# TN US SP

TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

iihs™

INDIAN INSTITUTE FOR HUMAN SETTLEMENTS

In Association With:

Keystone — A GROUP FOR ECO-DEVELOPMENT INITIATIVES

Gramalaya

CDD Consortium for DEWATS Dissemination Society

# Training programme on Fecal Sludge Management for Engineers in Trichy Corporation

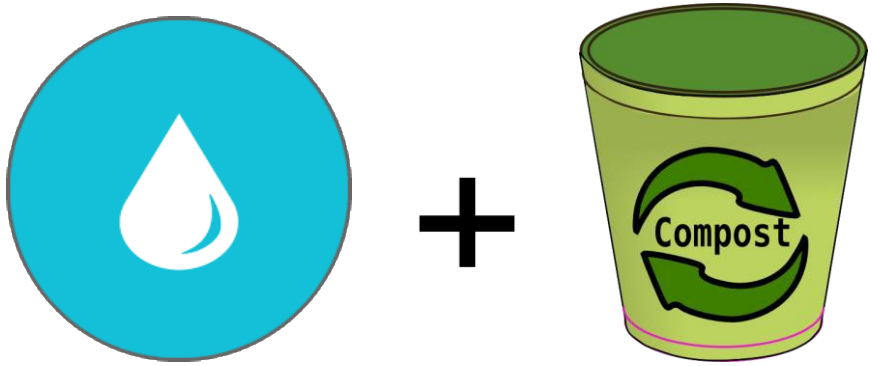
## Anaerobic digestion with co-composting : case study on Trichy

# Background

- Benefitiary population – 54,000 approx.
- Area available for FSTP – 1.6 acres
- Wards covered - 49, 45, 53, 57, & 60
- Households served - 10756 Households
- Capital cost : 3.6 crores
- O&M cost – 19 lakh per annum

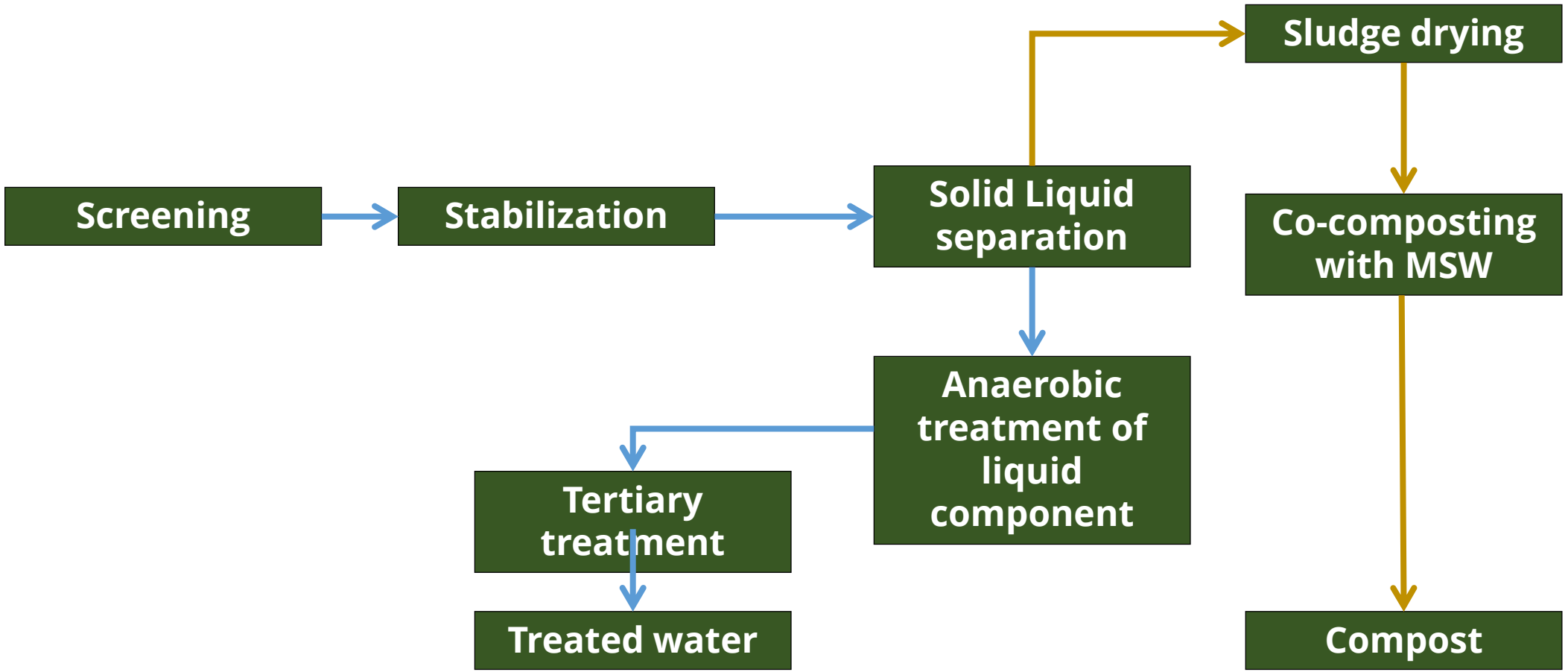
# Treatment outcomes

INPUT – Facel sludge

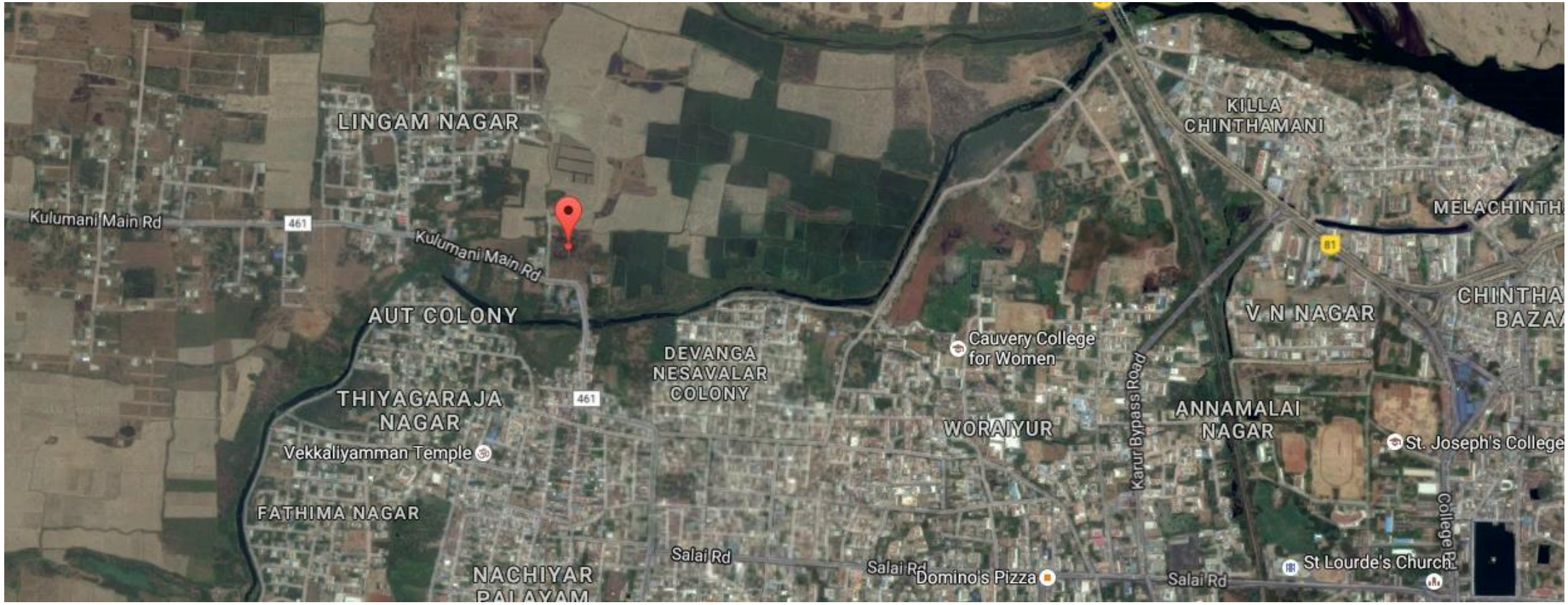



Output – Treated water, nutrient rich compost

# Treatment Concept



# Tiruchirappalli Location




- Proposed site for Fish Market - Buffer zone of 30 – 50 meters between FSTP boundary and fish market
- Nearby areas not connected to sewerage

