Lecture 6: River water quality

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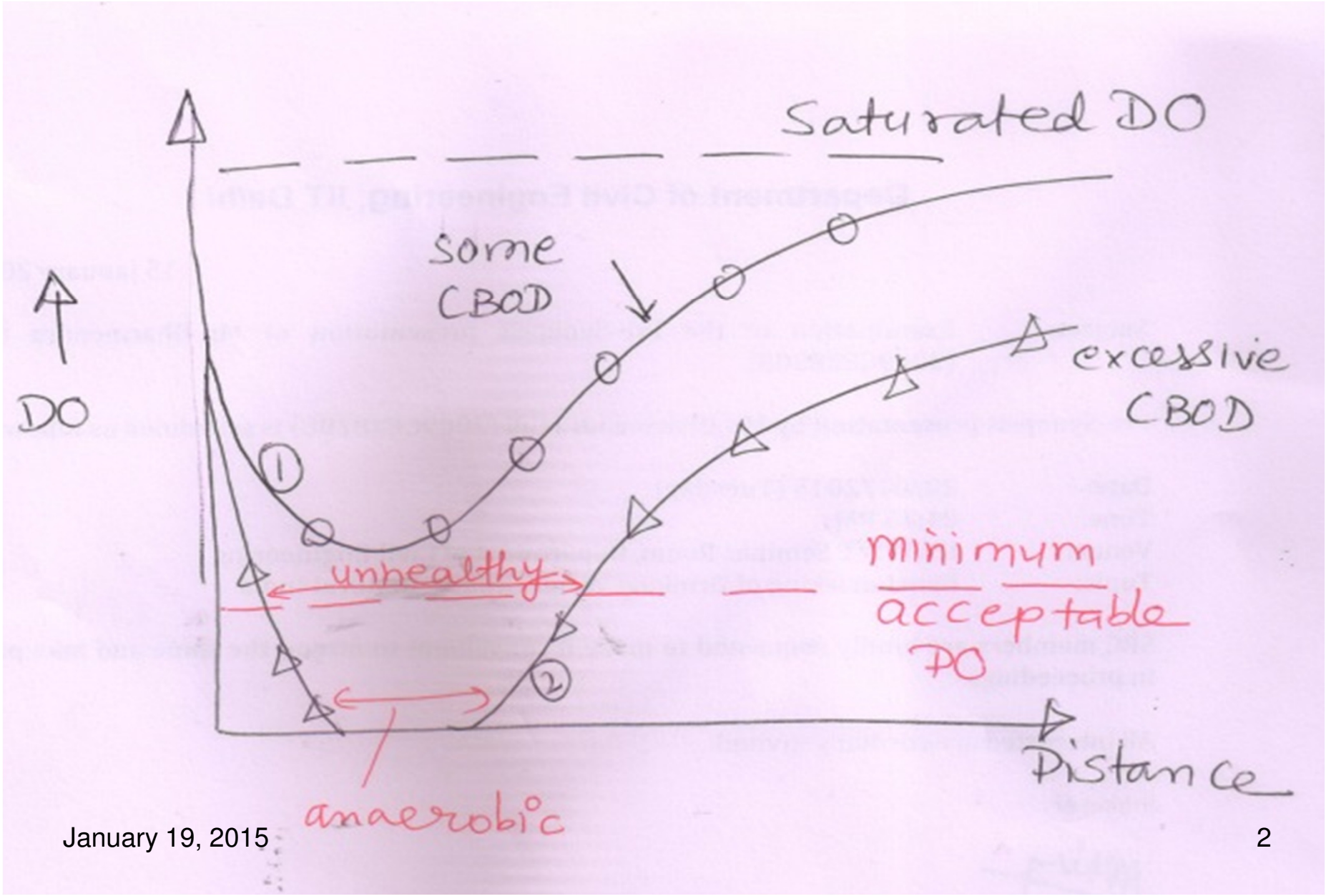
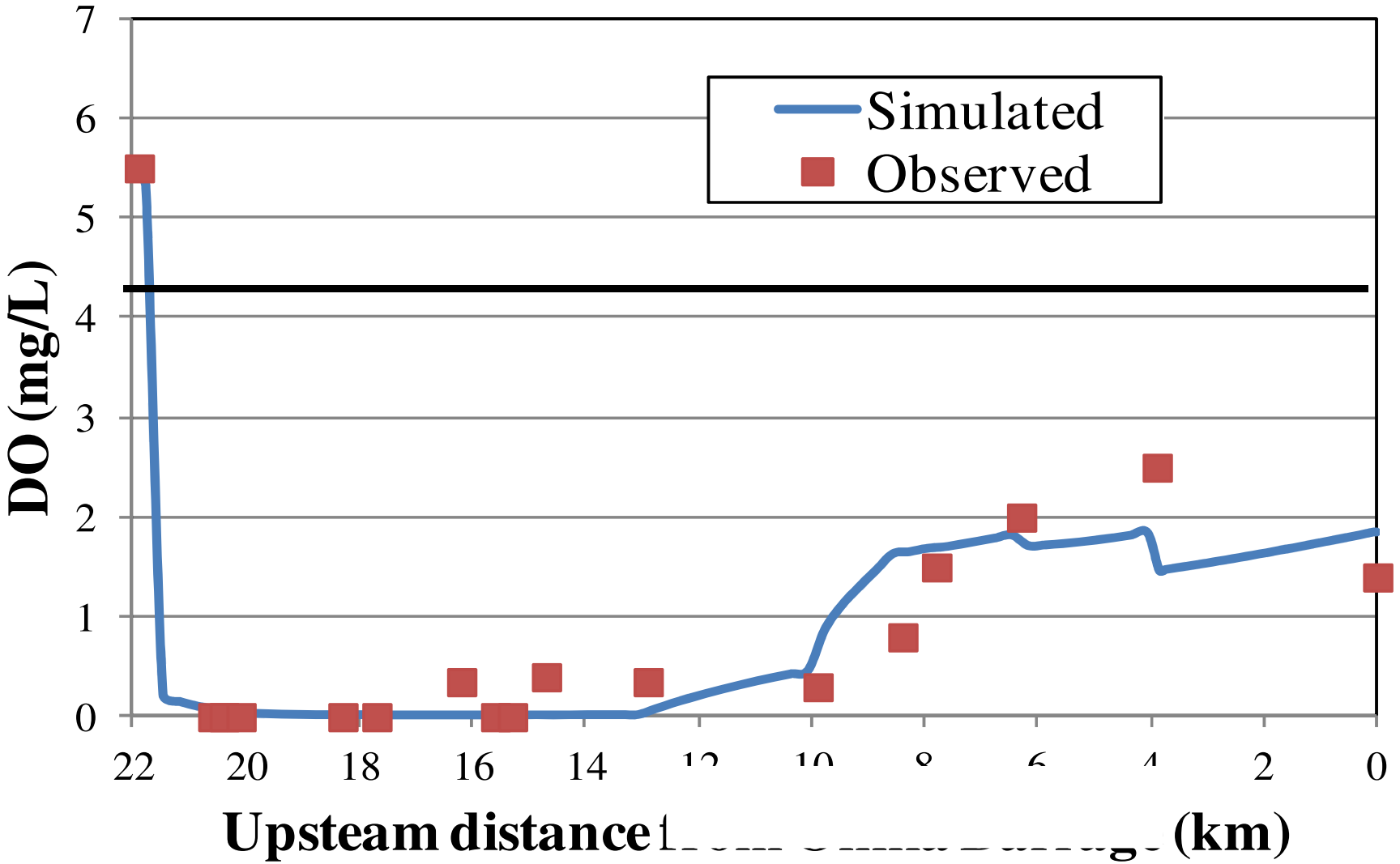
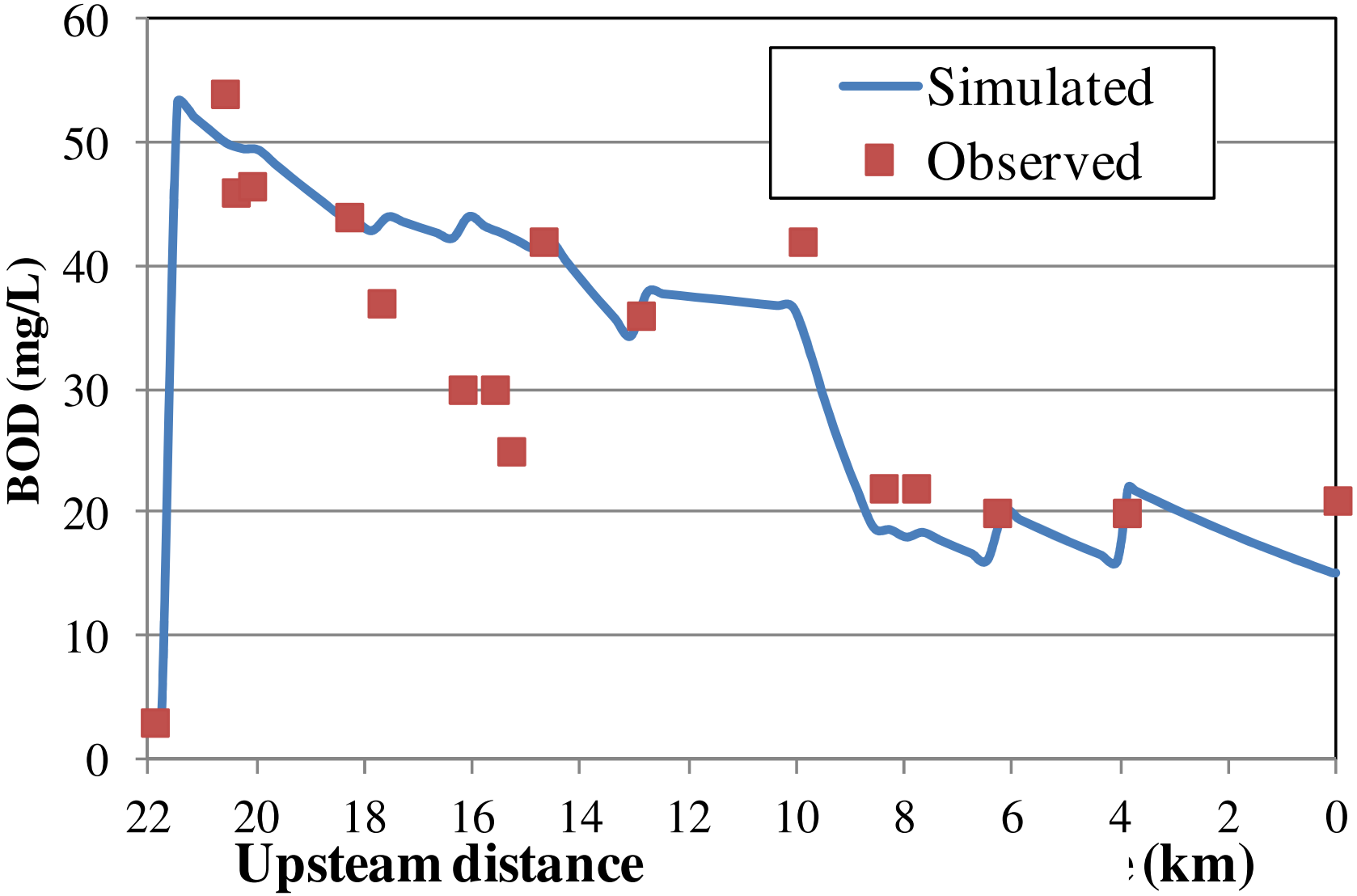
Objective: Analyzing river water quality data and determining need for treatment

