FLOW EQUALIZATION

Improve System Performance and Communicate Maintenance needs to Owner

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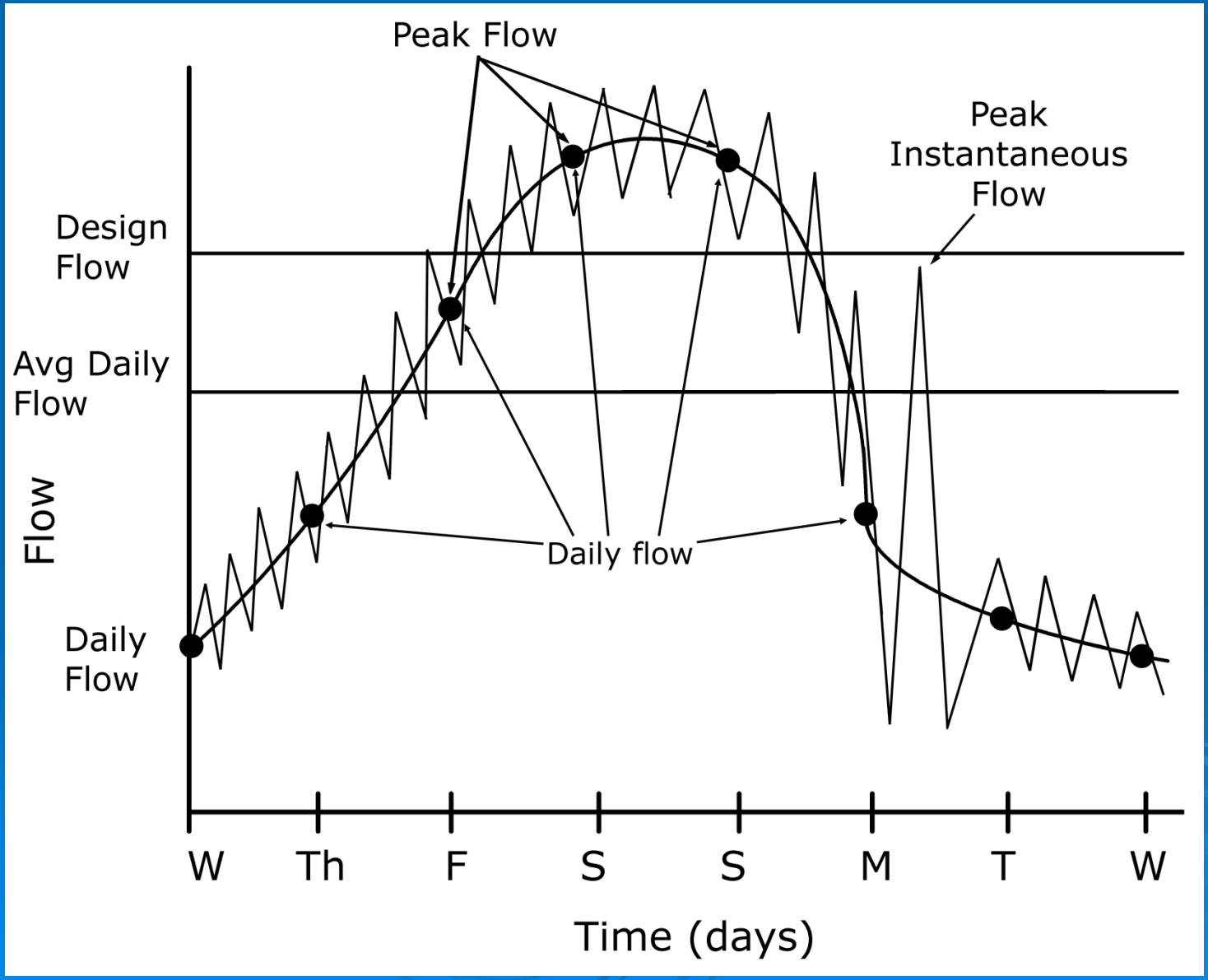
What we will learn

- What is Flow management
- Evaluating flow for design
- Choosing the right size tank
- Flow equalization tank functions
- Pump operation can communicate maintenance needs
- Malfunctions equated to risk

Variation in flow



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”

