



# Engineering Design Approach for Selection and Design of Treatment Technologies

**Dr. Linda Strande**

*Sandec: Sanitation, Water and Solid Waste for  
Development*



# Design Approach

[www.sandec.ch/fsm\\_tools](http://www.sandec.ch/fsm_tools)



# Design Variables

Client

... considering all design variables...

... to arrive at solution

- FS characteristics and quantities
- Existing FS infrastructure and services
- Skills and capacities
- Legal requirements, regulations, norms
- Social acceptance
- Operation and maintenance
- Financial viability
- Etc, etc, etc

**Over-design** wastes money and resources

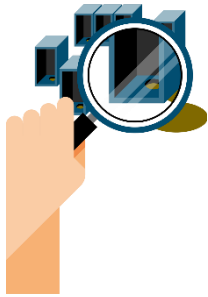
**Under-design** does not protect human and environmental health

work backwards...

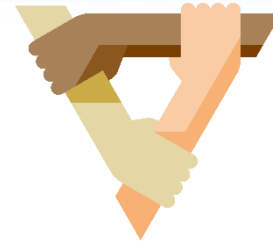
Required quality of treatment endproducts

# Design Variables?

I client



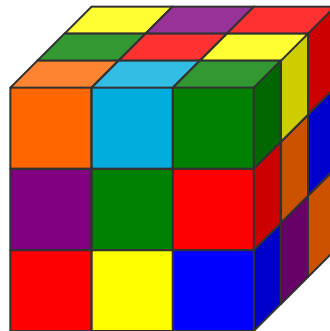
what else???



operations and maintenance

site evaluation  
and availability

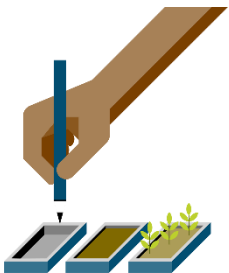
client demands



climate

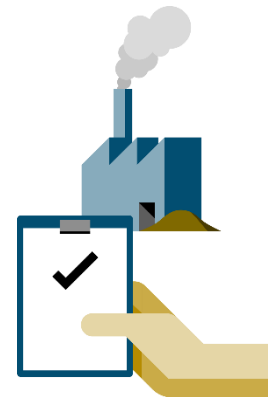
economic situation

sanitation and public health concerns



social preferences

policy and regulations



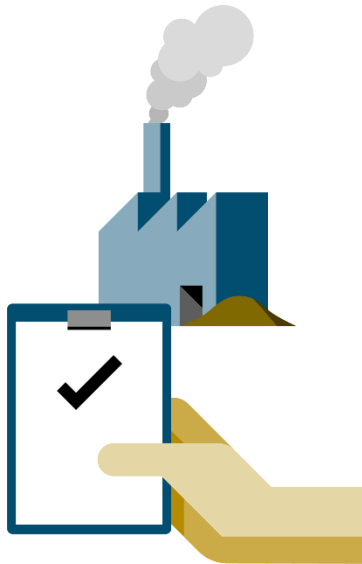
II. end-requirement of treatment products

# Design Approach



# Design for Resource Recovery

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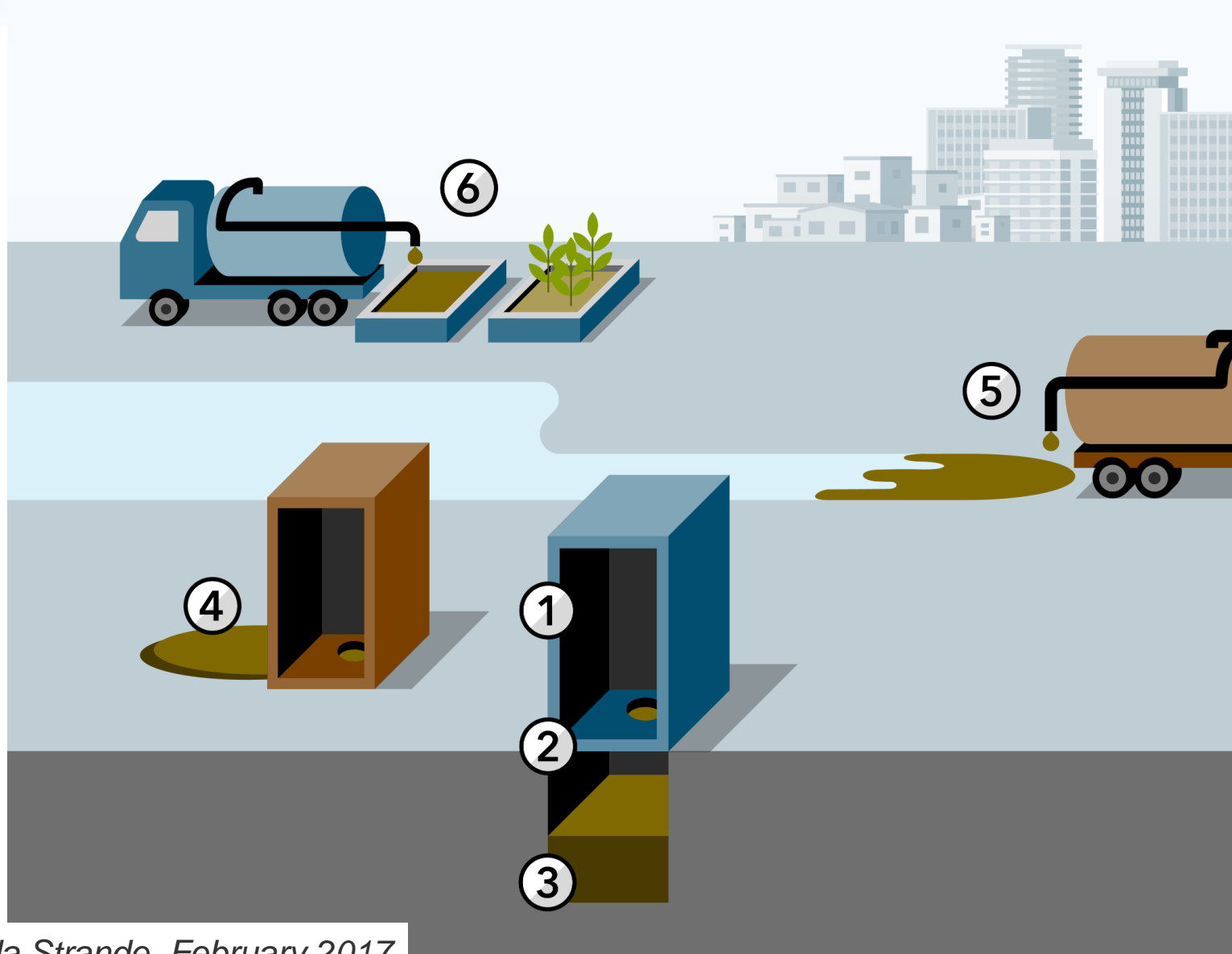
## Market Driven Approach for Selection of Faecal Sludge Treatment Products