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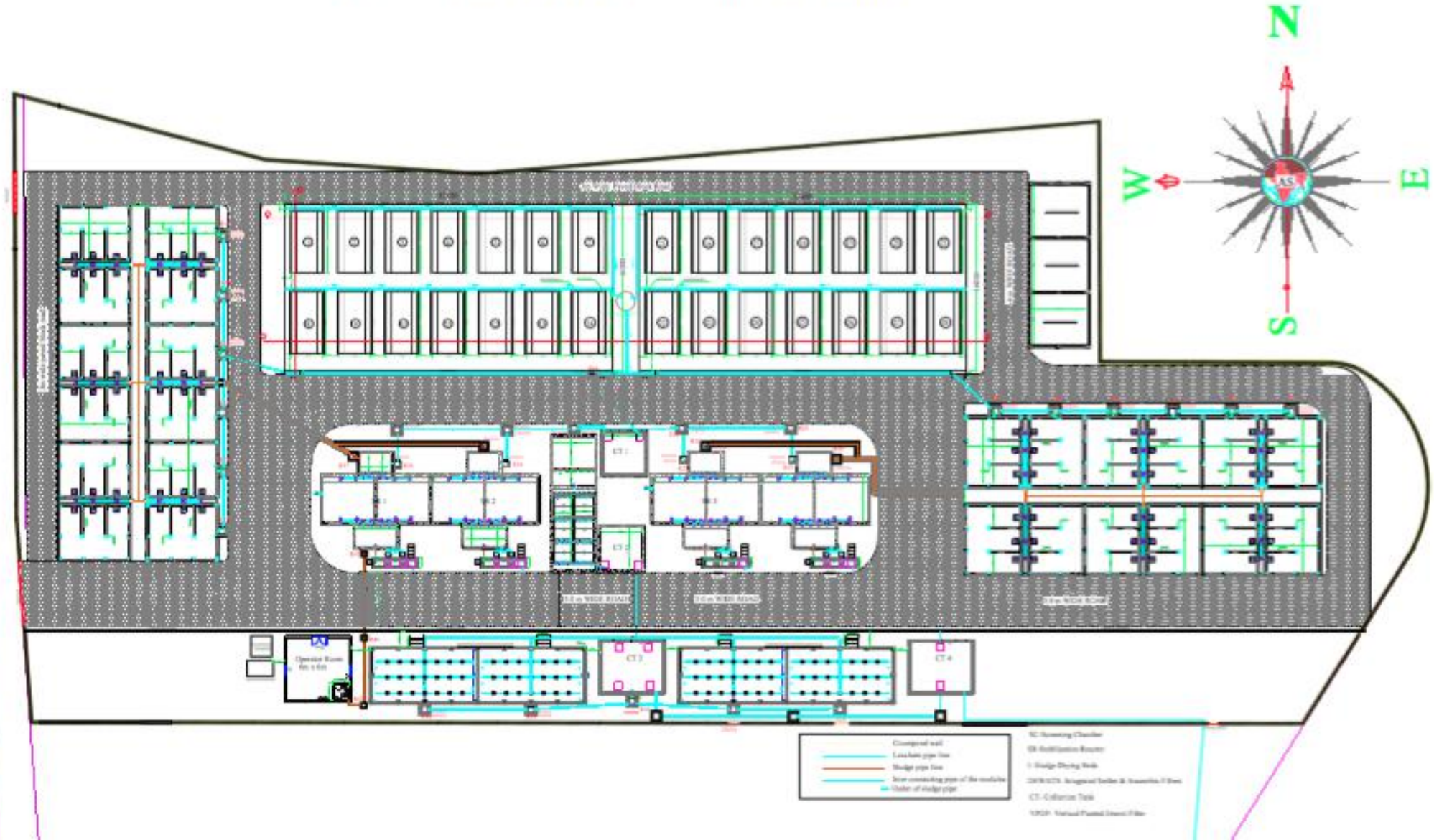
# FSTP Master Plan

Master Plan -FSTP,Tiruchirappalli-32Cum

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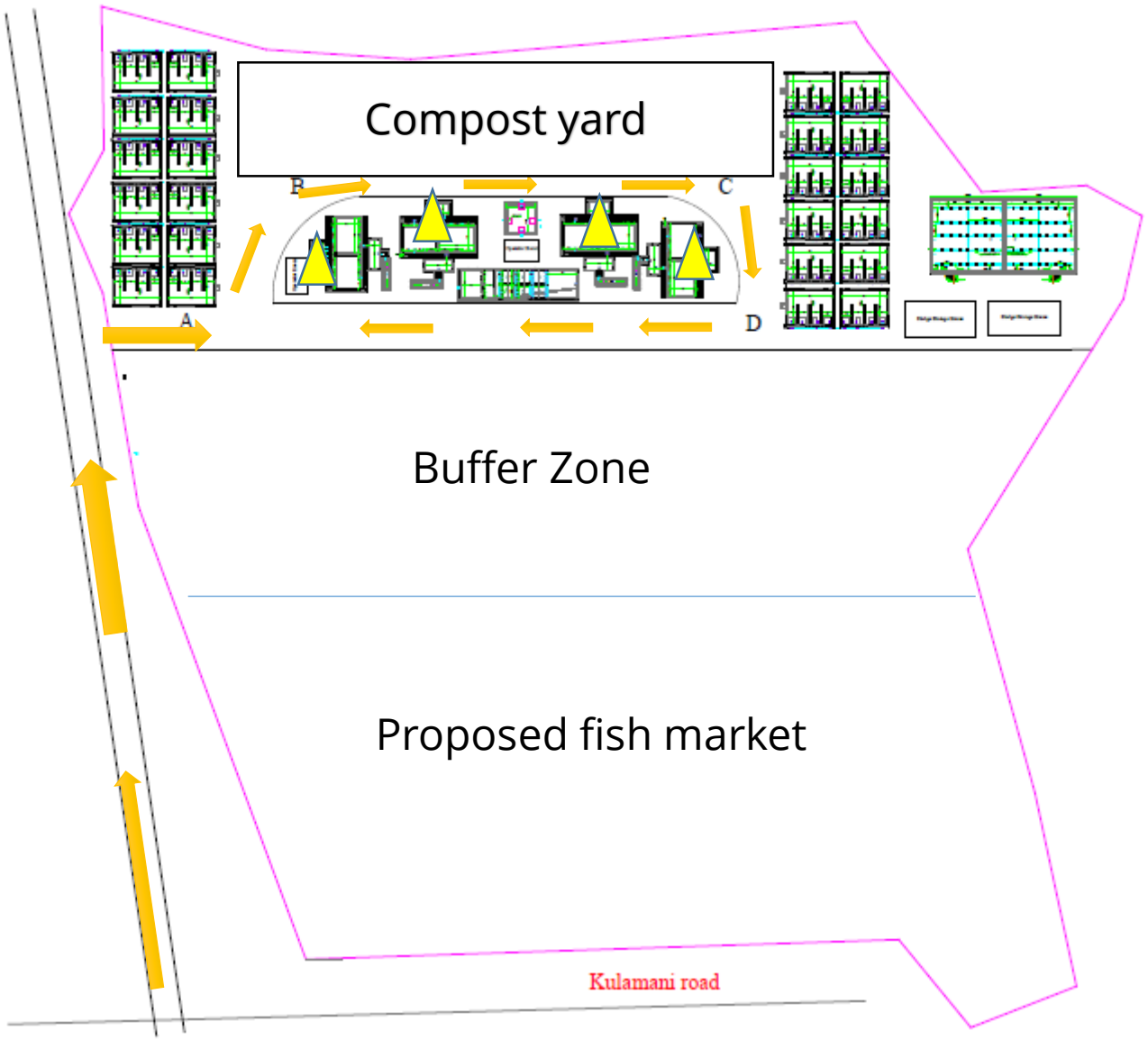
# FSTP – Truck route