Do not rely on published design criteria when repairing an existing system

EVEN designing for new construction

REAL FLOWS ARE CRITICAL

Wastewater flow characteristics

Type of Facility	Flow* (gal/cap/day)	lbs. BOD_5† (cap/day)	Runoff (hours)	Shock Load Factor
Airports - per passenger	5	.020	16	low
Airports - per employee	15	.050	16	low
Apartments - multiple family	75	.175	16	medium
Boarding Houses	50	.140	16	medium
Bowling Alleys - per lane (no food)	75	.150	8	medium
Campgrounds - per tent or travel trailer site - central bathhouse	50	.130	16	medium
Camps - construction (semi-permanent)	50	.140	16	medium
Camps - day (no meals served)	15	.031	16	medium
Camps - luxury	100	.208	16	medium
Camps - resort - night and day, with limited plumbing	50	.140	16	medium
Churches - per seat	5	.020	4	high
Clubs - country (per resident member)	100	.208	16	medium
Clubs - country (per nonresident member present)	25	.052	16	medium
Courts - tourist or mobile home parks with individual bath units	50	.140	16	medium
Dwellings - single family	75	.170	16	medium

Goldstein and Moberg, 1973

Data required

Flow characteristics:

- Average daily flow
- Peak flow
  - Regular highs
  - Weekly
  - Monthly
- Special occasions
  - How often: annually/ bi-annual, monthly?