Schoebitz, L., Andriessen, N., Bollier, S., Bassan, M., Strande, L.

# Design Approach



# Quantification and Characterization

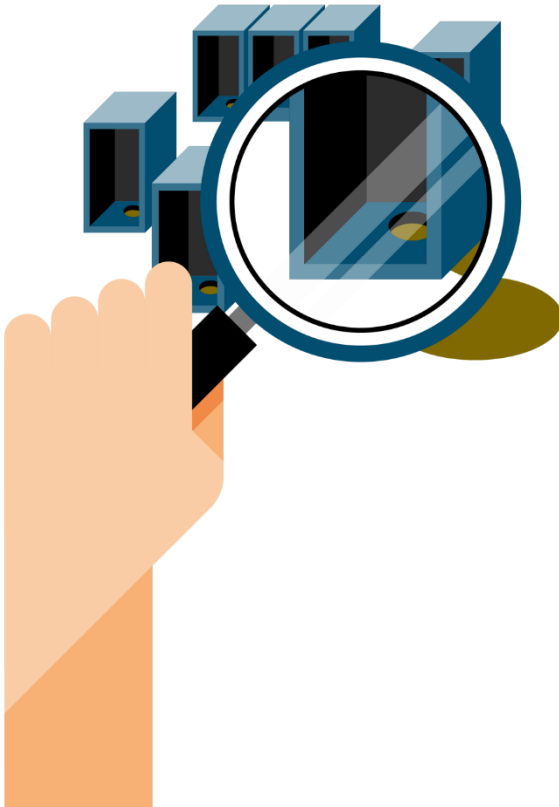




# Faecal Sludge Accumulation

In preparation

*Strande, Schoebitz, Bischoff, Ddiba, Okello, Lohri, Niwagaba*



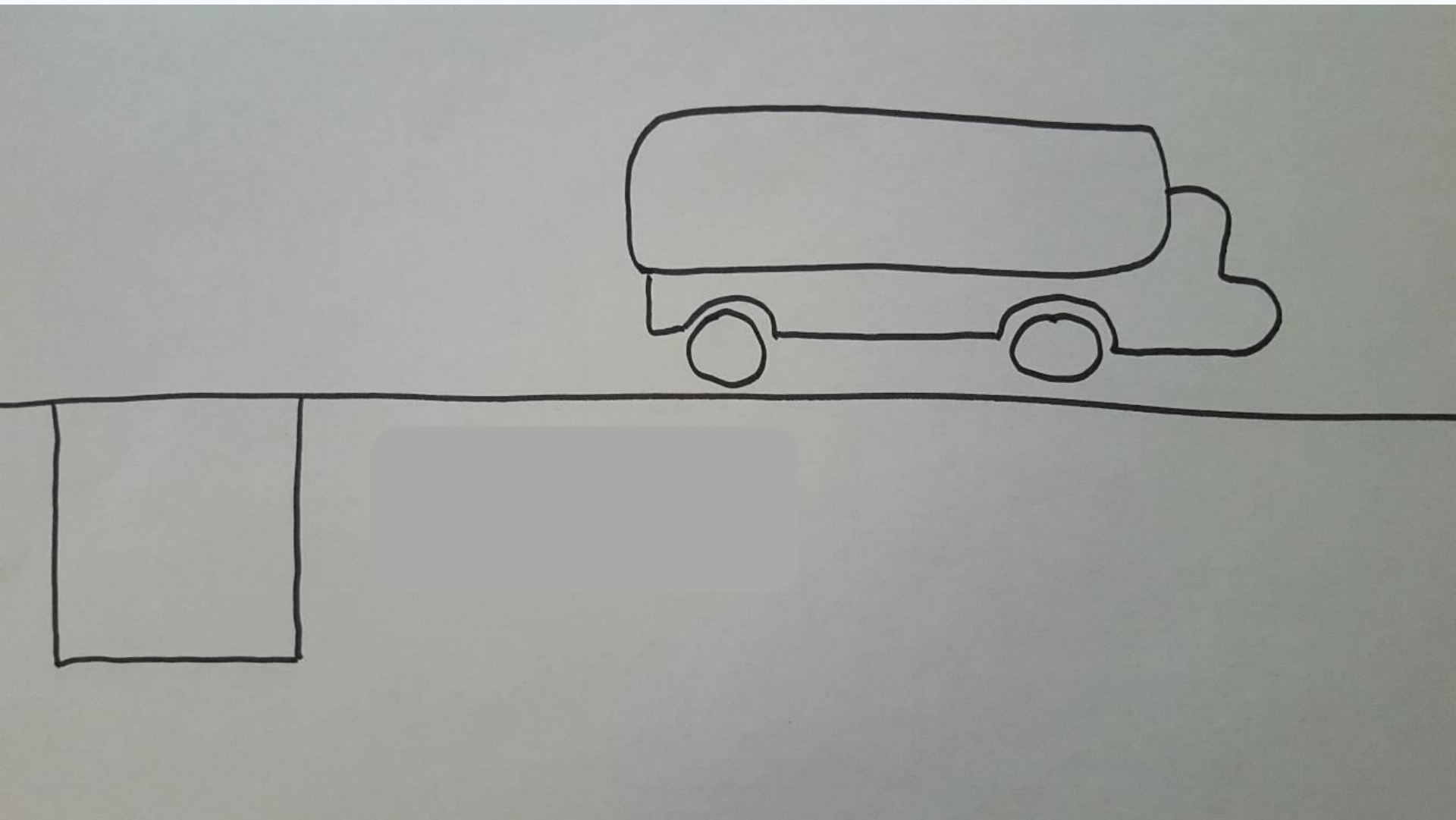
## Household Level

- Last emptied
- Emptying frequency
- # users
- Containment volume
- Was it full
- Was it fully emptied

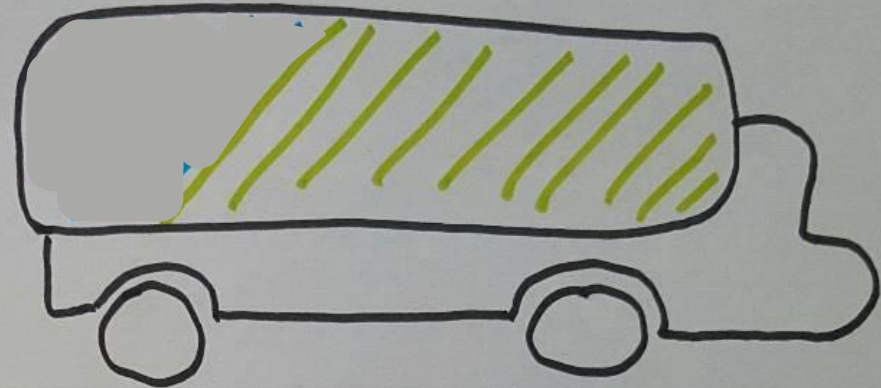
## Emptying Service

- Containment fully emptied
- Truck full
- Truck volume
- Water added

# Faecal Sludge Accumulation

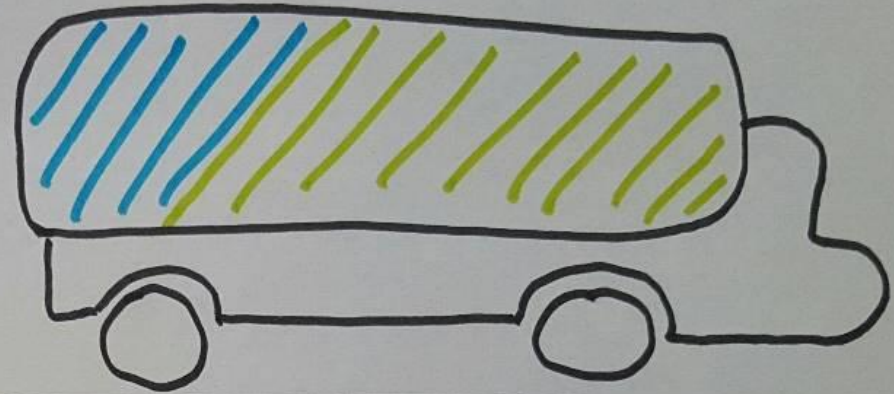


# Faecal Sludge Accumulation



1) Containment Empty Truck not Full

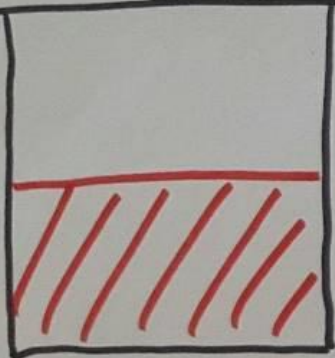
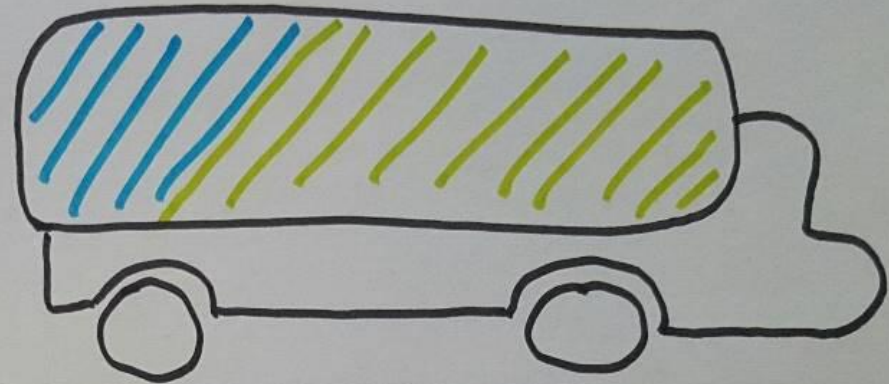
# Faecal Sludge Accumulation



- |                      |                |
|----------------------|----------------|
| 1) Containment Empty | Truck not Full |
| 2) Containment Empty | Truck Full     |

