tank for peak day i.e., Fridays, and Saturdays
(restaurants)

This however will not remove the organic overload
condition, only extend field life

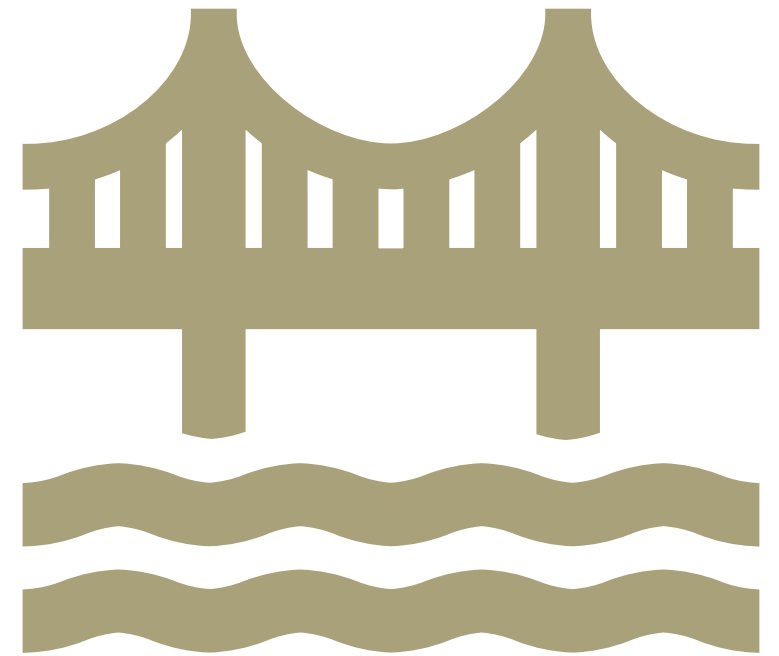
Things I learned

Strength of waste from septic tank

Recirculating Sand Filters

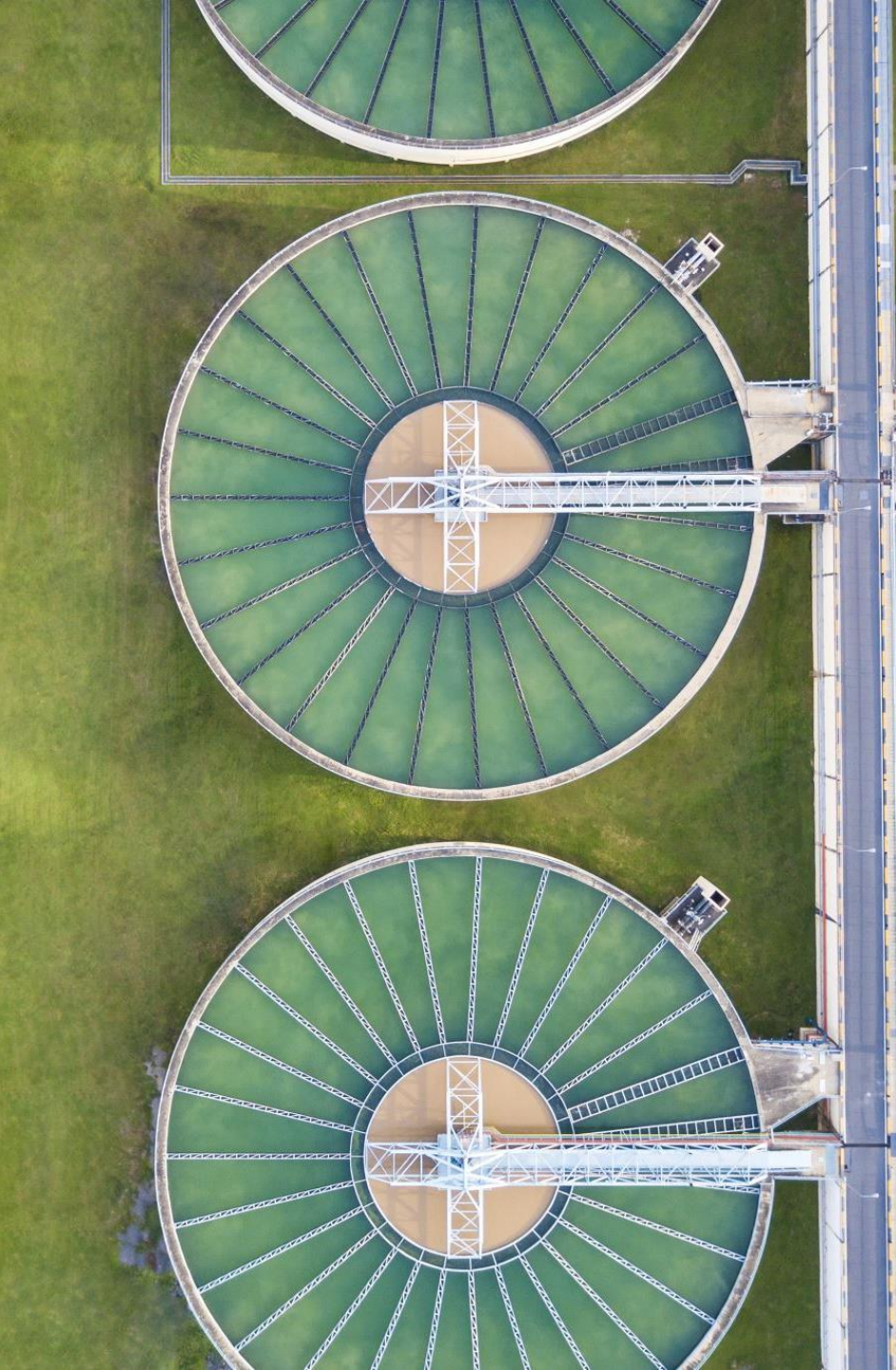
Guidelines for their design makes a distinction on whether it is a hydraulic or organic loading design