Water and Cash Flow are related

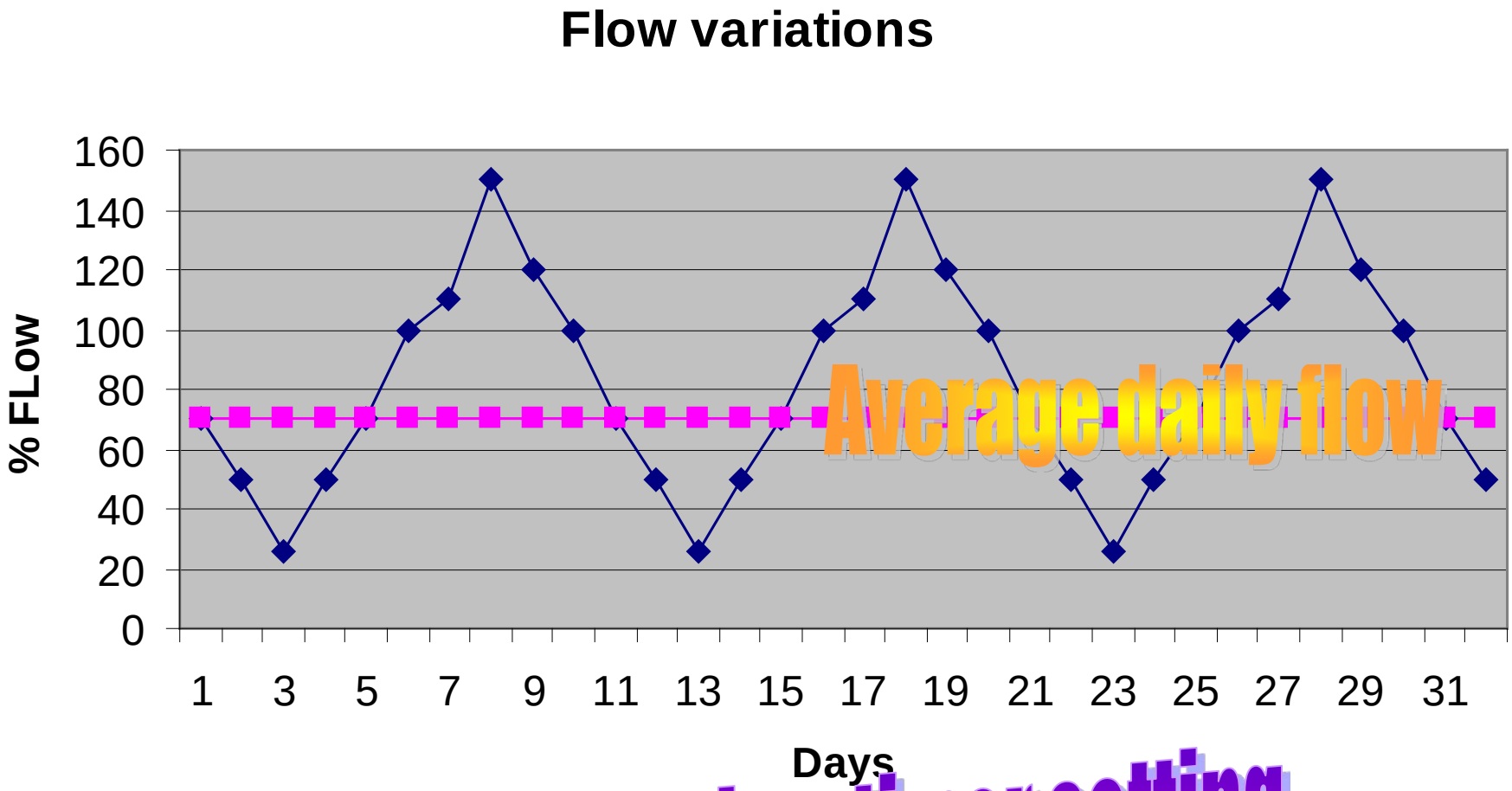
Water use habits

- To permanently reduce flows and peaks, water use habits must change.
- Educate system owners
  - Constant changes
- Help system owners see the $$$$ benefit to managing water use
- Need a good working relationship with owner

Flow equalization systems

- Makes the flow introduced to the treatment system more consistent. **Uses 24 hours**
- Flow equalization is important if:
  - The average daily flow is ≥ 70% of the design capacity
  - Water use habits or facility operations are variable-
    - Example: church only open on Sun.
  - Frequent peaks exceed system capacity
    - Wash day: cleaning service

Effects of flow equalization



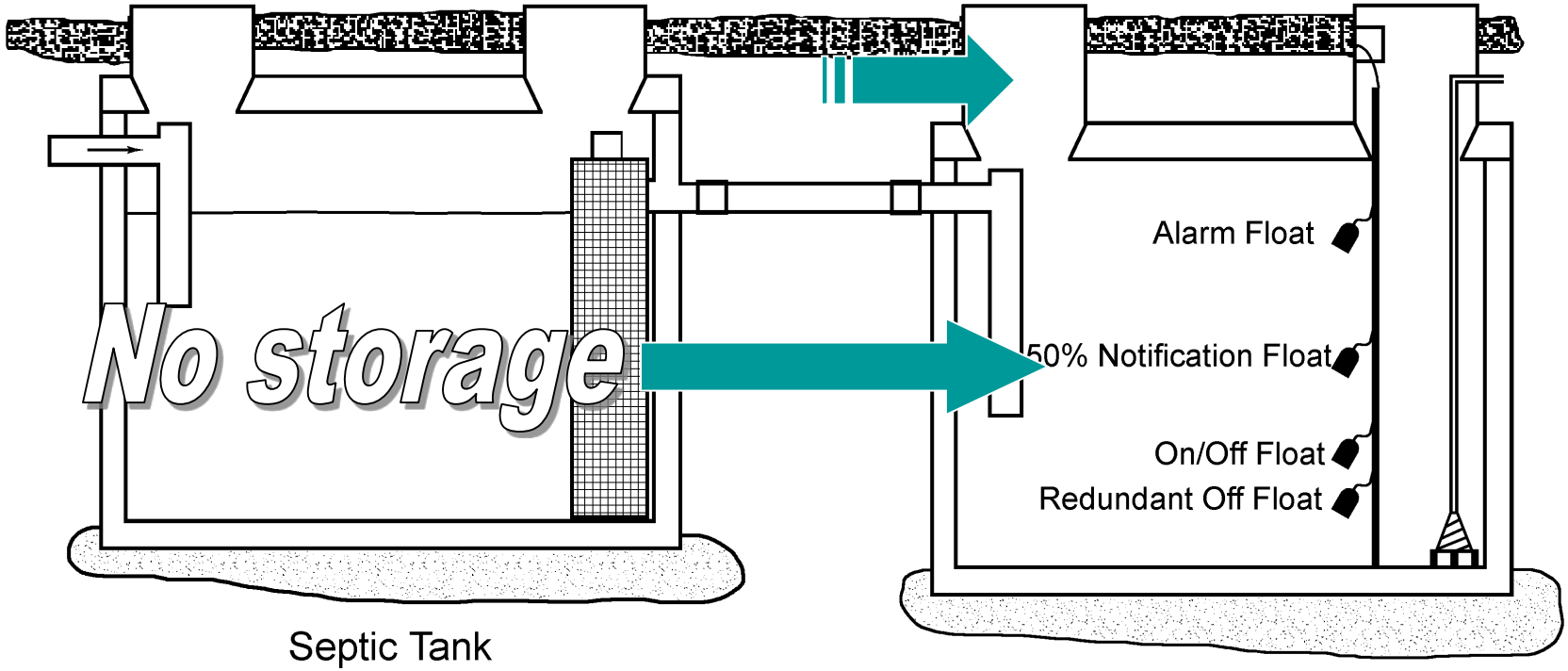
Use based on timer setting

Other benefits of a flow equalization system

- Monitoring of flows from the surge tank may help detect
  - major changes in flow patterns
  - leaking effluent
  - clogging orifices
- Provide storage and spread out water delivery after a power outage.
- Regular feeding the hungry population of microbes that are used for treatment.
- Regular resting

