WATER WISE

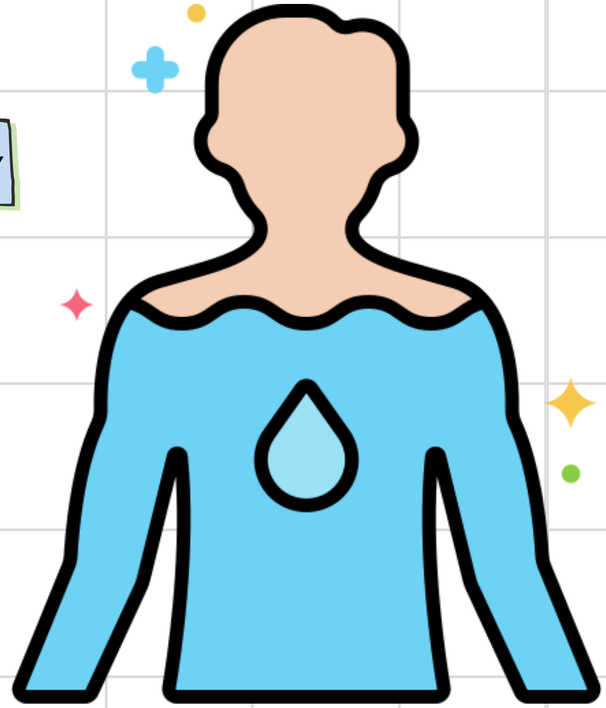
TEAM 57

PURE WATER & ITS IMPORTANCE

IMPORTANCE OF SAFE DRINKING WATER

- DETOXIFICATION
- HEALTH & CLEANLINESS
- NUTRITION
- SUSTAINIBLITY

PURE WATER IS THE WORLD'S FIRST AND FOREMOST MEDICINE



90% OF HUMAN BODY IS MADE UP OF WATER

USES OF WATER

Water scarcity hampers economic growth, affecting agriculture, industry, and services. Efficient water management boosts productivity. Water also supports biodiversity, energy production, and industrial processes, playing a crucial role in ecosystems and power generation.

Although 71% of Earth is water, 97.5% is salty, and 2 billion people face freshwater scarcity worldwide.

Current Water Demand Estimation

SEGMENT NAME	CAPACITY	Daily Demand
HOSTELS	7,056 ROOMS	1187875
RESIDENTIAL QUARTERS	2,628 POP.	354780
OTHER RESIDENCES	682 POP.	92070
COMMERCIAL ESTABLISHMENTS	--	44460
UTILITY & SERVICES	--	251035
OFFICES	236 STAFFS	10620
ACADEMIC AREAS	2,07,351 SQ. M	1372061
NEW CONSTRUCTIONS	94,830 SQ. M	560550

Daily Water Demand Estimates:

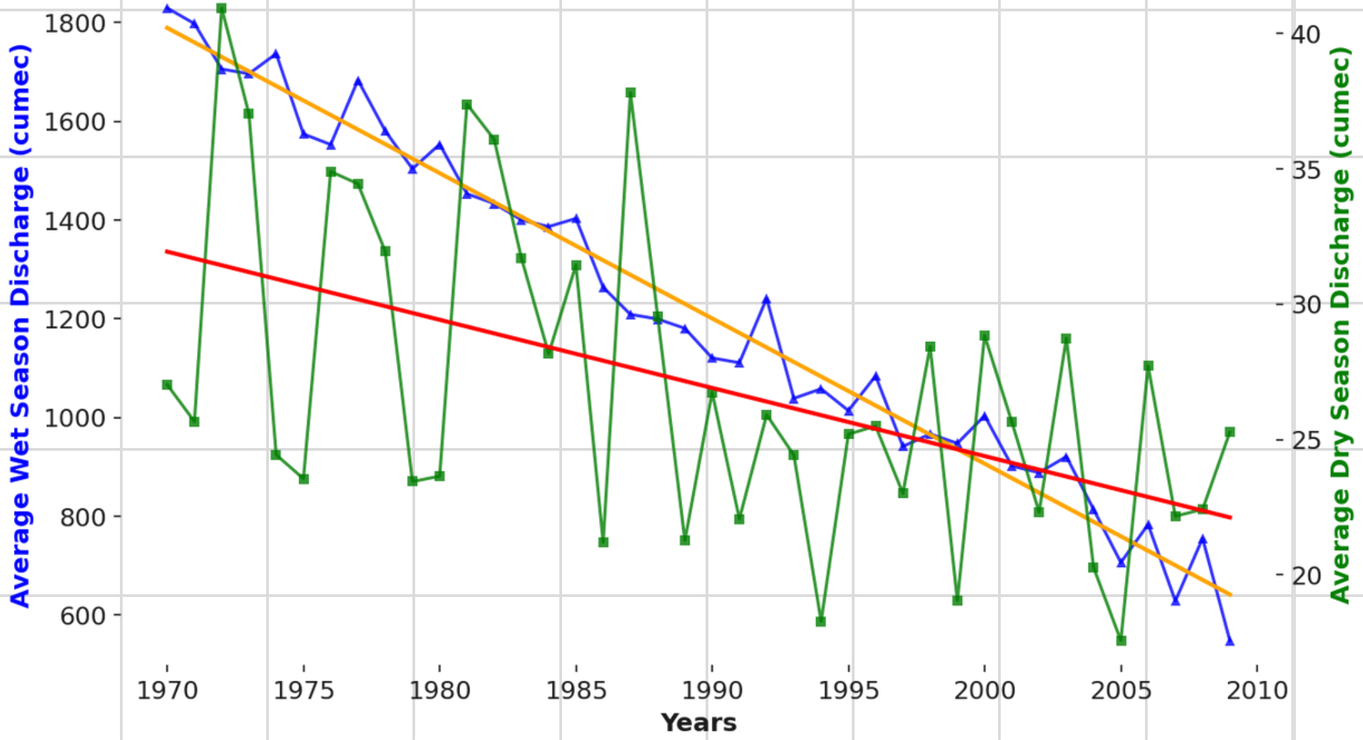
Total daily water demand: 38,73,451 liters per day.
Highest demand: Hostels (11,87,875 L/day) and **Academic Areas** (13,72,061 L/day).
Lowest Demand: Offices (10,620 L/day).

Water Demand in Special Scenarios

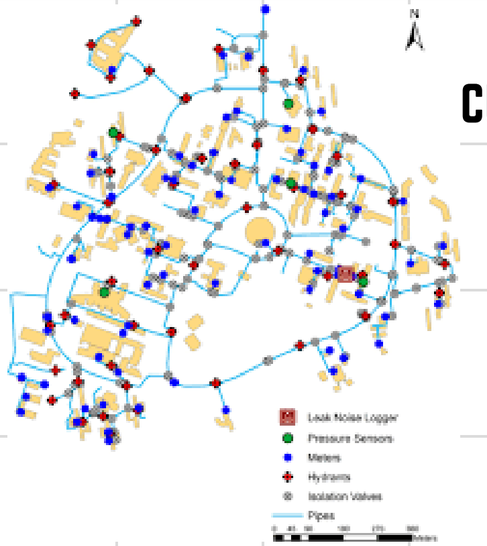
Peak Hour Demand (Factor = 2.0-3.0)
Vacation Period Demand (Reduced by 40-50%)
Special Events (Increased by 20-30%)

ESTIMATED WATER DEMAND 38,73,451 LITERS

Declining Levels of Brahmaputra

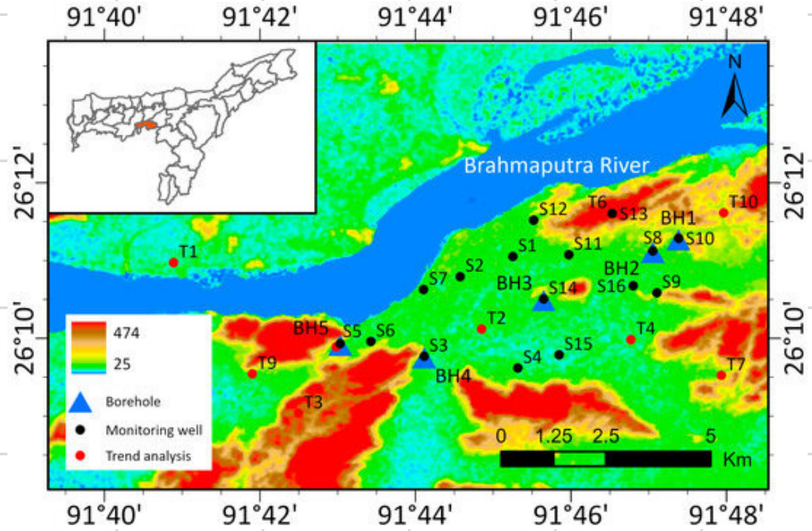


GIS MAPPING OF CURRENT WATER SYSTEM



DUE TO THIS DECLINE IN WATER LEVELS MORE WATER THAT WE ARE USING IS MORE CONTAMINATED

BRAHMAPUTRA WATER SUPPLY MARKING



CAUSES OF WATER VARIATION

a) Seasonal Variation

Monsoon Season (June-September):
Heavy rainfall (~1752 mm annually) causes flooding. Water levels rise rapidly due to increased discharge from Himalayan glaciers and rainfall.