Maybe this same logic should also be applied for establishments that have strong waste emanating from them to standard Title 5 fields



Things I learned

1. Recirculating Sand Filter design is based on several important factors (RSF)
 1. The recirculation ratio (RR)
 2. BOD₅ concentration of the sewage; and
 3. The time frame over which flow is generated within the facility
2. Compressed flows
 1. Shorter time interval (< 24 Hrs.) requires a properly designed equalization tank



The Recirculating Sand Filter

Apply this to a Leach Field

1. The recirculation ratio (RR)
This we can ignore
2. BOD_5 concentration of the sewage; and
3. The time frame over which flow is generated in the facility
4. Compressed Flow- equalization of flows



The Recirculating Sand Filter

Loading rate

RSF have 2 types

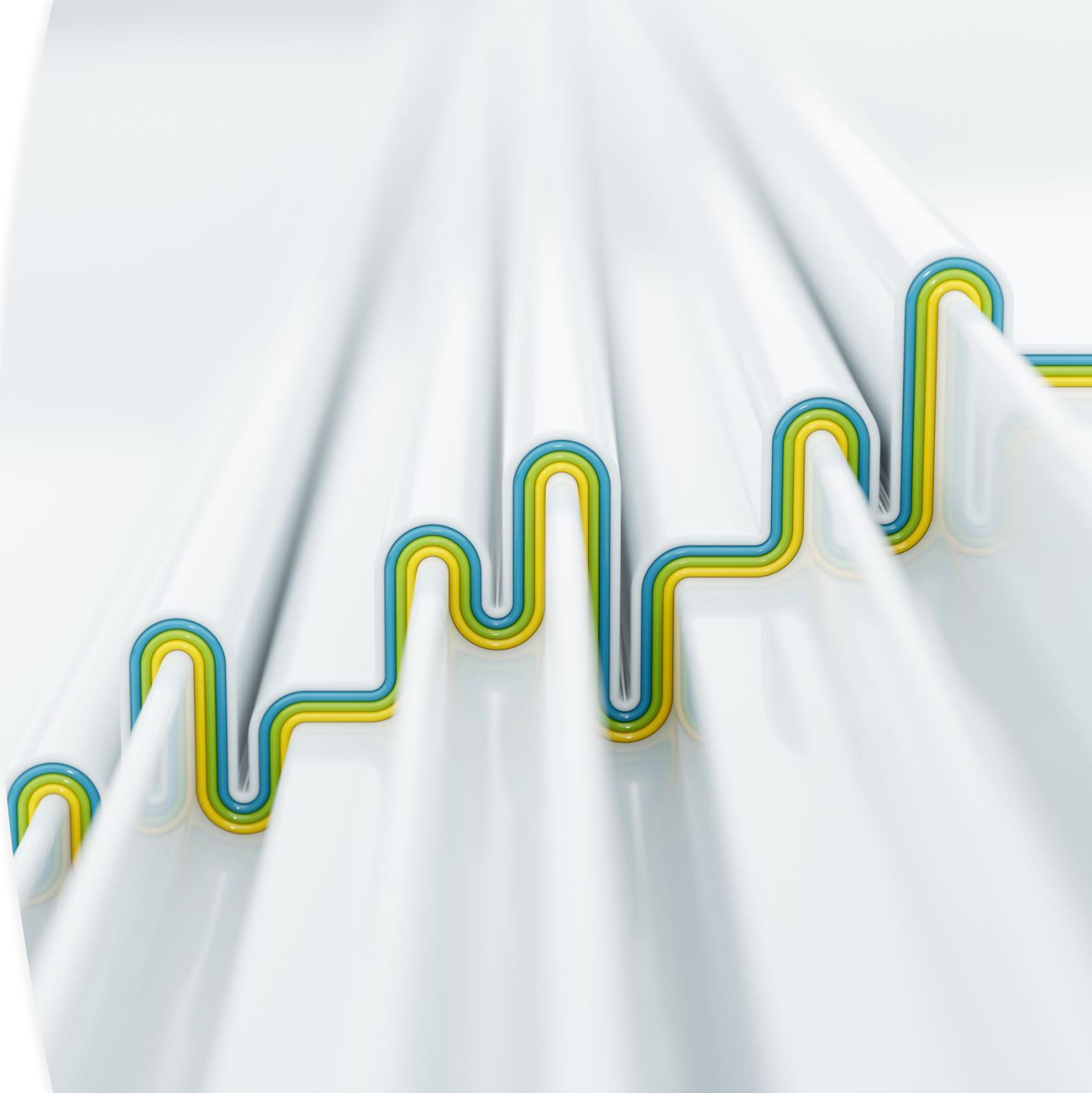
1. Hydraulic, 3 to 5 GPD/SF
2. Organic limit, 0.005 lbs. BOD₅/SF

Things I learned

Establish and organic loading rate for Title 5 leach field

How is this done?

1. We have most of what we need from the existing code used for design
 - a) Flow volume
 - b) Leach field size
 - c) BOD strength (250 mg/L)