Uses 24 hours

Flow equalization tank

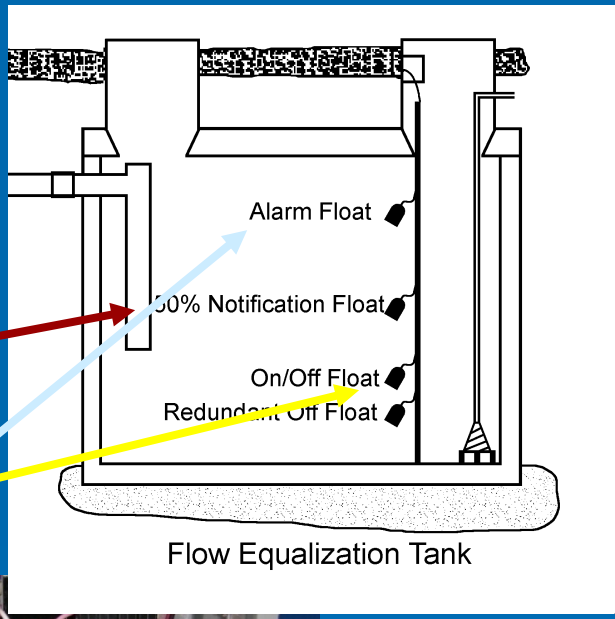


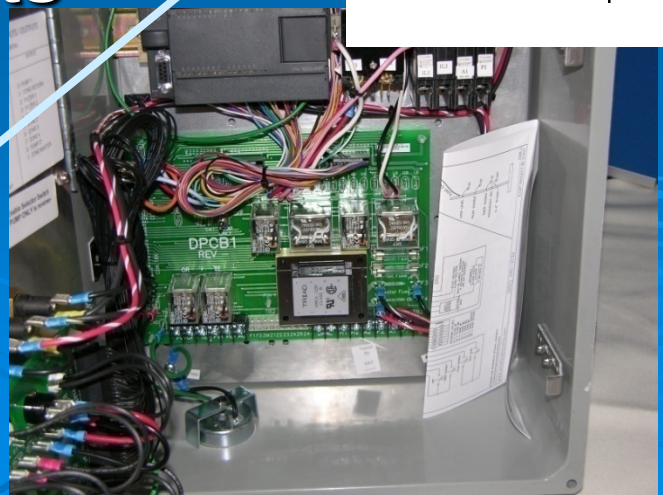
Design for the peak

Control panel needs

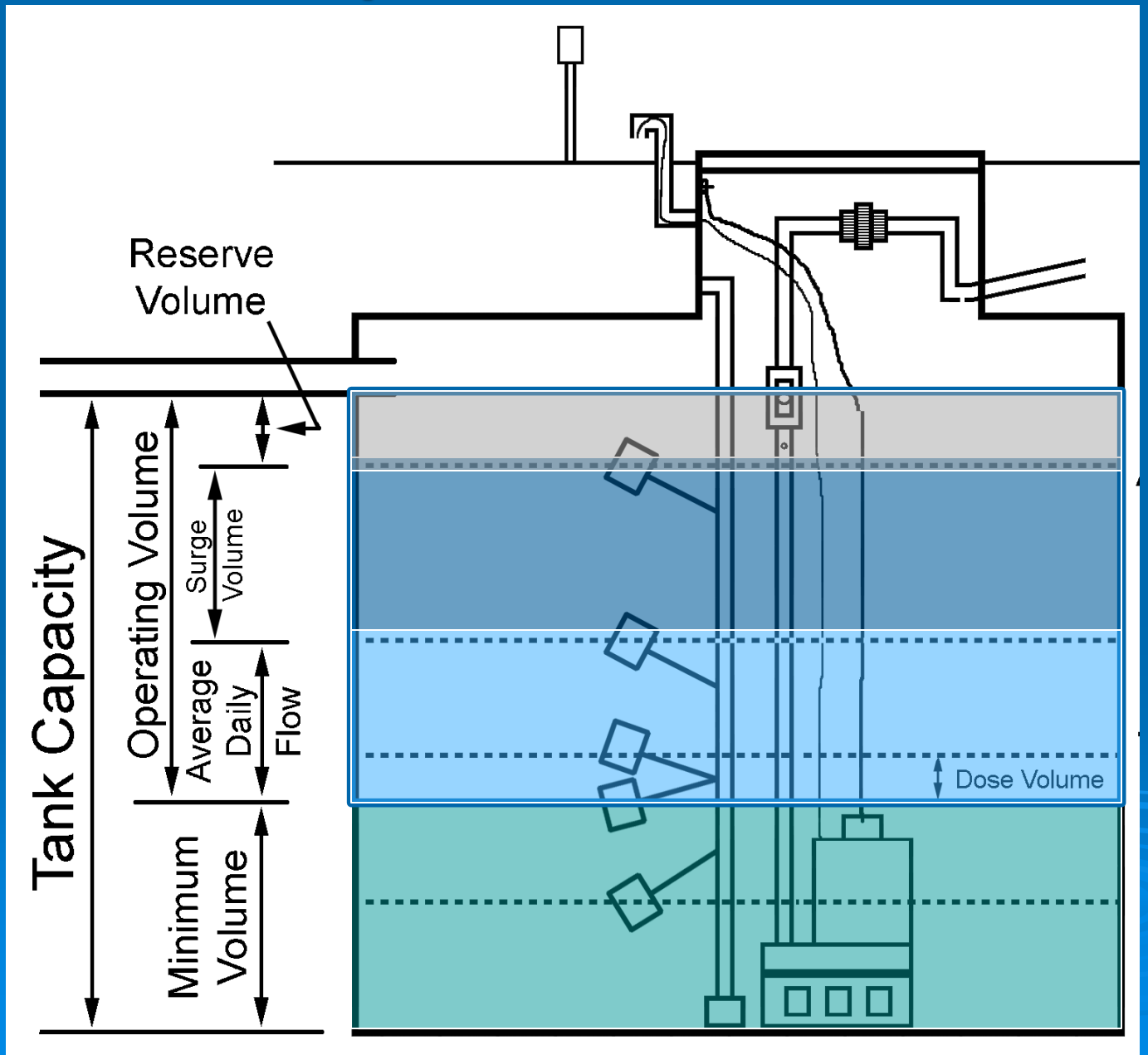
Timer

- Track doses
- Track time of pump operation
  - Flow measurement
- Track peak enable-design flow
- Track pump off events
  - Set flow too HIGH
- Track alarms
  - Set flow too LOW