Dry Season (October-May):
Water levels decline significantly, leading to water shortages.Reduced glacial melt and precipitation lower discharge.

b) Long-Term Trends

Climate Change: Increasing glacier retreat is affecting river discharge patterns.

Groundwater Extraction: Excessive withdrawal lowers water table and reduces base flow.

Urbanization & Deforestation: Reduces natural groundwater recharge and increases runoff.

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Water Supply Trends

SEDIMENTATION TANK

There are two tanks , each with capacity of 701.79 m 3

PRESETTLER TANK

There are two tanks , each of capacity 32 m 3

CASCADE AERATOR

Aeration rate = 0.035 m 2 /m3 /h

- Source: Brahmaputra River (650m from the plant)
- Facility: IIT Guwahati water treatment plant
- Established: Built and commissioned in 2006

- Source: Brahmaputra River
- Process: Pumped to a pre-sedimentation tank
- Detention Time: 4 hours for settling suspended materials

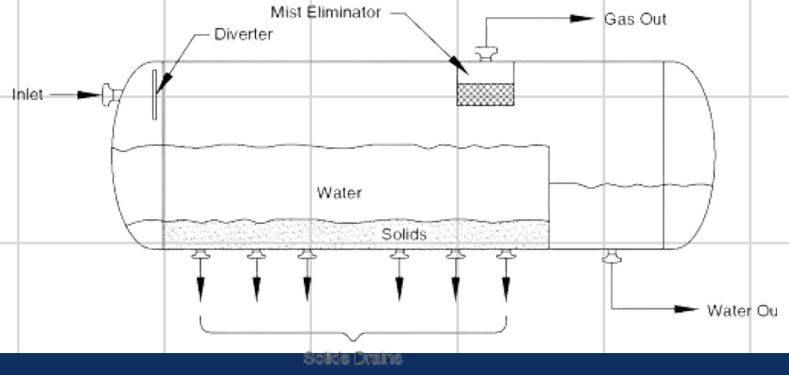
- Flow: Gravity-fed from pre-sedimentation tank to pre-settler tank
- Retention Time: 11 minutes
- Function: Removes fine suspended particles before further treatment

- Flow: Gravity-fed to cascade aerator
- Function: Increases oxygen levels and removes dissolved gases through step-based aeration

- Flow: After aeration, water moves through an RCC channel to flash mixers
- Process: Liquid ferric alum is added for uniform coagulation
- Mixers: Two units, each with a 175 m^3/h flow rate