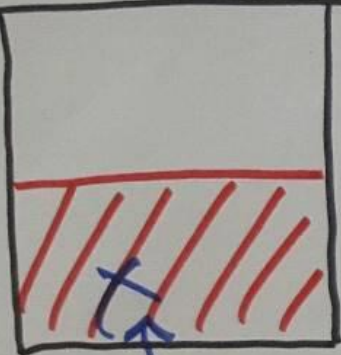
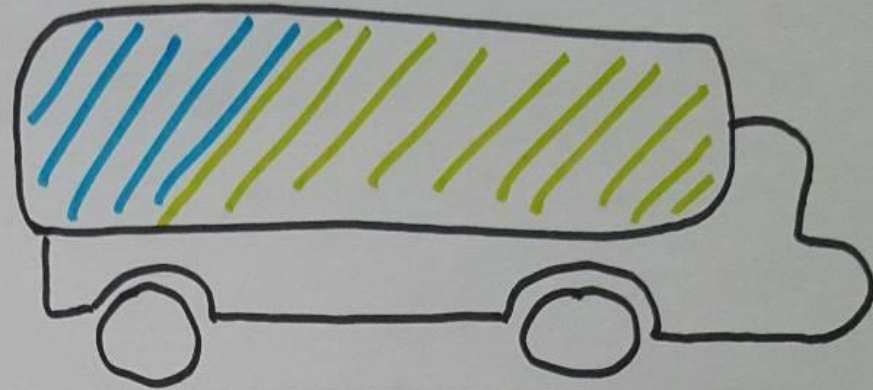


# Faecal Sludge Accumulation



- 1) Containment Empty Truck not Full
- 2) Containment Empty Truck Full
- 3) Containment not Empty Truck Full

# Faecal Sludge Accumulation



- 1) Containment Empty Truck not Full
- 2) Containment Empty Truck Full
- 3) Containment not Empty Truck Full

grate

$\Delta$  time

# Data Management

## GIS Tools

How to improve future estimates for quantification and characterization?