Discharge points

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# FSTP – Implementation

# FSTP – Design Overview

| Parameters | Tiruchirappalli |
|---|---|
| Treatment capacity | 32 KLD |
| Maximum number of cesspool vehicles discharged per day ( 4 m3 capacity) | 8 Nos. |
| Input sludge | Faecal sludge, Septage, Fresh sludge from public toilets and CTs ( proportionate dilution with FS) |
| End Product | Treated water<br>Compost (co-compost with MSW) |
| Area Requirement | 1.6 acres |
| Estimated Cost | Rs. 3.6 Crore |
| O&M Requirement per year | Rs. 19,00,000 |

# Treatment efficiency and end products

| Parameters | Input | CPCB Standards for discharge into water body | CPCB Standards for Irrigation |
|---|---|---|---|
| COD | 30000 mg/L | < 250 mg/L | N.A |
| BOD | 20000 mg/L | < 30 mg/L | 100 mg/L |
| TSS | 6000 mg/L | <100 mg/L | 200 mg/L |
| E-Coli | - N.A- | < 1000 MPN per 100 mL | N.A |

| End Products | |
|---|---|
| Treated water | Reused for plantations in the buffer zone, excess treated water to be discharged in the adjoining natural drain. |
| Bio Solids | Dried sludge to be co-composted with municipal organic waste. |

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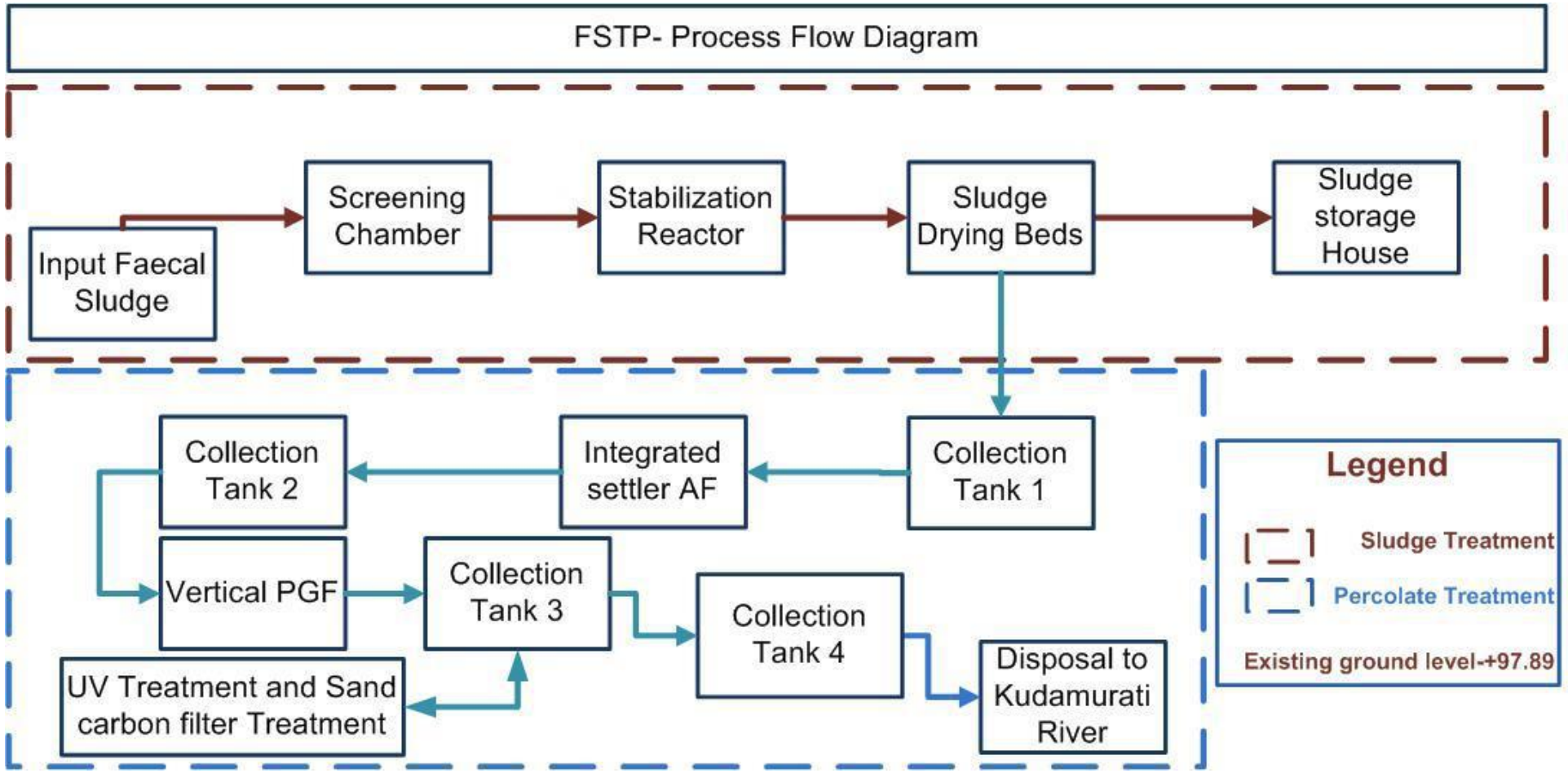
# Flow Description