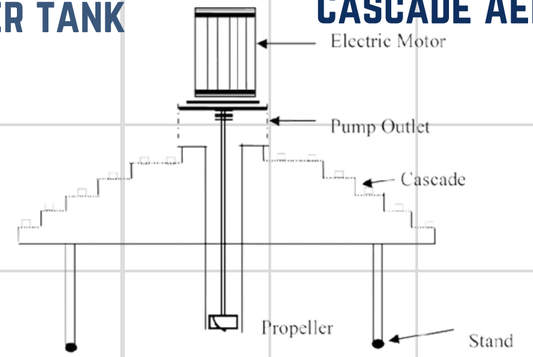
WATER INTAKE

PRE SEDIMENTATION TANK

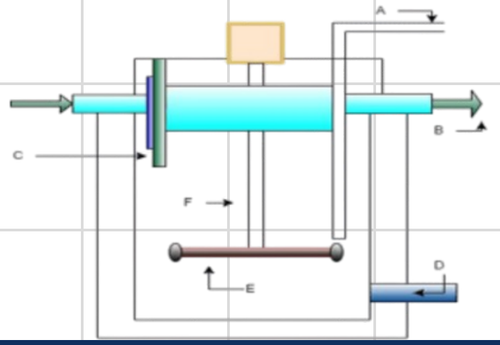


PRE SETTLER TANK

CASCADE AERATOR

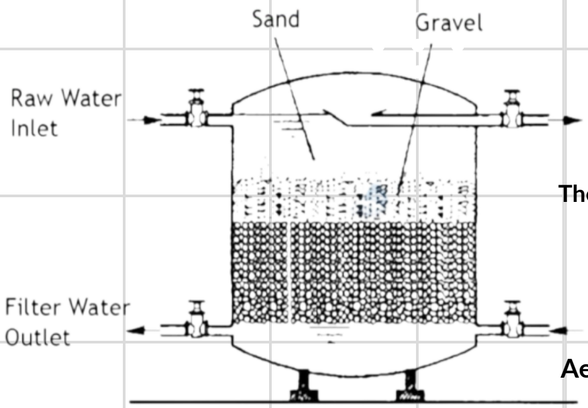


FLASH MIXER



Water Supply Trends

CLARIFLOCCULATOR



There are two tanks , each of capacity 32 m 3

Aeration rate = 0.035 m 2 /m3 /h

FILTER HOUSE

- Flow: Water moves from flash mixers to clariflocculators
- Function: Removes colloidal and suspended particles through flocculation & clarification
- Units: Two clariflocculators, each with a 175 m^3/h flow rate

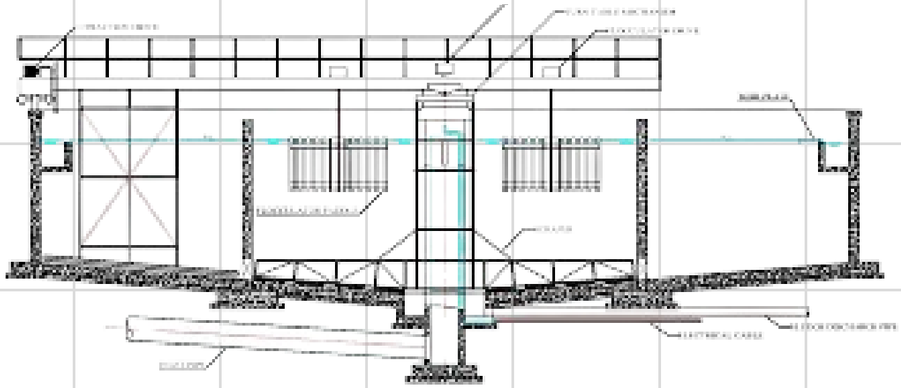
- Flow: Water moves from clariflocculators to the filter house
- Process: Three rapid sand filters with sand & gravel media remove remaining flocs
- Filters: Three beds, each with 2 sections
- Filter Rate: 98.20 Lpm/m^2

- The filtered water is held in two clean water reservoirs, each.
- Retention time: six hours each reservoir
- There are two reservoirs , each with capacity of 1050 m3

- Filtered water is pumped from the clean water reservoir to hilltop tanks, with electro chlorinated chlorine added during the process.
- A chlorination tank adds chlorine to water to disinfect it and kill harmful pathogens.

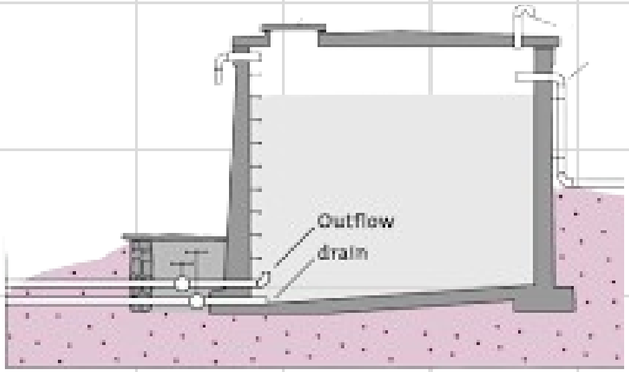
- Water is then stored in storage tanks until further distribution.
- IIT Guwahati has four water tanks, two located 100 meters from the treatment facility on a hilltop, distributing water to buildings and hostels.