Things I learned

Example for this

Flow for restaurant 5000
gallons/day

Leach field size 8000 sq ft

Title 5 assumed strength 250
mg/L

Pounds BOD volume (MG) x strength
 $(.005) \times (250) = 1.25 \text{ lbs./sf}$



Things I learned

Take a sample from establishment if existing and its system failed

or

Take sample from a similar establishment

Test result BOD was 400 mg/L



Things I learned

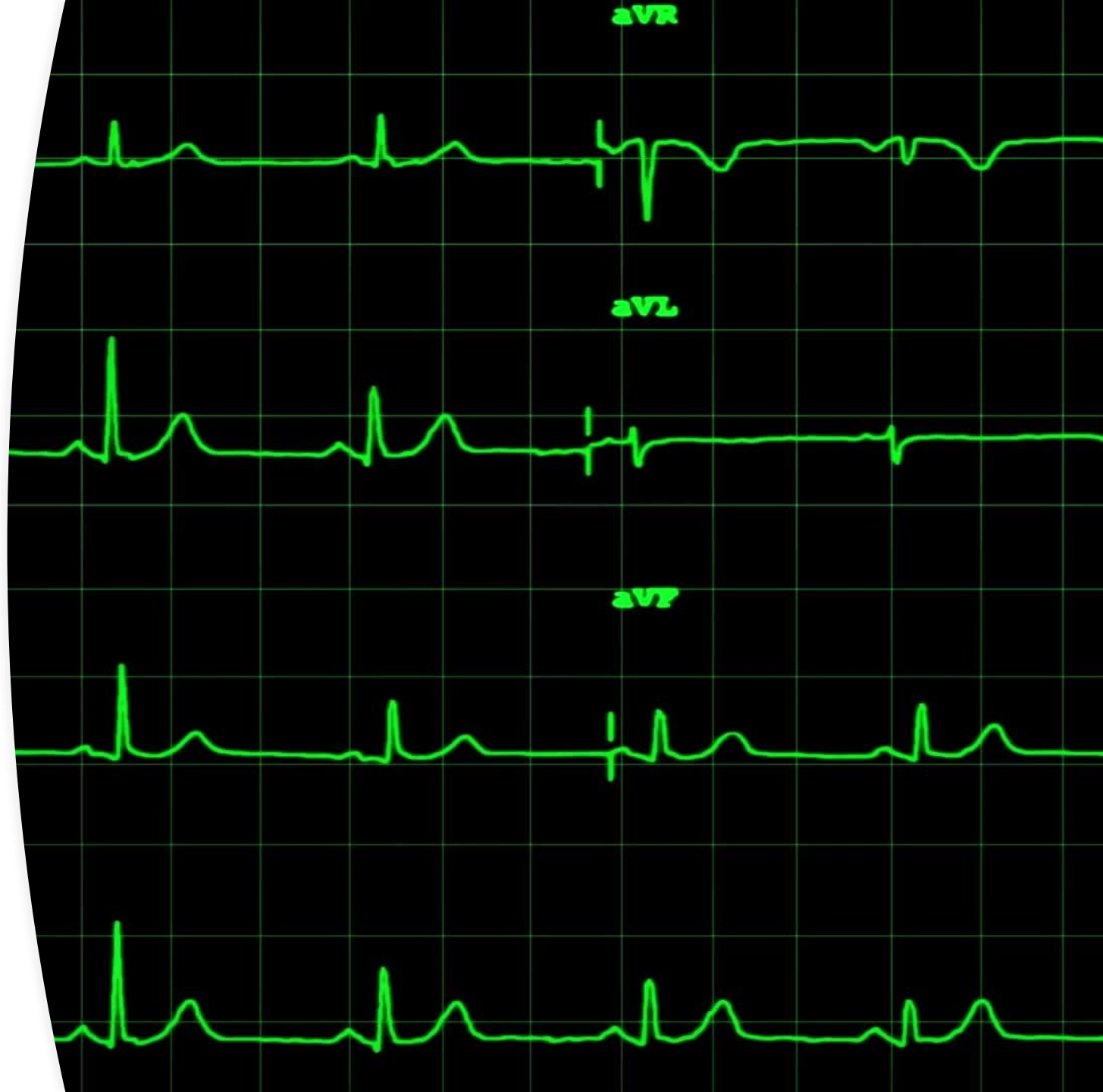
$$(400)/(250) = 1.6$$

Based on this value

$$(1.6) \times (8000) = 12,800 \text{ sf}$$

The leach area should be increased to 12,800 sf

This should be time dosed pumping to field





Things I learned

Strength of Waste

Things I learned

What Causes this to happen?

1. Gravity flow to leach field residential home