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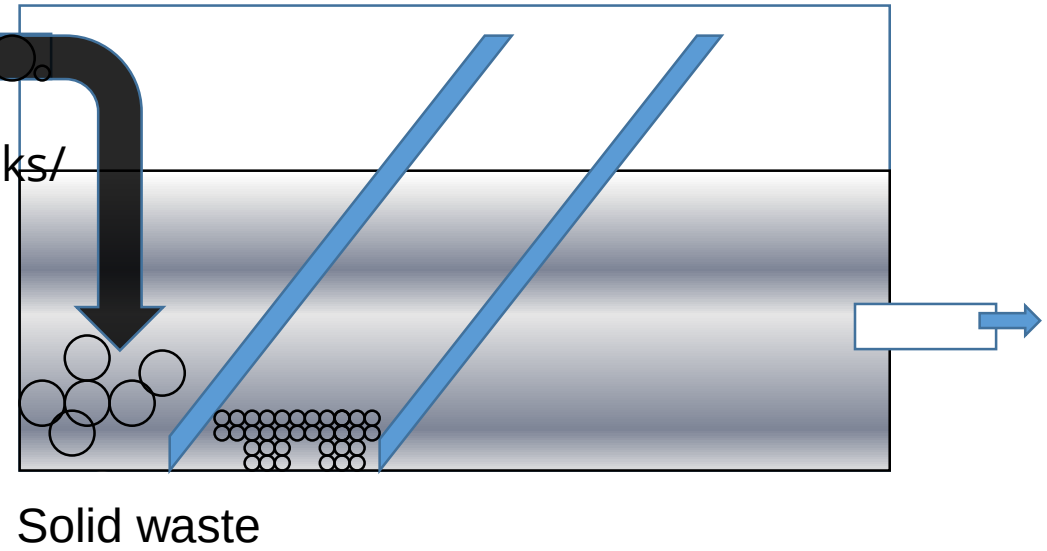
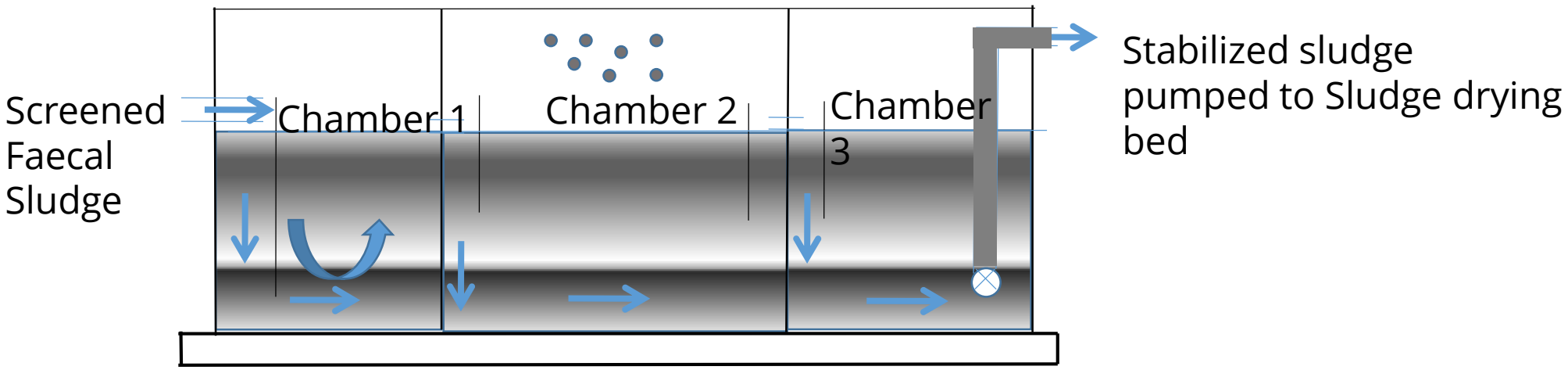
# Screening Chamber



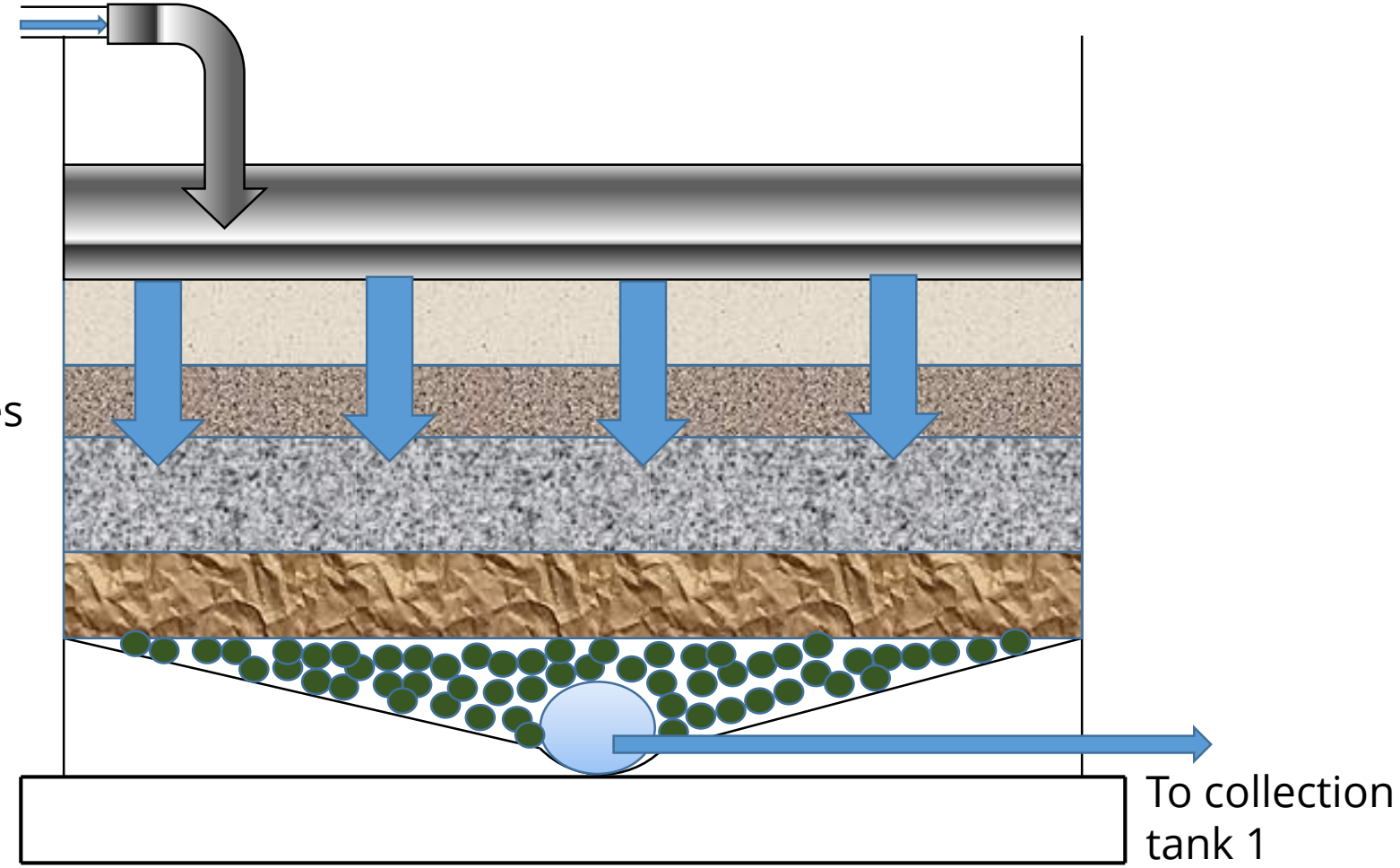

- Removal of solid waste
- Removal of sand and grit
- Consists of a course screen and fine screen
- Effluent is discharged into stabilization reactor for further treatment

# Stabilisation Reactor




- Consists of three chambers: Mixing, Stabilization and solid liquid separation
- Digests the organic solids and reduces smell
- Total retention period is 11 days
- The sludge along with the water is pumped into sludge drying beds

# Sludge Drying Bed




- Sludge from Stabilization reactor is applied on the sludge drying bed
- The bed has filter media of sand and graded aggregates