1.Effect of pollution on DO sag curve



Example 1: Multiple drains entering into river AA

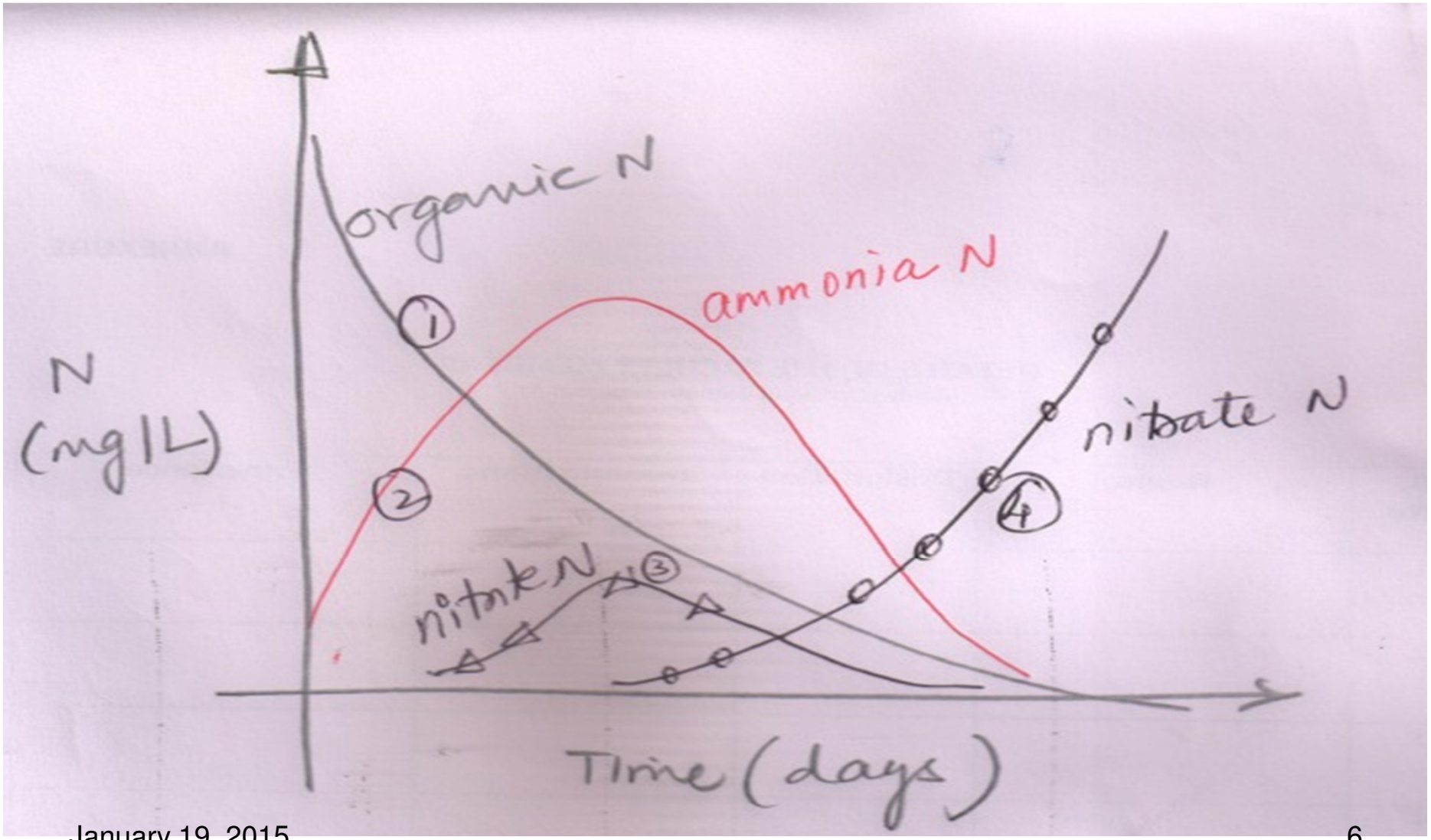



60
50
40
30
20
10
0
BOD (mg/L)
Simulated
Observed
22
20
18
16
14
12
10
8
6
4
2
0
Upsteam distance
(km)

Question

- Which region is not safe for aquatic species (required DO=4mg/L)?
- Should we do something in river? Or in drain?
- Which parameter to vary and how?
- How to calculate % treatment required in drain?
- What information are required?

2.Change in Nitrogen form in a polluted river under aerobic conditions



Fate of N-based compounds in river water

- The figure indicates the trend of inter-conversion of different forms of N.
- With time, one can find different forms of N present in water (ex: ammonia-N; nitrite-N).
- The form of nitrogen detected in water can indirectly tell about time elapsed since introduction of N-based pollution in river.
- One of the indicators of human fecal pollution

Modification steps

- Its better to control pollution in drain instead of doing in river itself.
- Polluter can reduce BOD or COD upto desired level so that drain water when mixed with river water do not exceed the required receiving body standard for DO and BOD.

Treatment method

- For treatment, the polluter has to decide about type of treatment required (chemical or biological or a combination of these two methods)
- For oxygen demanding wastes (high BOD/COD value), generally biological method (such as aerobic process; anaerobic process) is preferred over chemical methods (such as oxidation).

Treatment method

- For oxygen demanding wastes (low to medium BOD/COD value), first chemical method is used to make waste biodegradable and then biological method is used.
- The first step of using chemical method can improve BOD/COD value of oxygen demanding waste and can help in subsequent biological process.

Water Treatment Plant Schematic

Objective: To introduce water treatment plant schematic and need for different unit processes

Step 1. List water quality characteristics which need to be removed

- Parameters:
  - Ions (arsenate; chromate ions;nitrate)
  - Organic compounds (pesticides, etc.)
  - Pathogens (viruses, if we have human fecal pollution)
  - Solids (depends if there is a fracturing in subsurface)
  - Gases(methane, etc.)