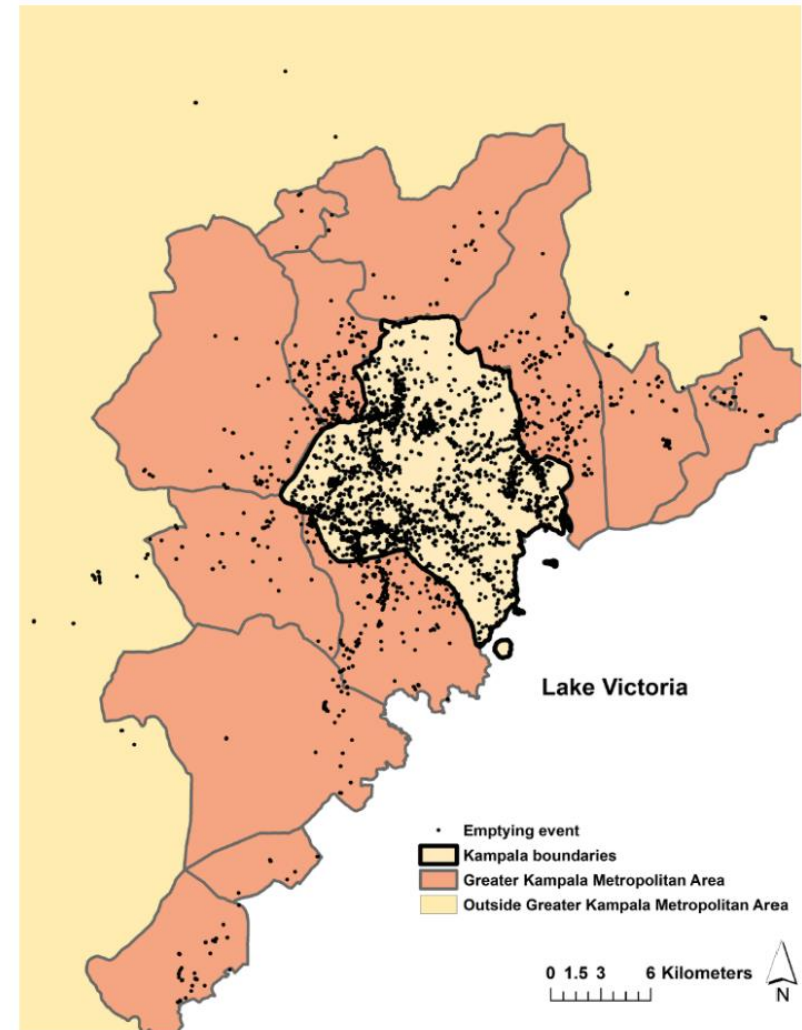


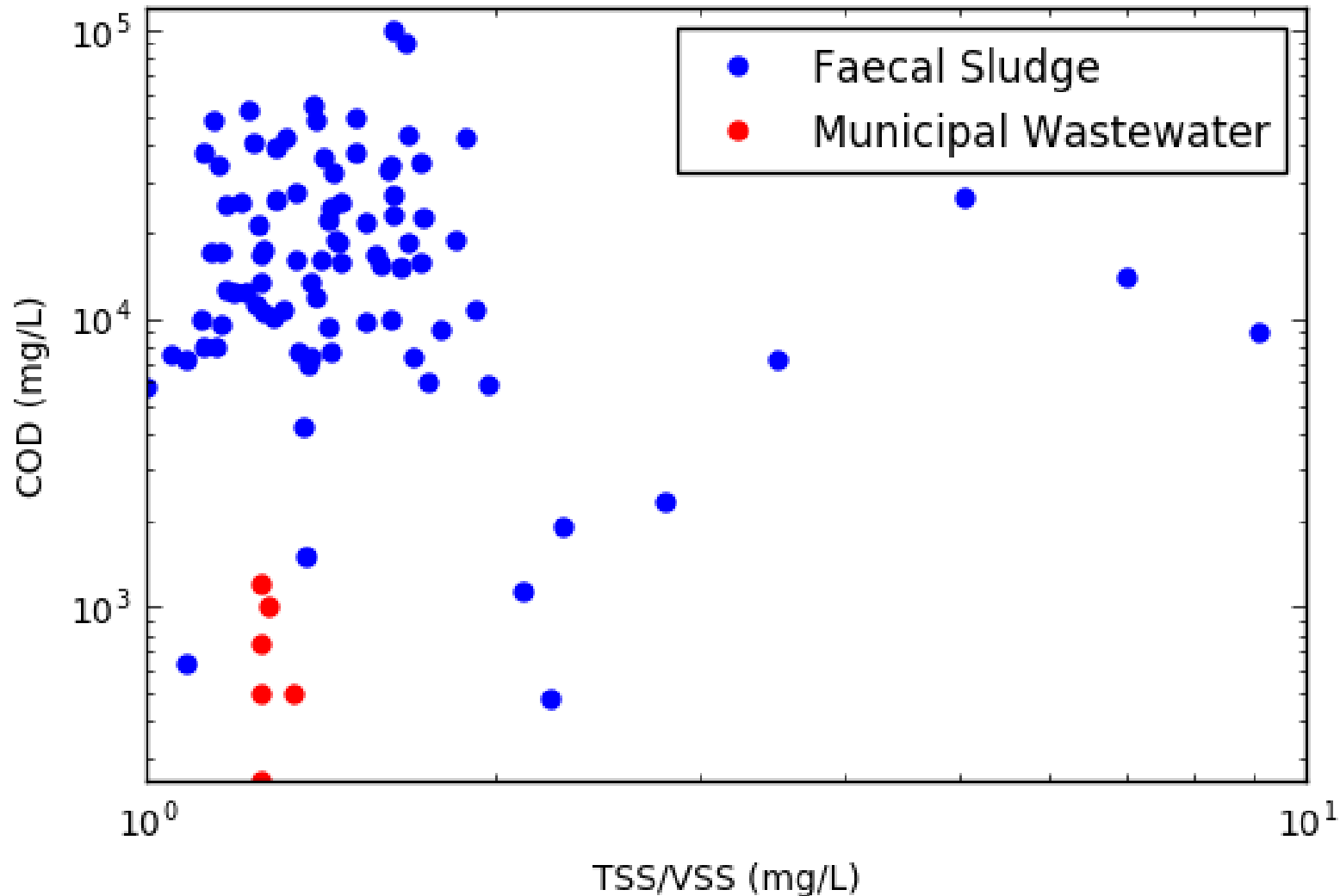
Figure 19: Distribution of emptying events

**Schoebitz, L., Bischoff, F., Lohri, C.R., Niwagaba, C., Siber, R., Strande, L. GIS analysis and optimization of faecal sludge logistics at city-wide scale in Kampala, Uganda. Sustainability (in press)**

*Dr. Linda Strande, February 2017*

# Variability of Faecal Sludge

Importance of characterization!!!





# Hypothesis: Spatially Available

## Demographic Data – 180 Samples

In preparation

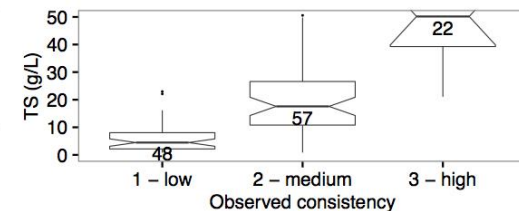
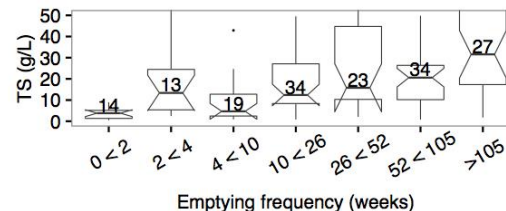