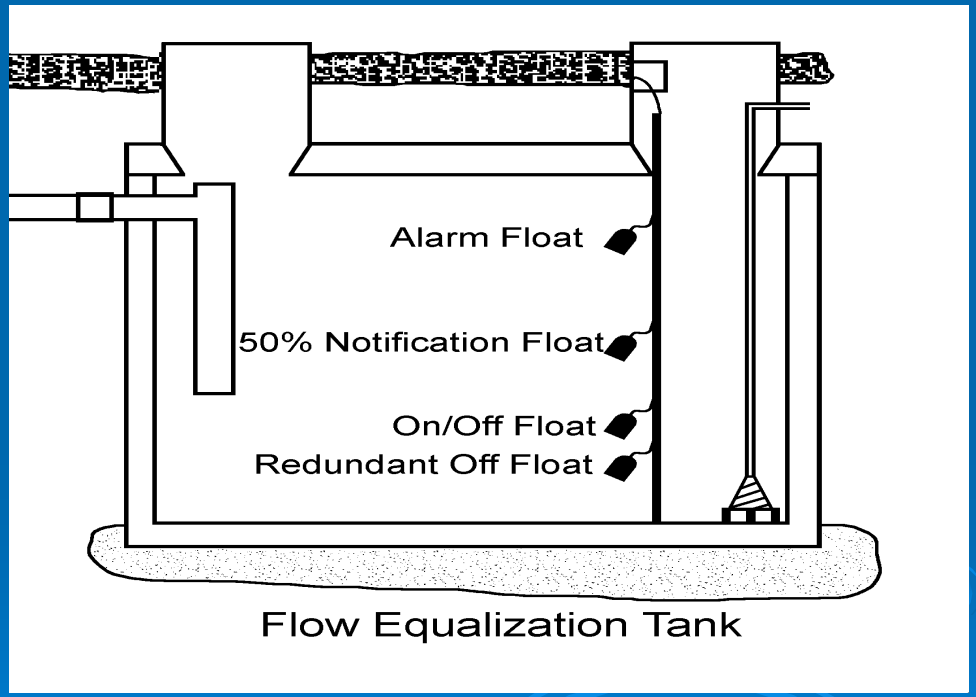


Required volumes



Calculating for commercial

- Measure the flow
  - Read meter
  - Calculate flow
- Calculate volume in tank
  - Daily flow - timed dose
- Necessary storage
  - Surge volume
  - Storage volume [surge volume + avg.]
- Operating volume
  - Storage volume + reserve volume
- Tank capacity
  - Sum all necessary volumes [min.+ operating]