Progressive clogging of field



That is because the same section of pipe (inlet) always receives flow and food.



Result voids between sand grains shrink and become anaerobic



Result mother nature will put more troops there to feed on it

Things I learned

2. Pressure dosing to leach field

Having the laterals too far apart

- Code allows 6-foot separation

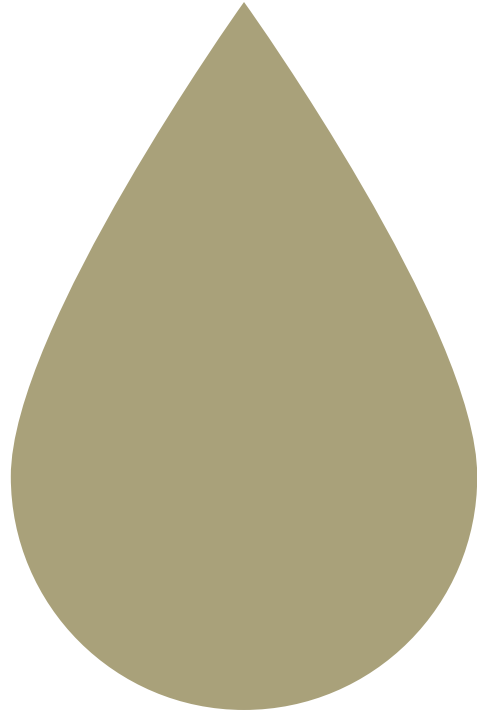
Having the orifices too far apart

- Not staggering orifices

Not doing time dosing over 24 hours

Pumping to the whole field a once

- Using zone pumping



Things I learned

Effluent “T” Filters

1. They are as important as pumping your septic tank!
2. If you do not pump your septic tank regularly, especially commercial establishments
3. A premature failure of the septic system