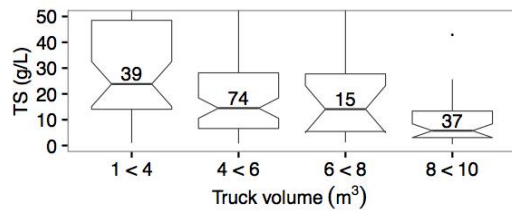
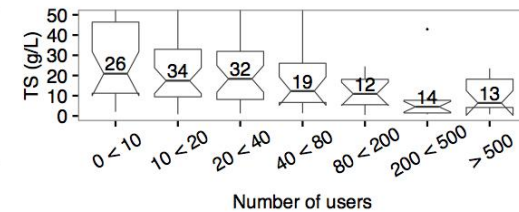
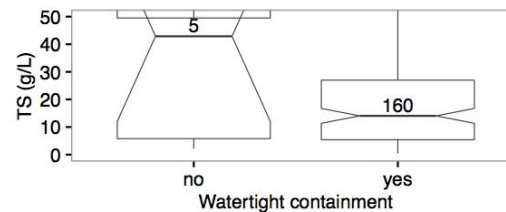
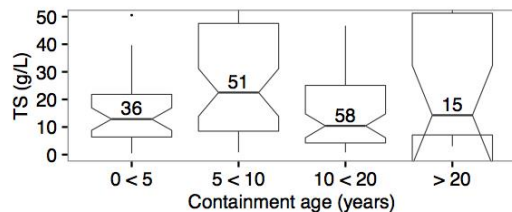
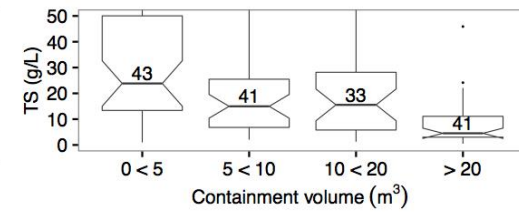
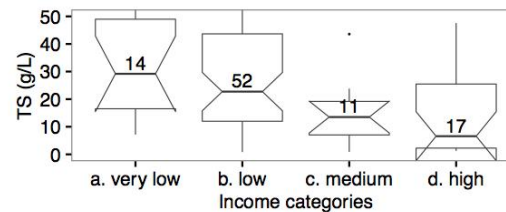
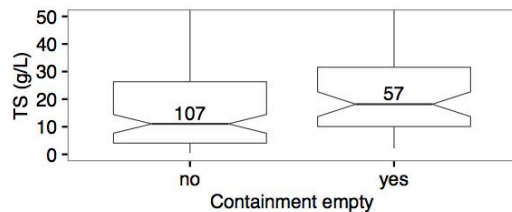
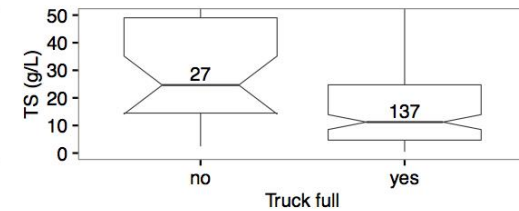
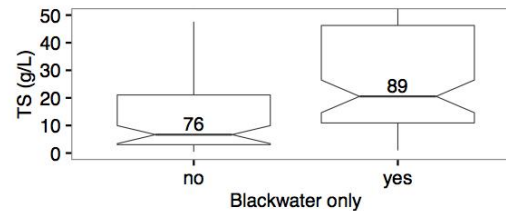
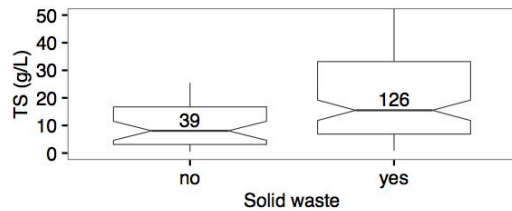
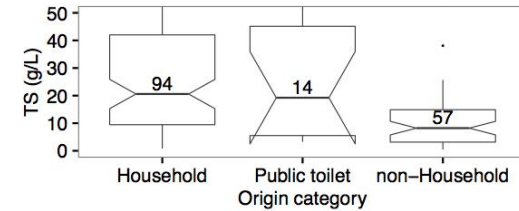
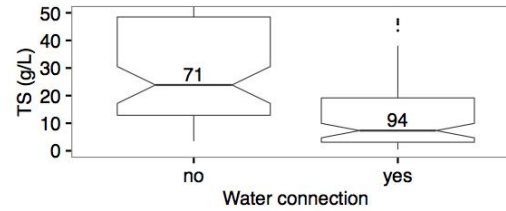
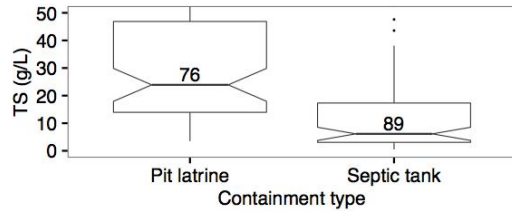
Strande, Schoebitz, Bischoff, Ddiba, Okello, Lohri, Niwagaba