Step 2. Identify unit(s) which can remove at least one type of contamination

- Ions (removal by: adsorption; coagulation-flocculation; chemical precipitation; bio-adsorption; membrane process)
- Organic compounds (degradation/removal by: oxidation; adsorption; biodegradation; reduction-oxidation; irradiation; membrane process)

Step 2 contd.

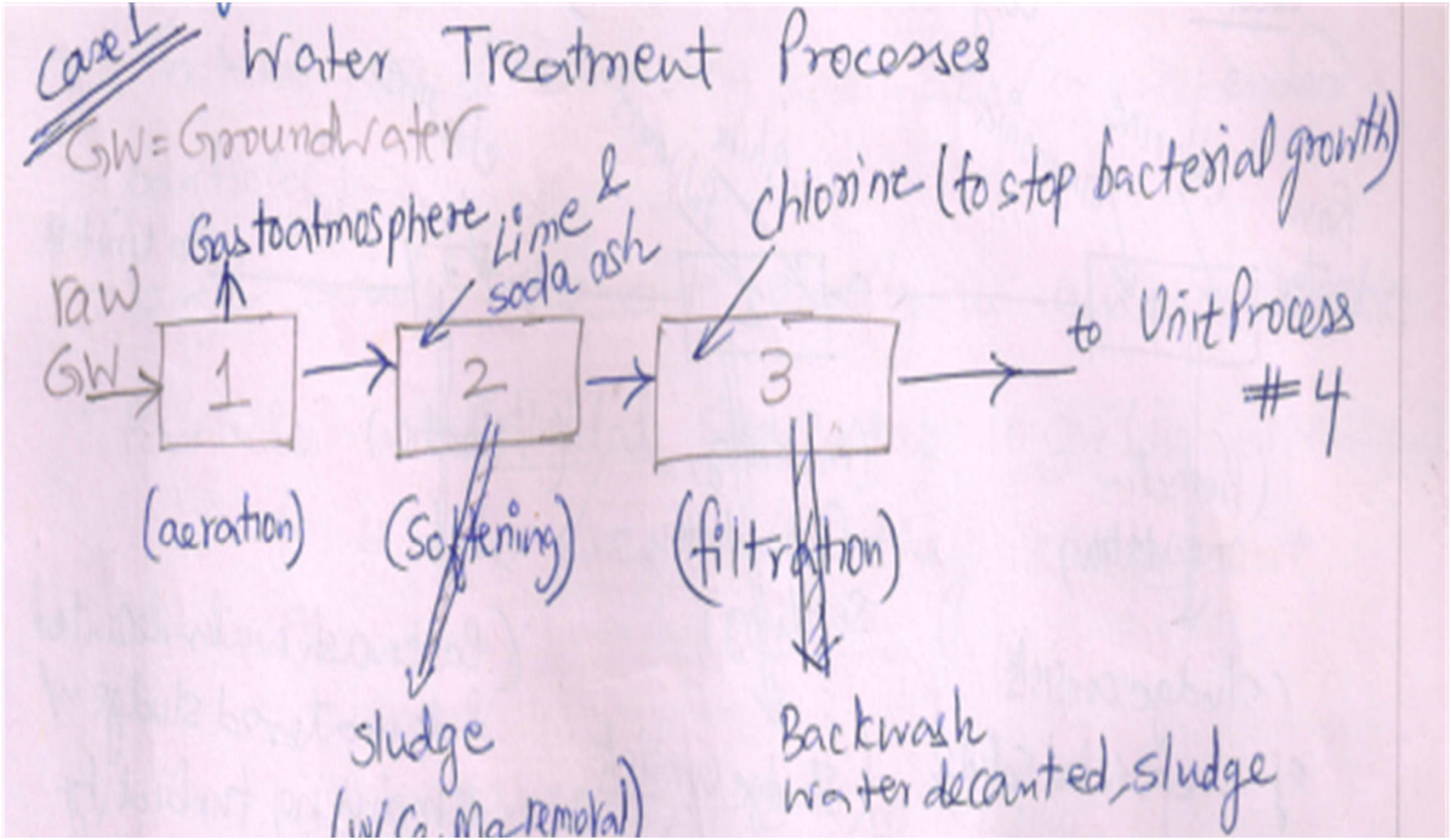
- Pathogens (killed by : adsorption; coagulation-flocculation; chemical precipitation; disinfection; boiling; irradiation; membrane process)