Things I learned

Effluent “T” Filters

Use the proper size for the application

I found at one location

Contractor used residential effluent “T” in a commercial application

System failed in 7 years

Things I learned

Effluent “T” Filters

1. This was a senior housing complex with multiple disposal systems.
2. The one I worked on was the associations second replacement.
3. In doing the redesign in addition to installing a proper sized effluent “T” filter
4. I had a float valve installed to give out an alarm if water level in septic tank was at the height of the top of the discharge pipe



Things I learned



Orenco[®] Biotube[®] FT-Series Commercial Effluent Filters remove about two-thirds of suspended solids from effluent, helping extend drainfield life. They are used in new or existing tanks, for commercial or heavy residential use. Biotube FT-Series Commercial Effluent Filters come with a filter cartridge, PVC housing, and an extendable PVC handle. A slide rail is available as an option for large filters, to make it easier to install and service them, and it is required on filters for tanks that have only one access location.

- 8-inch, 12-inch, or 15-inch (200-mm, 300-mm, 375-mm) nominal filter diameters available
- 1/8-inch (3-mm) or 1/16-inch (1.5-mm) filter mesh available
- Corrosion-proof construction
- Extendable handle
- Easy to clean
- Optional slide rail for easy installation and tank access for servicing (required for use in tanks with only one access)
- Optional float bracket available for high-level alarm assembly
- High-level alarm assembly ordered separately
- Lifetime warranty

Things I learned

Effluent “T” Filters

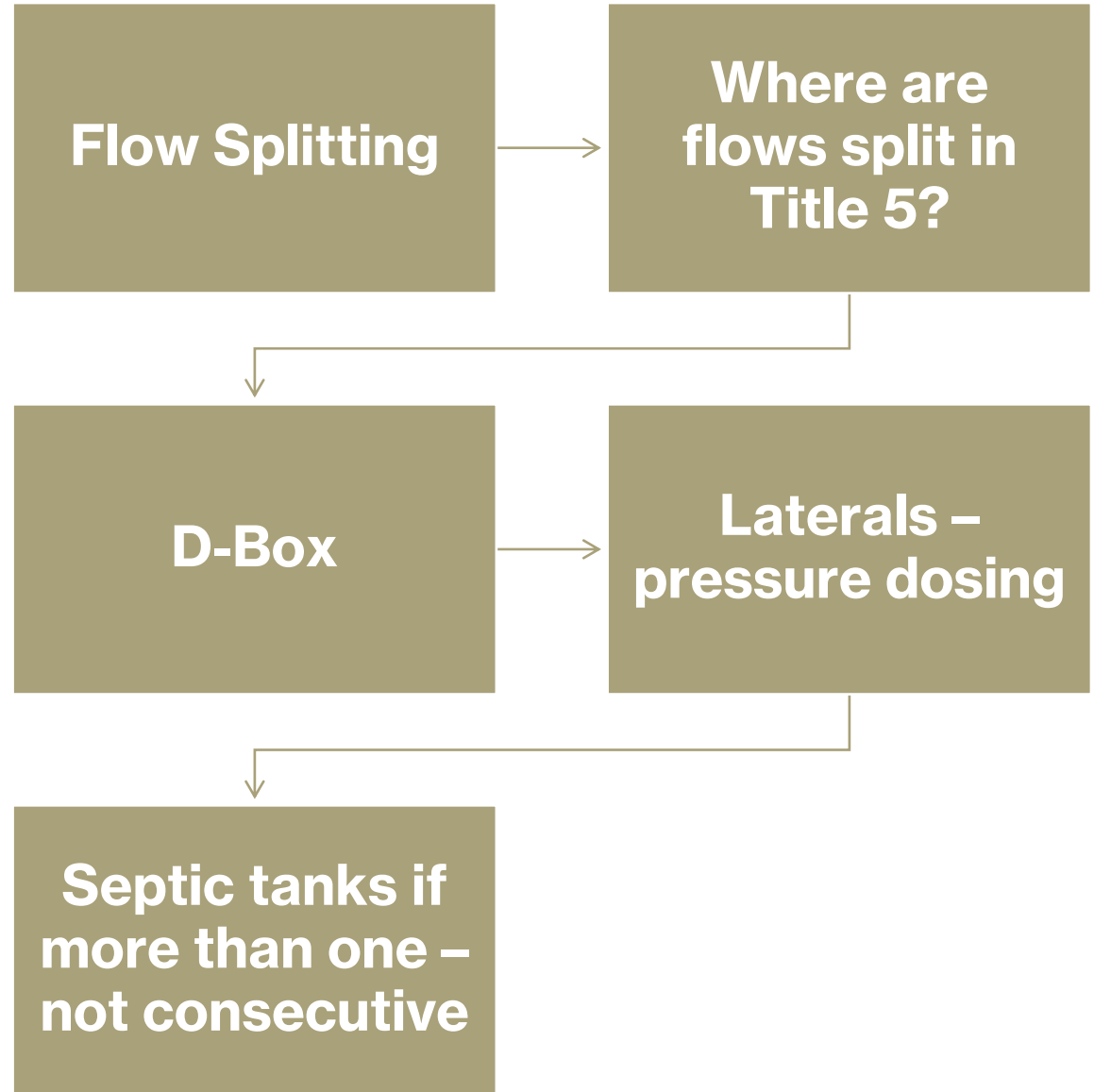
Recommend riser be exposed to surface to facilitate easy cleaning