# Predictors of Characteristics

In preparation

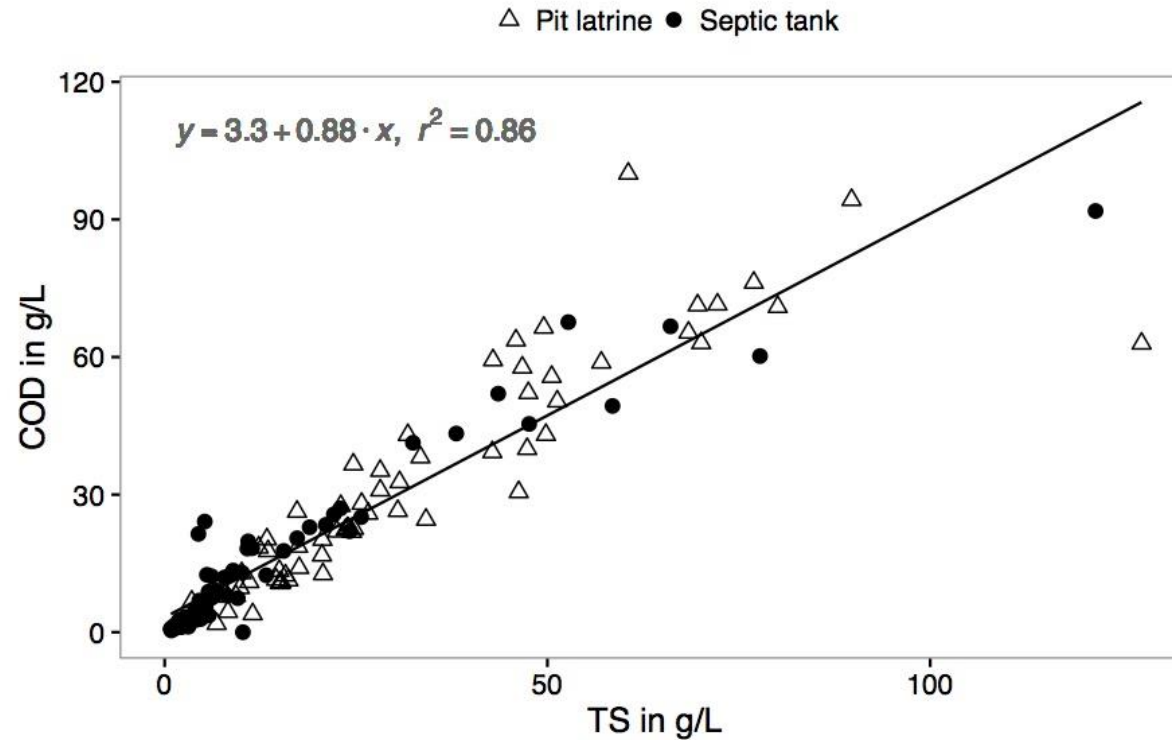
Strande, Schoebitz, Bischoff, Ddiba, Okello, Lohri, Niwagaba