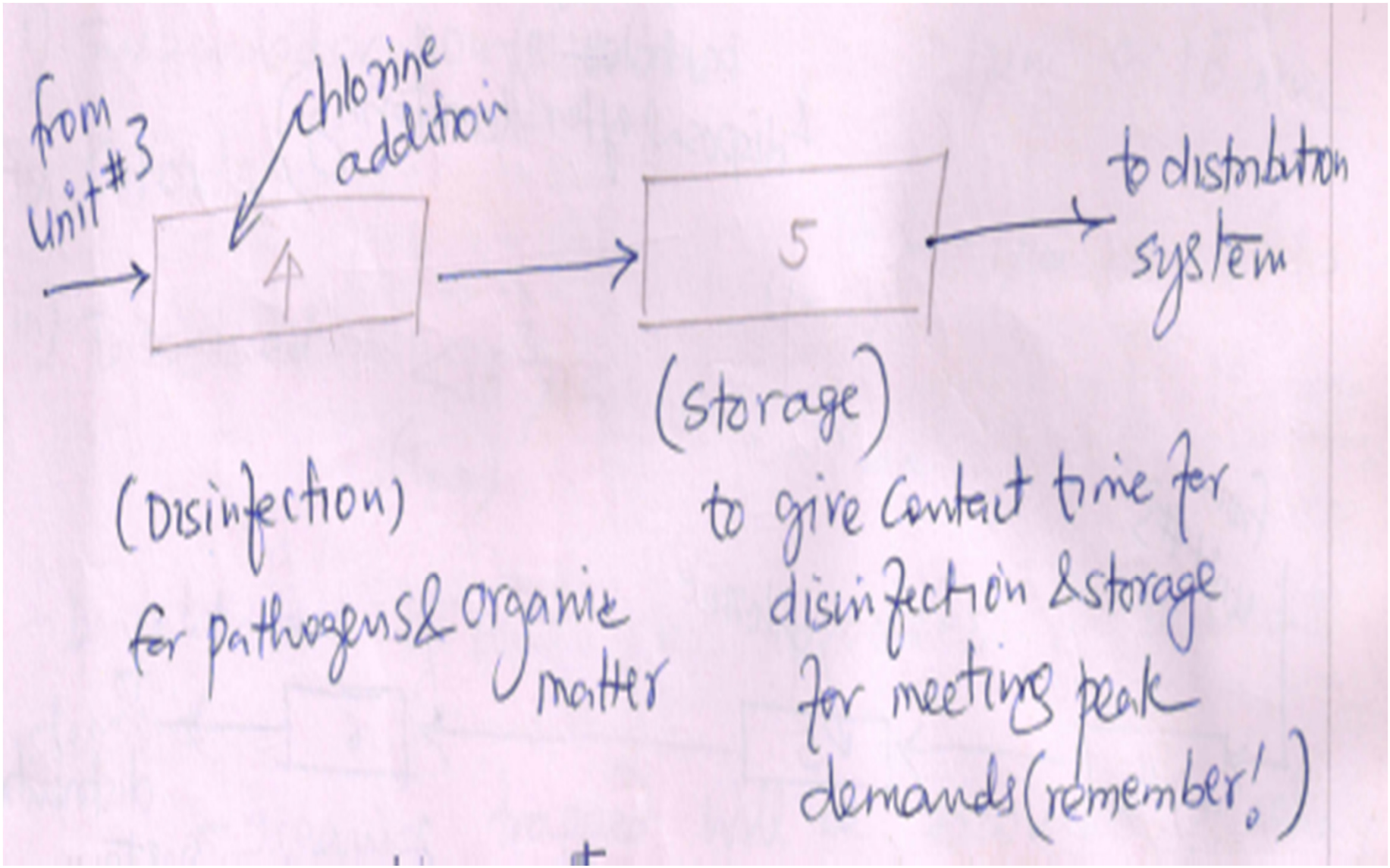
Step 2 contd.

- Solids (removal by : settling; filtration; membrane process)

- Gases (removal by) : aeration; adsorption; solubilization)

Example 1: Groundwater →produce drinking water)




from Unit #3
chlorine addition
4
5
to distribution system
(storage)
(Disinfection)
for pathogens & organic matter
to give contact time for disinfection & storage for meeting peak demands (remember!)