CLARIFLOCCULATOR

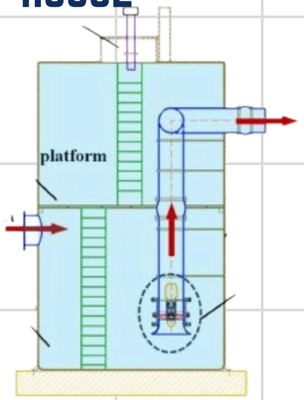


FILTER HOUSE

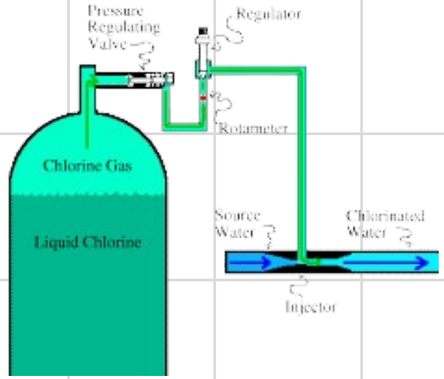
CLEAN WATER RESERVOIR



PUMP HOUSE



DISTRIBUTION

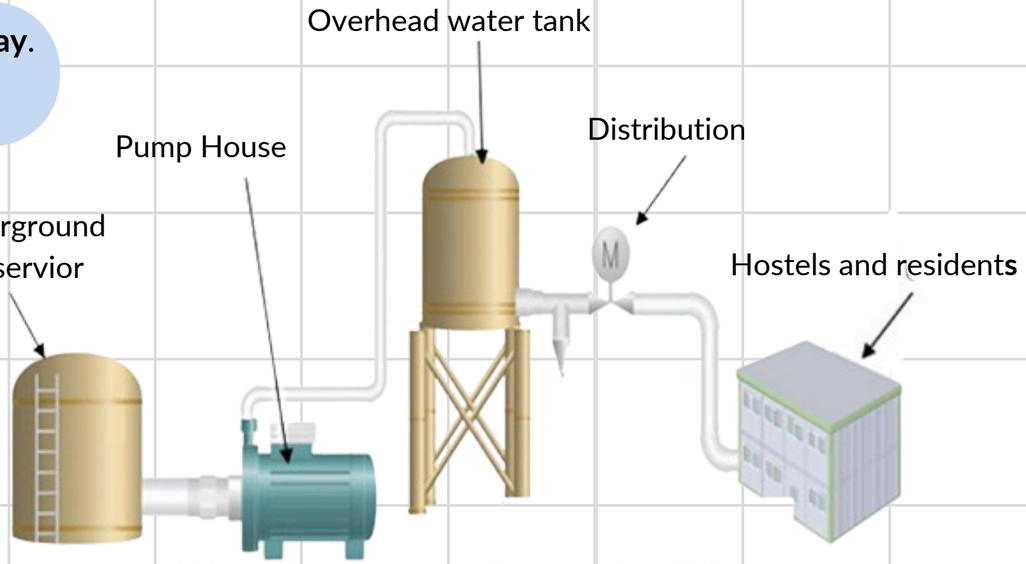


Water Distribution System

WTP's Capacity was determined to be **61,19,320 L per day**. It's maximum capacity worked out to be **86,39,040 L**.

IIT Guwahati's temporary water storage capacity was determined to be 50,50,450 L/day.

Underground Reservior capacity: **21 lakh** litre
4 Overhead Tanks : 2 near WTP and **2** at hilltop .At extreme condition, if the maximum capacity and temporary water storage capacity gets fully utilized, water demand up to **1,36,89,490 L** per day could be served.



Water Distribution System At IITG

Sector Wise water Storage capacity

Table 5.2 Temporary Water Storage Capacity in IIT Guwahati Campus

S. No.	Sector	Capacity (L)
1.	Sector-1	3,62,000
2.	Sector-2	2,50,500
3.	Sector-3	3,24,200
4.	Sector-4	2,66,000
5.	Sector-5	5,47,750
6.	Hilltop Tanks and WTP Reservoirs	33,00,000
	Total	**50,50,450**

PROBLEMS

🚨 While gravity-fed water distribution is efficient and cost-effective, pressure loss over distance slows tank filling, affecting water supply to hostels and residences.

🚨Sector Wise low storage: as from the data, each sector do not have same storage capacity , Hence, some hostels are facing water scarcity issues.

SOLUTIONS

Solar-Powered Pump System

Solar-powered low-energy pumps assist with water pressure in areas with low flow, operating during daylight hours to reduce energy costs while relying on sustainable solar power for efficient operation.

standardize storage capacities

Standardizing storage capacities involves upgrading water tanks in sectors with lower capacity to match the rest of the campus, ensuring equitable distribution and preventing water scarcity in hostels and residences.

Analysis of Water Quality Results

Number of Samples Tested:

March 2022: 8 samples from different locations (Water Treatment Plant, various hostels, staff quarters, and the academic complex).

January 2023: 3 samples from Water Treatment Plant, Disang Hostel, and Guest House.