# COD – TS Correlation

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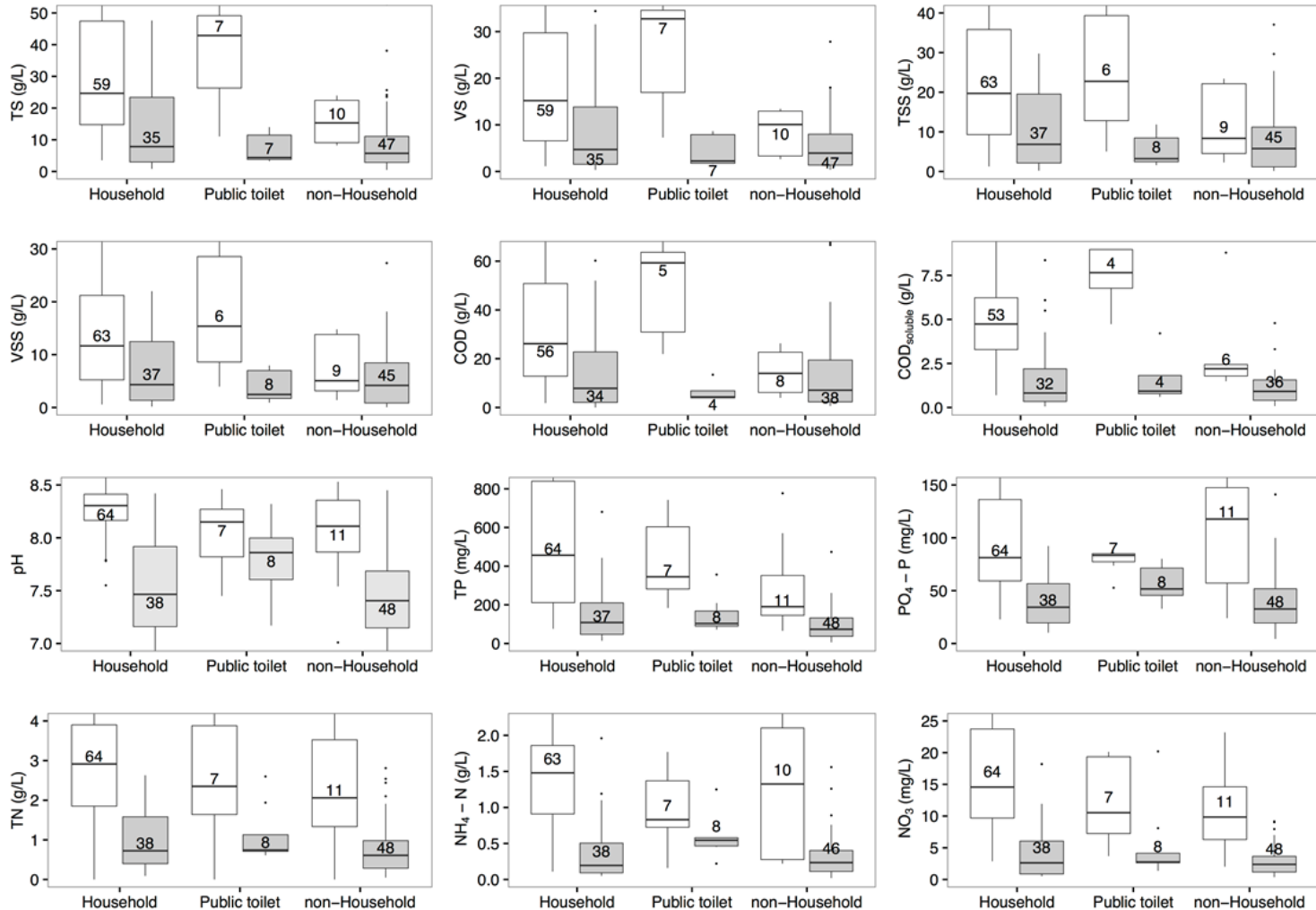
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# Predictors of Characteristics

In preparation

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# Sampling Location

In preparation

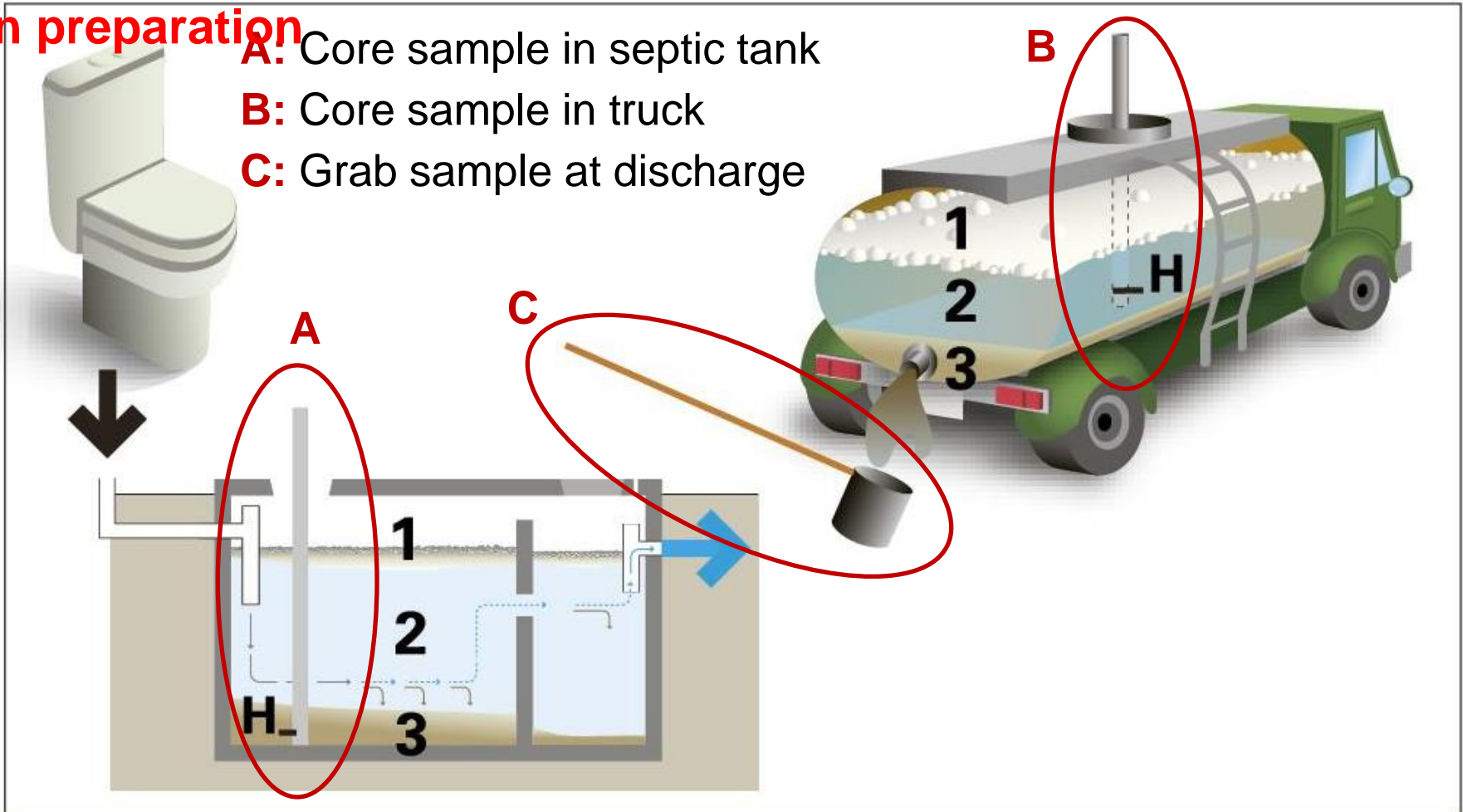
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In preparation