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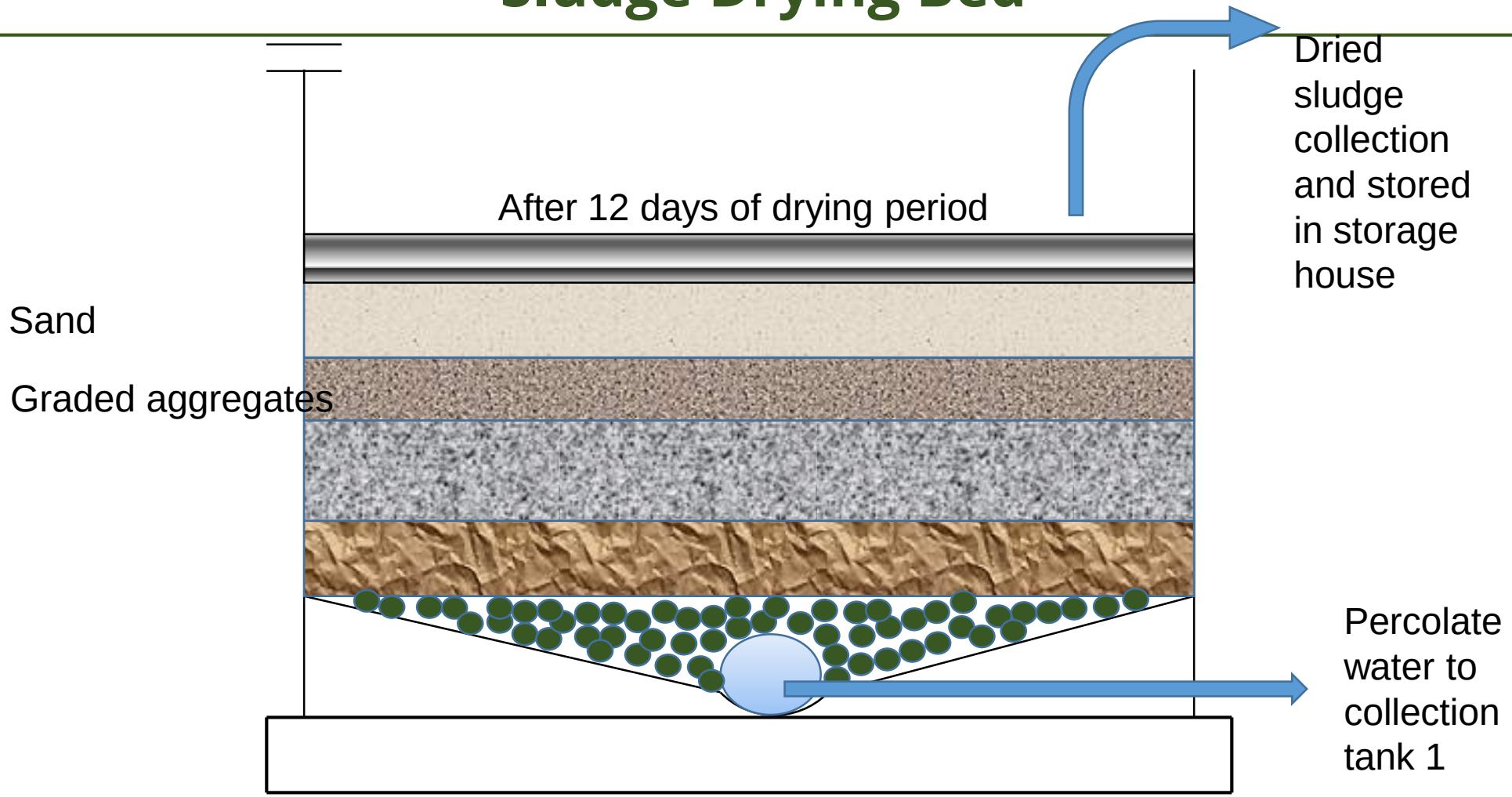
# Sludge Drying Bed




- ✓ Water percolates through the filter media and gets collected in collection tank 1
- ✓ After 12 days of drying the sludge is collected and stored in sludge drying bed for co-composting

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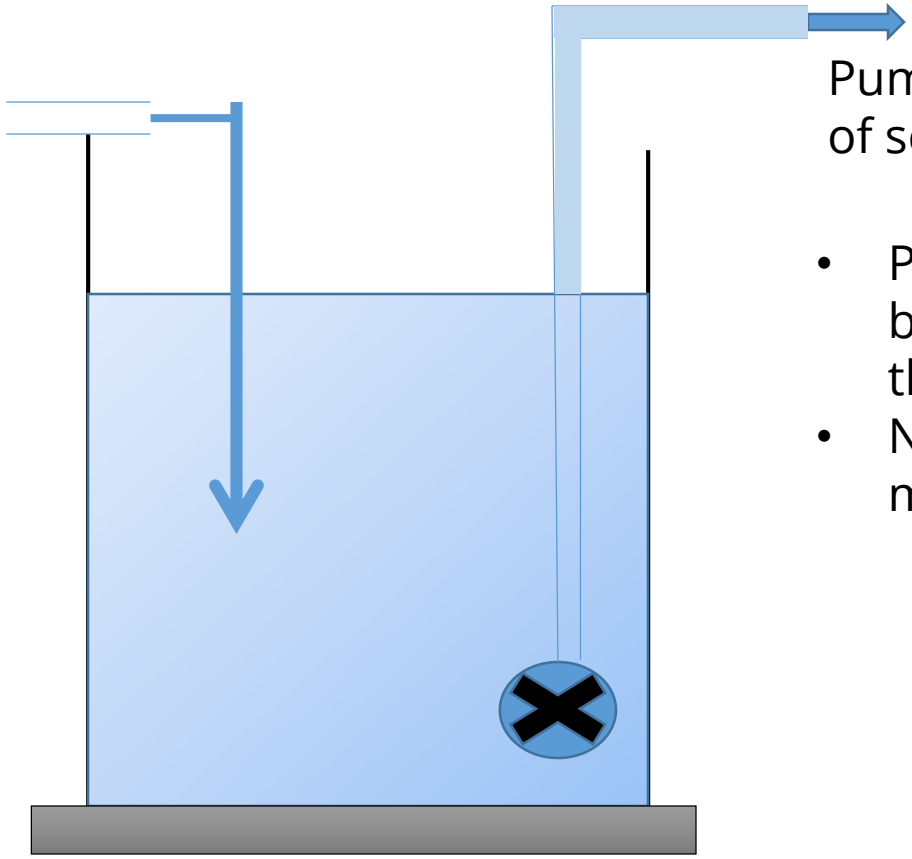
# Collection Tank -1

Percolate from the Sludge Drying Bed



Pumped To inlet of settler

- Percolate from the sludge drying bed is collected and then pumped to the inlet register of the settler
- No treatment involved in this module