Flow controlled by surge tank

Peaking 20%

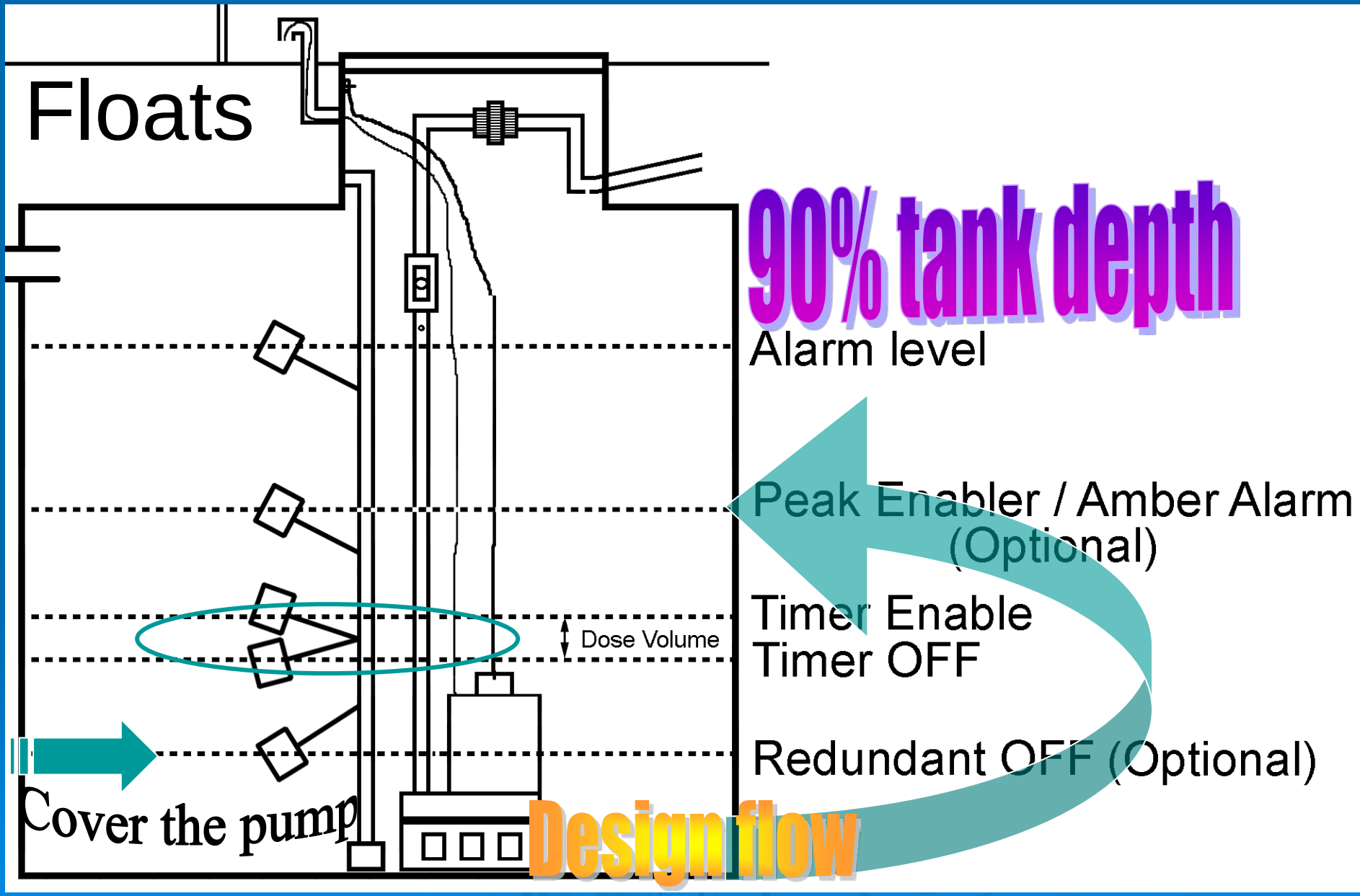
Day	Daily flow (gal)	Timed dose (gal)	Surge vol. (gal)
Sunday			700
Monday	250	350	600
Tuesday	200	350	450
Wednesday	150	350	250
Thursday	200	350	100
Friday	250	350	0
Saturday	700	350	350
Sunday	700	350	700

Storage volume

Storage volume = surge vol. + avg.