**A:** Core sample in septic tank

**B:** Core sample in truck

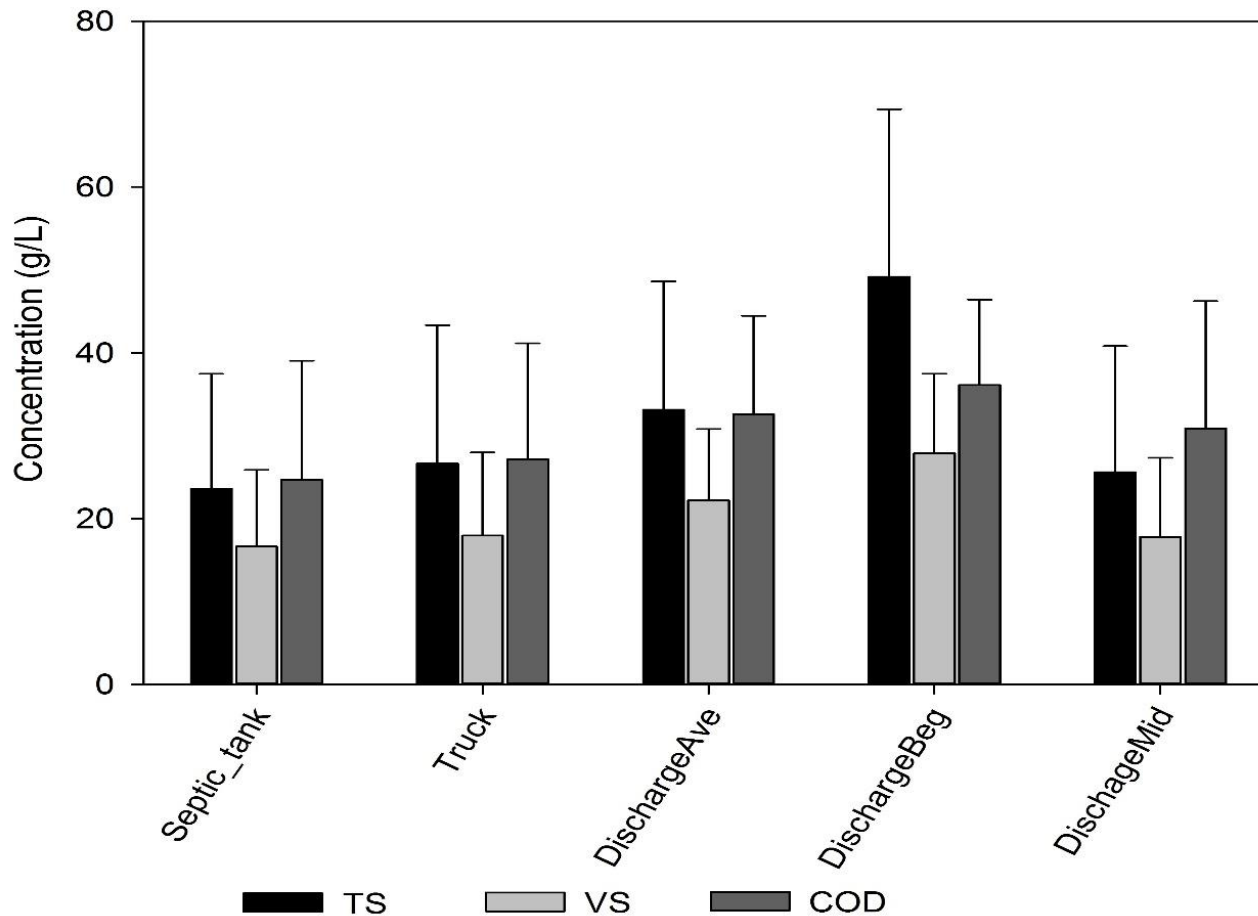
**C:** Grab sample at discharge



# Sampling Location

In preparation

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# Design Approach





# Massive Open Online Course "Introduction to Faecal Sludge Management"

**Language:** English  
**Subtitles:** French, Spanish and English  
**Costs:** FREE

[www.coursera.org/learn/faecalsludge](http://www.coursera.org/learn/faecalsludge)

**eawag**  
aquatic research ooo

**coursera**

**Start:**  
**1st of May**  
**2017**