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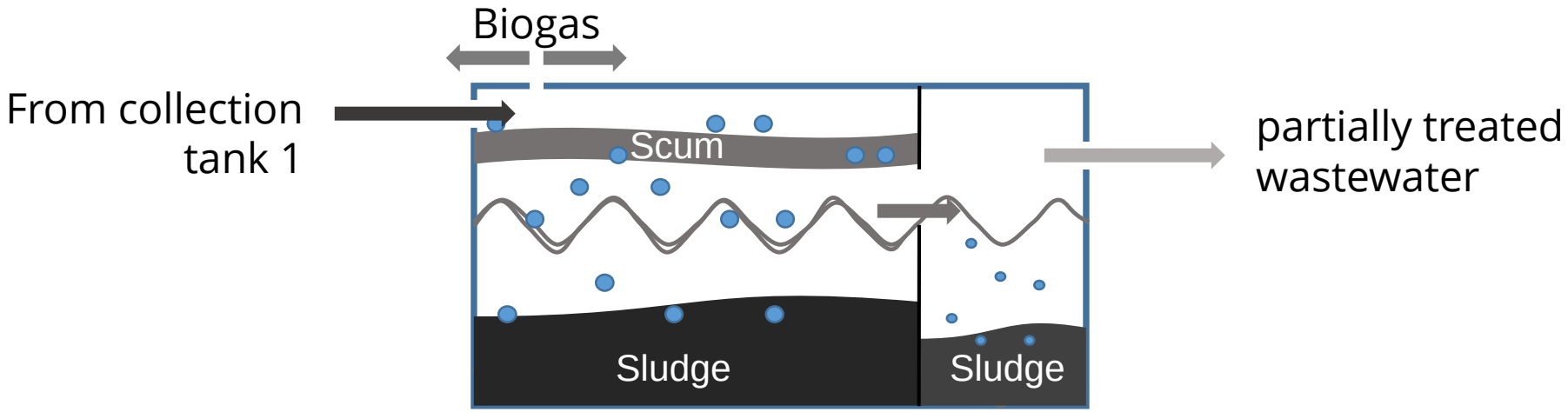
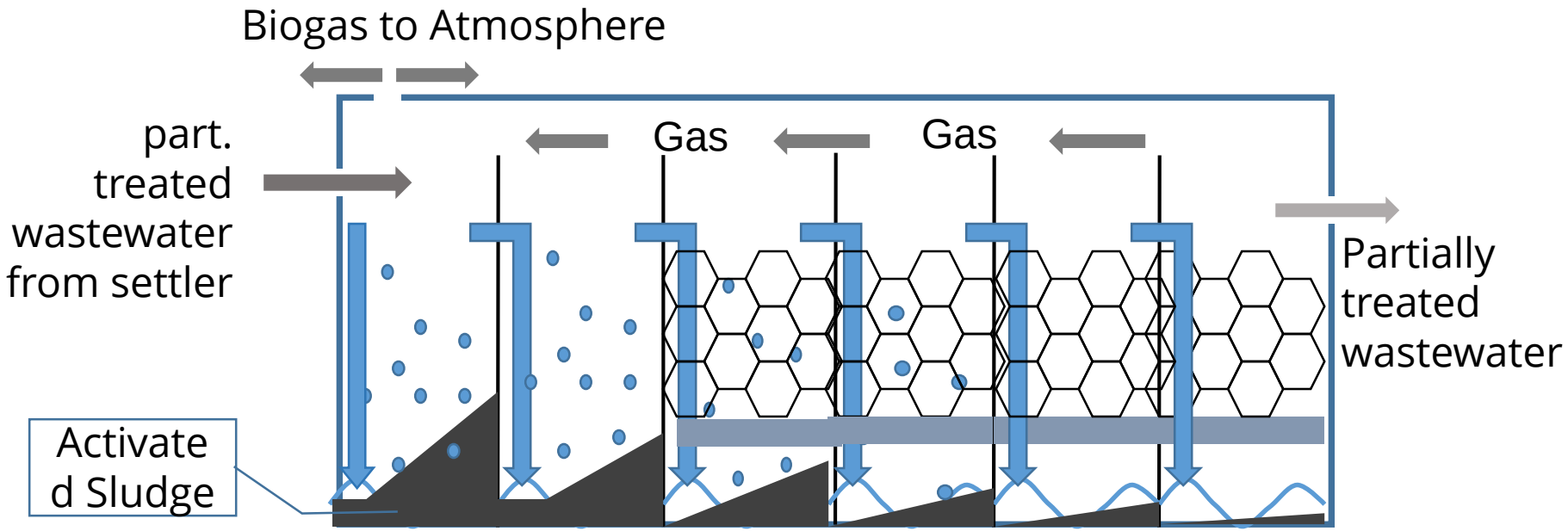
# DEWATS - Settler




- Settler removes the heavy particles which settle down at the bottom of the first chamber
- The retention time is around 2 – 4 hours

# DEWATS - Anaerobic Filter

## Secondary treatment




- The partially treated wastewater from the settler goes into the Anaerobic filter
- Treatment and removal of the soluble pollutants are removed in this module
- It has filter media in the chambers which help in provide surface area for biofilms to grow

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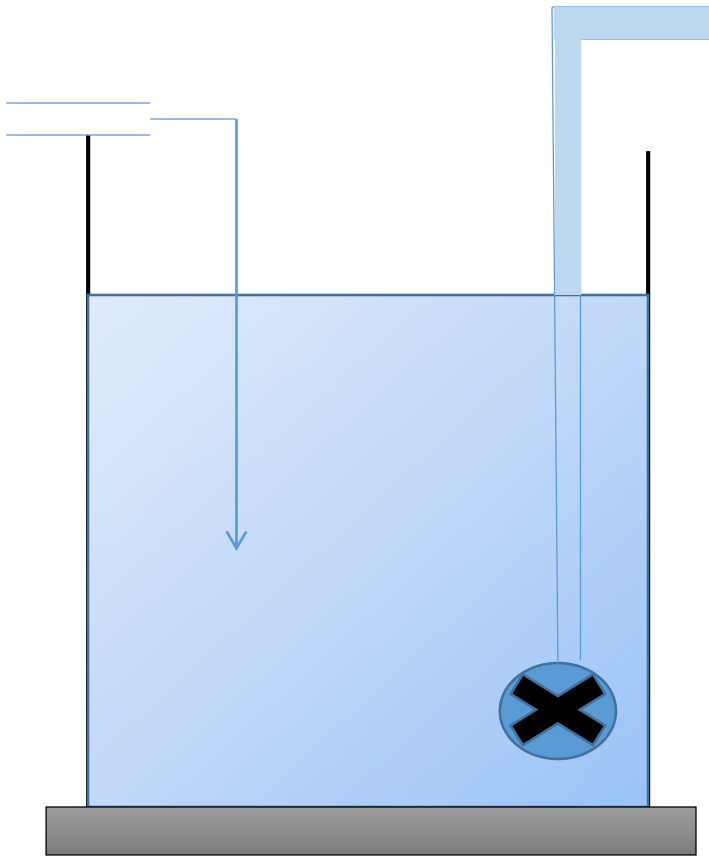
# Collection tank - 2

Treated percolate from DEWATS



To Planted Gravel Filter

- Effluent from the AF is collected in the collection tank -2
- The collected water is pumped into the distribution chamber of the PGF
- No treatment in this module