700 + 350 gpd = 1050 gallons

- Storage x peaking = design vol.
- 1050 x 1.2 = 1260 gallons


Floats
90% tank depth
Alarm level
Peak Enabler / Amber Alarm
(Optional)
Timer Enable
Timer OFF
Dose Volume
Redundant OFF (Optional)
Cover the pump
Design flow

Monthly event

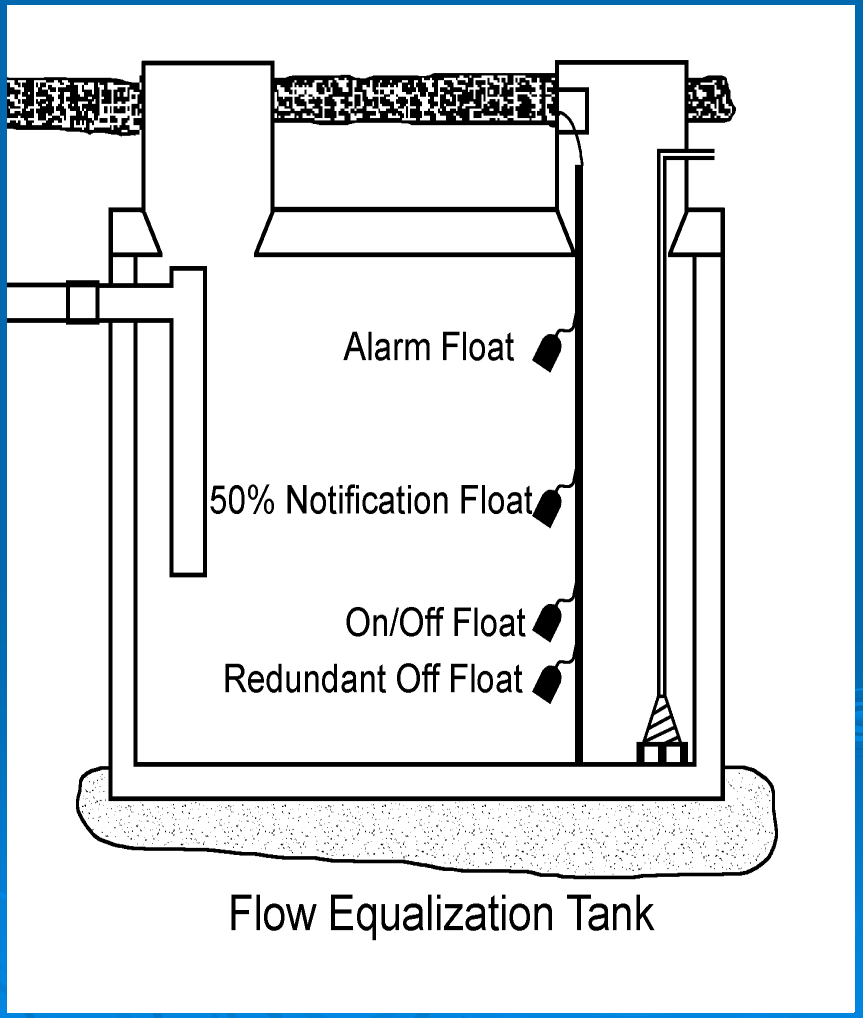
- Increasing storage
- 30% increase
- Multiply storage x 1.3

Annual event

- Single use service
- Portable toilets
- Washing schedule
- Pre cooking
- Clean up
- Pump extra capacity from tank

Flow equalization tank & haul

- Lower the extreme peak
  - Special events
- Too costly for infrastructure needed for special event extreme flow/strength
- If the peak flows only happen a few times a year
- Pump the extra flow from surge - equalization tank



Critical Controls for measuring flow through a system

- Meter readings
  - Elapsed time meter (ETM) present:
    - Present reading_____(PTR)
    - Last reading_____(LTR)
  - Cycle/event counter (CC) present:
    - Present reading_____(PCR)
    - Last reading_____(LCR)