Treatment schematic (GW→ Potable drinking water)

- Raw Ground water → aeration chamber → Softening unit → Filtration with chlorination →Disinfection → Storage
- See sequence of units used
- Chemical is required to be added
- Water is treated
- Chemical sludge is produced

Units used for (GW→ Potable drinking water)

- Aeration chamber (to remove gases; using air)
- Softening unit (to remove cations; using softener and/or cation exchangers)

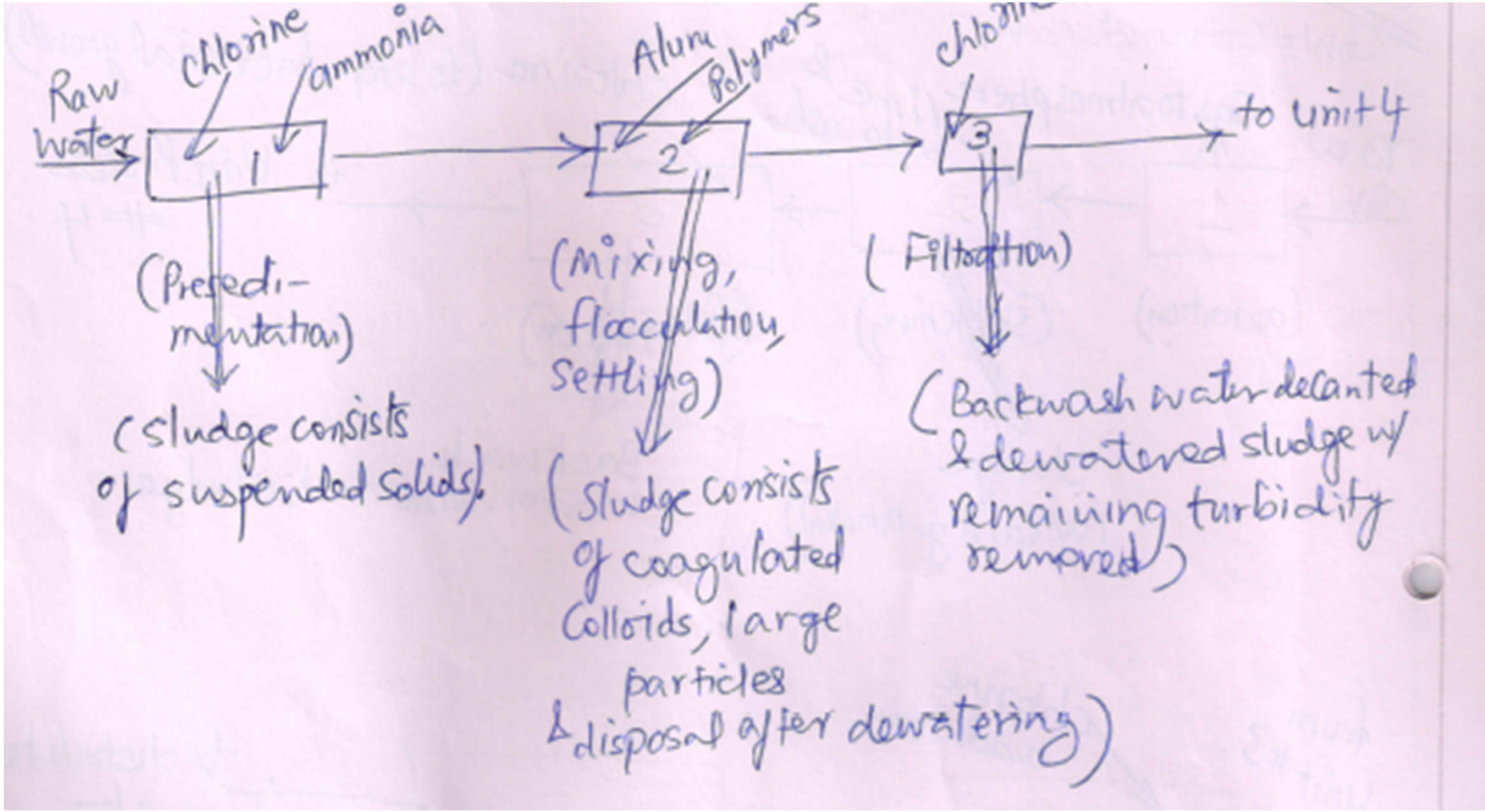
Treatment schematic (GW→ Potable drinking water)