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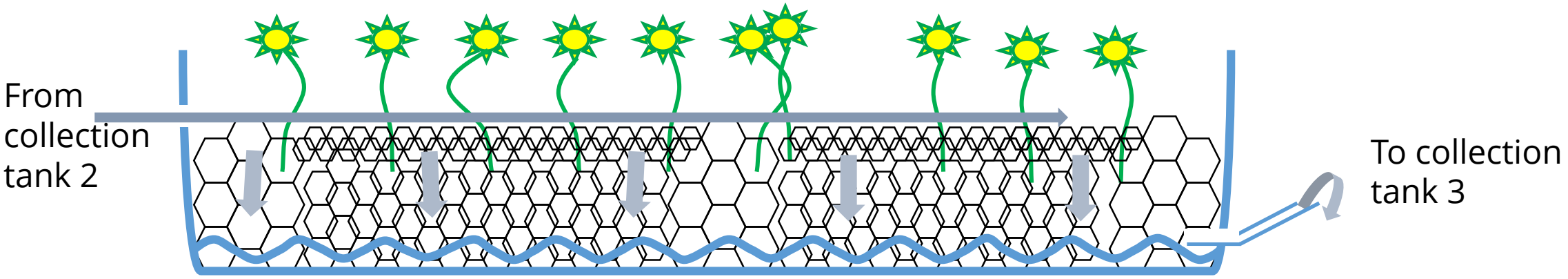
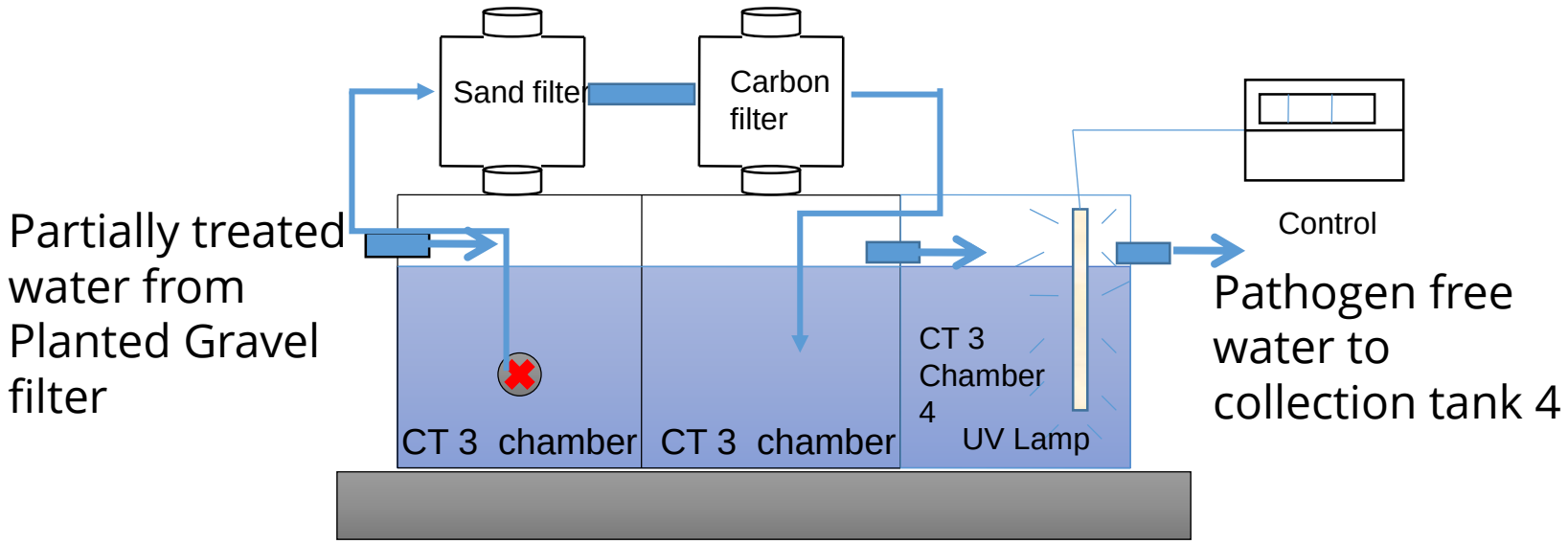
# DEWATS - Planted Gravel Filter




- The water pumped from collection tank 2 is fed into the PGF
- PGF removes the suspended solids and absorbs nutrients
- The percolate from PGF is collected in collection tank 3

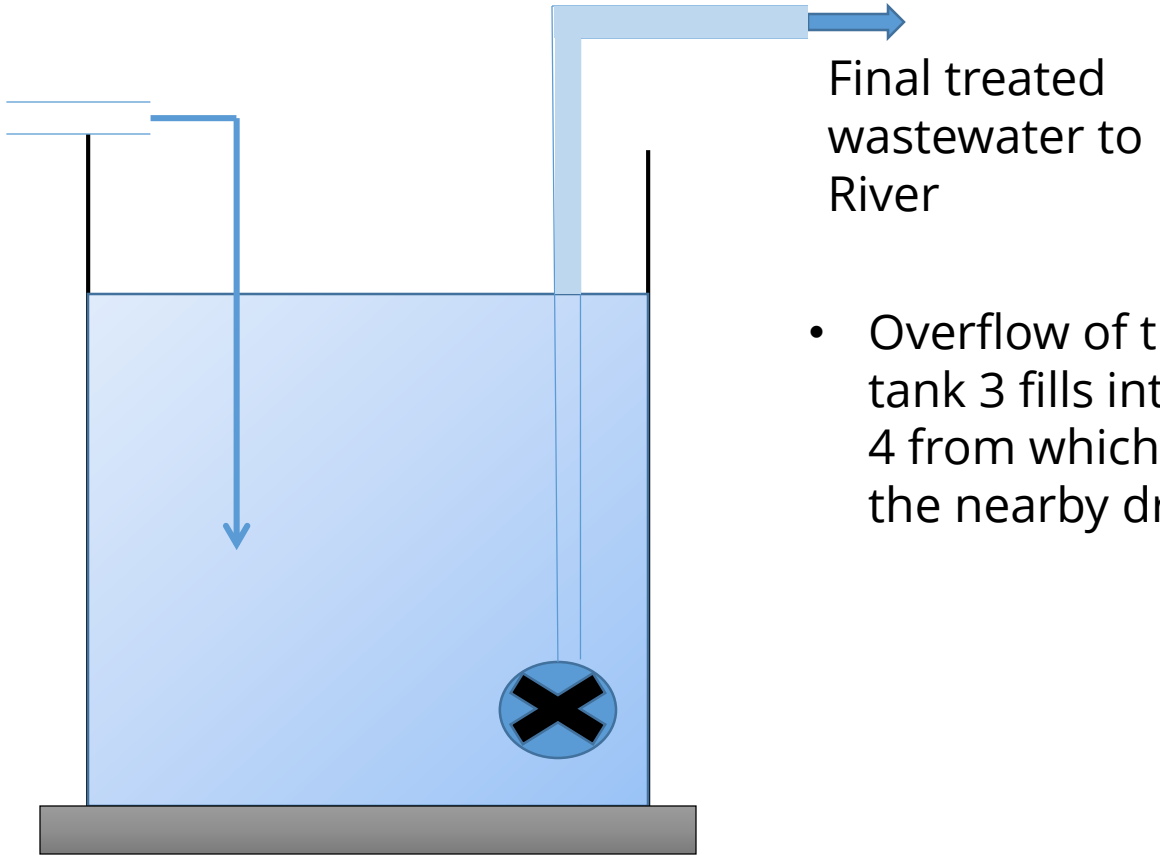
# CT 3 with Sand & Carbon Filter and UV lamp




- Water from the PGF is collected in the collection tank 3
- Water from the first chamber is pumped into the sand and carbon filter and discharged into the 2nd chamber
- Overflow of 2nd chamber is collected in 3rd chamber where it is disinfected with UV lamps

# Collection tank - 4

Pathogen free water



Final treated wastewater to River

- Overflow of the collection tank 3 fills into collection tank 4 from which it is pumped to the nearby drain