Number of Doses: CC

- Using Cycle Counters (CC)
  - What do I need to have?
  - Days between readings
    - (only when in operation)
  - Designed number of cycles (Dose frequency)
  - Change in value = Total number of cycles (NC)
  - Designed maximum cycles
  - Days x Dose frequency = Max cycles
  - Compare to actual

Cycle Counter Operation

- Cycle Counter Reading:
  - Present reading: 45,289 cycles
  - Last reading: 44,891 cycles
  - Calculate the number of cycles by subtracting Last reading from the Present reading.
  - 45,289 cycles – 44,891 cycles = 398 cycles
- What does it mean?
  - Total times the system turned on/off

Estimating Water Usage Based on Cycle Counter Reading

- Number of cycles over period of time ÷ Days in period of time = Pump cycles per day (CPD)
- Site with annual site visit, design 4-5 CPD
  - 398 cycles ÷ 365 days ≈ 1 CPD
- Same site with 100 days between visits
  - 398 ÷ 100 = 4 CPD
- Another site
  - 3905 cycles ÷ 365 days = 10.6 CPD

Measuring Flow: CC

- Using Cycle Counters (CC)
  - What do I need to have?
  - Days between readings
    - (only when in operation)
  - Change in value = Total number of cycles (NC)
  - Dose Volume (DV) - Use net volume
    - Net volume – Remove drain back from volume pumped
  - Total flow
    - NC x DV = Total flow
  - Total flow ÷ Days = Average Daily Flow

Total Gallons with CC

- Cycle Counter (CC)
  - [(PCR) – (LCR)] x (DV) = ___Total gallons
    - (45,289 – 44,891) x 77.3 gal = 30,765
  - Total gallons ÷ (# of days this period) = ___GPD
    - 30,765 gal ÷ 365 days = 84 GPD

Measuring Flow: ETM

- Using Elapsed Time Meter (ETM)
  - What do I need to have?
  - Days between readings
    - (only when in operation)
  - Change in value = Total number of units
    - Minutes
    - Hours
  - Pump capacity (gpm)- will not be the net volume
  - Total flow = Elapsed Time x Pump capacity
  - Total flow – (total d-back) ÷ Days = Average daily flow

Total Gallons with ETM

- Elapsed Time Meter (ETM)
  - [(PTR) – (LTR)] x (GPM) = Total gallons
    - (15,703 – 14, 509) x 25.8 gpm = 30,805 gal
  - Total gallons ÷ (# of days this period) = ___GPD
    - 30,805 gal ÷ 365 days = 84 GPD

Calculating Gallons Per Day (GPD)

- Total gallons ÷ (# of days this period) = gpd
  - CC: 30,765 gal ÷ 365 days = 84 gpd
  - ETM: 30,805 gal ÷ 365 days = 84 gpd
- But only Seasonal Home!
  - CC: 30,765 gal ÷ 100 days = 307 gpd
  - ETM: 30,805 gal ÷ 100 days = 308 gpd
- Design flow = 450 gpd
  - (308 gpd ÷ 450 gpd) x 100 = 68%

A difference in the Daily flow estimates communicates????

- Which flow estimation method is accurate? CC or ETM
- What does a CC estimate of daily flow represent: number of dose & dose volume
- What does an ETM estimate of daily flow represent: pump run time and pump flow rate
- What if CC estimate is 84 GPD and ETM estimate is 168 GPD?
- Time dosed systems: pump tank fills up!!!!!

What does a High Level in the Time Dosed Pump Tank mean?

Verify pump flow rate!!!!

Malfunction

- Defined: Not performing its intended purpose.
- Component malfunction versus System malfunction
- Purpose of treatment System
  - Protect Public Health
  - Protect Public Safety
  - Protect Environmental Health
  - Protect Environmental Safety
- Hard malfunction: component malfunction leads to System malfunction
- Soft malfunction: component malfunction does not result in System malfunction

High level condition communicates

- Excess water usage
- Pump malfunction
- System water tightness issue
- Maintenance needed
- Timer malfunction
- Timer settings
- Float settings – tether length
- Float malfunction
- Power was off for a period of time

Special features

- Aeration – provide mixing and aeration of wastewater.
- Pump placed on bottom of tank to remove solids
- Pump and haul accumulated “extra” water from extreme peak flow events

Summary

- Flow equalization
- Comparison of flow rates
  - Design flow
  - Daily average flow
  - Peak flow
  - Permitted flow
- Flow equalization tank improves system performance – equalizes water volume and oxygen requirements for treatment
- Demand and Timed dosing system communicate different messages
- Malfunction responses managed according to risk.