If 2 compartment tank, then 2 risers to surface

This might encourage homeowner to clean them between pumping's



Things I learned



Things I learned

Flow Splitting

Pressure Dose Flow Splitting

The Flow must come from the bottom of the “Tee” Connection

Why?

- So, the pressure line can drain back
- So, the lateral can all become pressured with proper volume

Things I learned

Flow Splitting

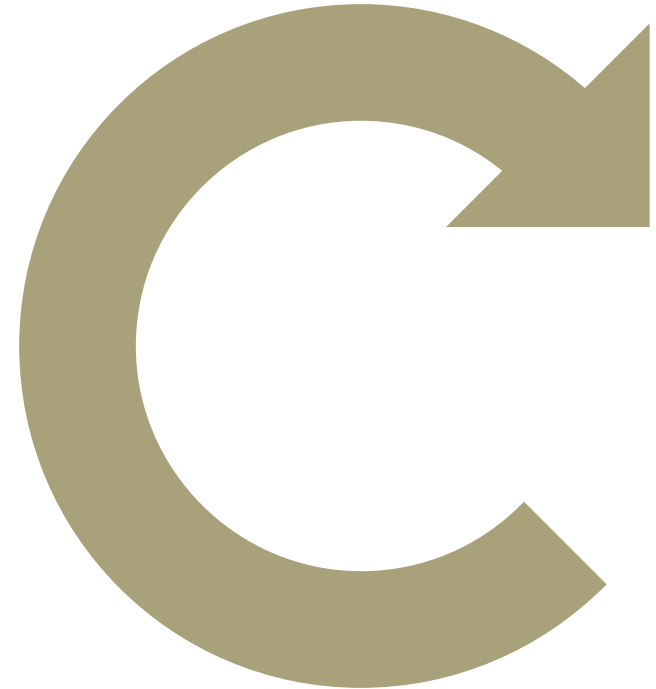
For Two Septic in parallel figuration

Use a "Tee"

With in coming pipe and 2 exit pipes at same elevation

For more than Two Septic in parallel figuration

Use a D-Box





Recap

**Gravity Flow is Rate of Flow
over a specific time interval**

Sizing Grease Tank

**Compressed Flow creates
problems**

**Title 5 values are not Volumes,
but peak rates of gravity flow**

**Organic or hydraulic loading to
leach field for strong waste?**

Proper size effluent “T” filters

Flow Splitting

Questions ?

Available for peer reviews and assist in your designs

Roland (Joe) Dupuis dcubed3@comcast.net