- Filtration with chlorination (to remove solids; to kill microbial growth on filter unit surface)
- Disinfection (to kill microorganisms before water is supplied for public consumption)
- Storage

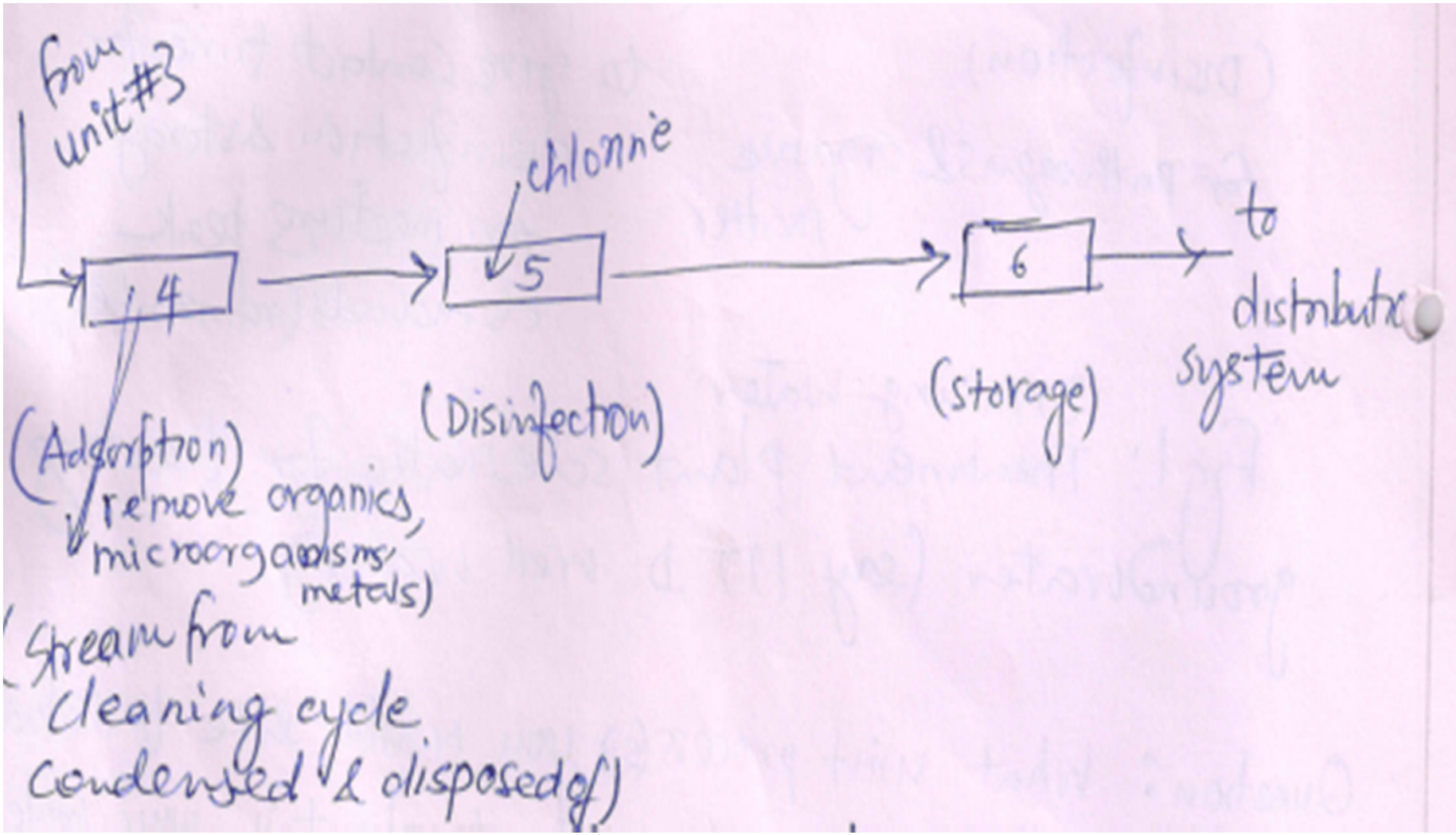
Example 2: Yamuna River Water →produce drinking water)

- Think for 5 minutes for two steps.
- Step 1: water quality characteristics determination
- Step 2: selection of units, their order

Example 2: Yamuna River Water →produce drinking water)



Example 2 schematic contd.



Next class: Friday