# Co-composting of treated faecal sludge with Municipal organic solid waste-

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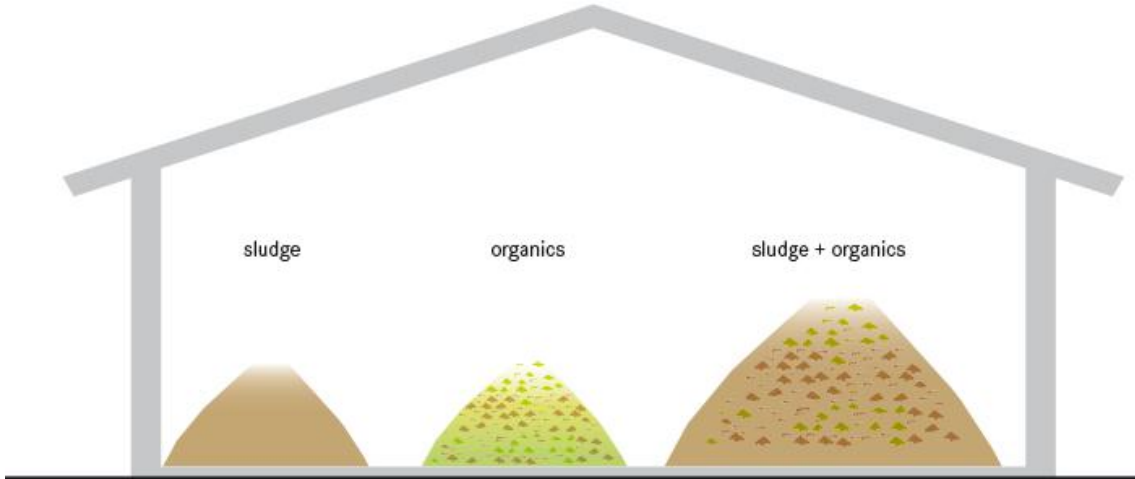
# Feedstock Used

1. Dried Faecal sludge
2. Municipal wet waste
3. Leaf litters

# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. Layering of faecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

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# Steps involved in co-composting process

1. **Sorting**
2. Shredding
3. Preparation of bed
4. Layering of faecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

Sorting of the municipal solid waste is done to remove the inorganic waste which can hinder the composting process. It can be done manually with proper protectic gear

# Steps involved in co-composting process

1. Sorting
2. **Shredding**
3. Preparation of bed
4. Layering of fecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

The sorted municipal waste is then shredded by means of a shredder in order to ease the process of laying it. Shredding also helps in better composting efficiency and air flow

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# Steps involved in co-composting process

1. Sorting
2. Shredding
3. **Preparation of bed**
4. Layering of fecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

The bed is prepared for laying of the faecal sludge and the shredded organic waste. The bottom layer is carefully laid with a thin layer of brown material — leaves, chopped stems, wood chips

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# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. **Layering of fecal sludge and organic waste**
5. Overturning of the compost layers
6. Collection of compost

The Feed materials (Faecal Sludge and Wet waste) are carefully layered in 1:2 ratio respectively one on top of another. The height of the compost pile is about 6 feet.

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# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. Layering of fecal sludge and organic waste
5. **Overturning of the compost layers**
6. Collection of compost

After a period of 15 days, the compost pile is overturned to the adjacent bed. This is to enhance the aeration and mixing of the compost. After the first turning, it has to be carried out every week. The thermophilic range of 60 – 70º Celsius is maintained. pH – 6 to 7;


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# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. Layering of fecal sludge and organic waste
5. Overturning of the compost layers
6. **Collection of compost**

After the composting process which takes around 60 – 90 days, the compost is black in colour with reduced height. This can be collected by means of a shovel and personal protective gears

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# Windrow feedstock after completion of maturation phase

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# Characterization of fecal sludge

**Sample Marked: "FAECAL" sludge**

| SL NO | Test | Unit | Result |
|---|---|---|---|
| 1 | pH | ----- | 4.60 |
| 2 | Conductivity | µmhos/cm | 3800 |
| 3 | Organic carbon content | % | 44.37 |
| 4 | Nitrate Nitrogen | % | 0.17 |
| 5 | Soluble phosphates as $PO_4$ | % | 1.50 |
| 6 | Potassium as K | % | 0.07 |
| 7 | Lead as Pb | mg/kg | BDL |
| 8 | Arsenic as As | mg/kg | BDL |
| 9 | Chromium as Cr | mg/kg | BDL |
| 10 | Cadmium as Cd | mg/kg | BDL |
| 11 | Nickel as Ni | mg/kg | BDL |
| 12 | Iron as Fe | % | 0.015 |
| 13 | Zinc as Zn | mg/kg | BDL |
| 14 | Manganese as Mn | mg/kg | BDL |
| 15 | Copper as Cu | mg/kg | 0.020 |

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# Characterization of municipal solid waste

**Sample Marked: Muncipal Wet/Waste**

| SL NO | Test | Unit | Result |
|---|---|---|---|
| 1 | pH | ----- | 3.88 |
| 2 | Conductivity | µmhos/cm | 2500 |
| 3 | Organic carbon content | % | 53.25 |
| 4 | Nitrate Nitrogen | % | 0.05 |
| 5 | Soluble phosphates as $PO_4$ | % | 0.25 |
| 6 | Potassium as K | % | 0.36 |
| 7 | Lead as Pb | mg/kg | BDL |
| 8 | Arsenic as As | mg/kg | BDL |
| 9 | Chromium as Cr | mg/kg | BDL |
| 10 | Cadmium as Cd | mg/kg | BDL |
| 11 | Nickel as Ni | mg/kg | BDL |
| 12 | Iron as Fe | % | 0.014 |
| 13 | Zinc as Zn | mg/kg | BDL |
| 14 | Manganese as Mn | mg/kg | BDL |
| 15 | Copper as Cu | mg/kg | 0.018 |

# Analysis values of windrow 1

| Sl. No. | Parameter | Organic compost (FCO, 2009) | Results of 60 days | Results of 88 days |
|---|---|---|---|---|
| 1 | pH | 6.5 – 7.5 | 7.02 | 7.07 |
| 2 | Conductivity (as dsm-1), not more than | 4 | 0.15 | 1.24 |
| 3 | Particle size | Minimum 90% material should pass through 4.0 mm IS sieve | - | Passes |
| 4 | Moisture, percent by weight, maximum | 15 – 25 | - | 30.2 |
| 5 | Bulk density (g/cm3 ) | Less than 1.0 | - | 0.77 |
| 6 | Total Organic Carbon, % by weight, minimum | 12 | 42 | 18.2 |
| 7 | Total Nitrogen (as N), % by weight, minimum | 0.8 | 1.21 | 0.23 |
| 8 | Total Phosphate (as P205) % by weight, minimum | 0.4 | 0.48 | 0.2 |

# Analysis values of windrow 1

| Sl. No. | Parameter | Organic compost (FCO, 2009) | Results of 60 days | Results of 88 days |
|---|---|---|---|---|
| **9** | Total Phosphate (as P205) percent by weight, minimum | 0.4 | 0.48 | 0.2 |
| **10** | Total Potassium (as K20), percent by weight, minimum | 0.4 | 2.61 | 0.98 |
| **11** | C:N ratio | <20 | 1:34.7 | 12.1 |
| **12** | Lead(mg/kg) | 100 | 85 | 84.9 |
| **13** | Chromium (mg/kg)) | 50 | 32 | 31.1 |
| **14** | Cadmium | 5 | 0.37 | 0.37 |
| **15** | Nickel(mg/kg) | 50 | 23.5 | 23 |

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# Analysis values of microbes

The results for helminthes egg count of the faecal sludge and co-composted sludge :

| Pathogen | Treated faecal sludge | Compost standards |
|---|---|---|
| Helminth eggs | 100 EPG | ≤ 3-8 eggs/gram of dry solids (Source: Xanthoulis and Strauss 1991) |
| Faecal coliforms | $60*10^5$ CFU/100ml | <1000 MPN/g (Source: CCME When compost contains only yard waste) |

# Thank You