PARAMETER	ACCEPTABLE LIMIT	MARCH 2022	JANUARY 2023	REMARKS
TURBIDITY (NTU)	≤ 1	0.57 – 7.27 (1 ABOVE LIMIT)	0.4 – 0.5 (ALL WITHIN LIMIT)	IMPROVED
PH	6.5 – 8.5	6.85 – 8.41 (WITHIN LIMITS)	6.99 – 7.30 (WITHIN LIMITS)	STABLE
CHLORIDE (MG/L)	≤ 250	7.16 – 10.33 (WELL BELOW LIMIT)	3.90 – 5.99 (FURTHER REDUCED)	IMPROVED
TOTAL HARDNESS (MG/L AS $CACO_3$)	≤ 200	98 – 102 (WITHIN LIMIT)	114 – 116 (WITHIN LIMIT)	SLIGHT INCREASE
ALKALINITY (MG/L AS $CACO_3$)	≤ 200	88.67 – 142.67 (WITHIN LIMIT)	82 – 96 (WITHIN LIMIT)	DECREASED SLIGHTLY
IRON (MG/L)	≤ 0.3	0.32 – 0.49 (ABOVE LIMIT)	0.40 – 0.55 (ABOVE LIMIT)	NO IMPROVEMENT
TOTAL COLIFORM (MPN/100 ML)	0	DETECTED (UNSAFE FOR DRINKING)	NOT DETECTED (SAFE)	MAJOR IMPROVEMENT

Key Improvements (2023 vs. 2022):

- Microbiological safety has improved significantly – Total coliform is now absent in all tested locations.
- Turbidity has reduced and is within permissible limits.
- Chloride content has slightly decreased.
- pH levels remain stable within the acceptable range.

Concerns and Areas for Further Improvement

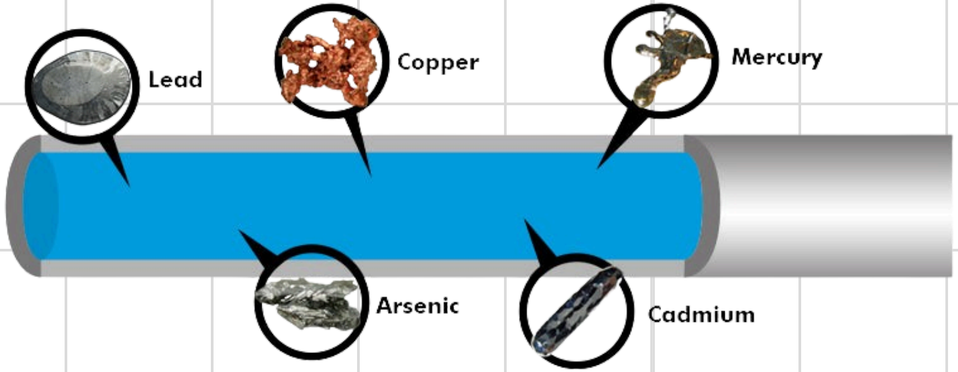
- Iron content still exceeds the permissible limit of 0.3 mg/L
- Alkalinity has slightly decreased but remains acceptable.
- Fewer locations were tested in 2023 (only 3 samples vs. 8 in 2022), so comprehensive safety across all areas remains uncertain.

PROBLEMS IN THE CURRENT SYSTEM

Undetected Pipeline Leakages

Leading to significant water wastage

High Contamination Levels



Elevated iron and heavy metals found in water quality reports

Inefficient Chlorination & Malfunctioning Gauges

Inadequate Water Treatment Plant (WTP) Capacity

Unable to treat new pathogens, including industrial waste and antibiotics

Declining Water Levels & Contaminated Brahmaputra River Water

Severe drop in the Brahmaputra river's water levels

Leaking Taps & Absence of Water Recycling

Absence of Water Recycling

Lack of Regular Water Testing & Neglected Storage Tank Maintenance

Inadequate Sewage Treatment

Short Term Solutions To The Problem

USE OF MULTIMETER AT HOSTELS

OVERVIEW

Monitoring water quality parameters in a hostel setting is crucial to ensure safety, efficiency, and compliance with health standards. Here's how each parameter applies to a hostel's water system

ADVANTAGES

Following are some parameters that could be measured and kept a record of:

- pH : ideal range is 6.5-8.5
- Electrical Conductivity
- TDS (Total dissolved solids)
- Salinity
- Specific Gravity & Temperature
- Oxidation-Reduction Potential
- Conductivity Factor

COST

The multimeter costs around ₹12,000

ELECTROCOAGULATION

Electrocoagulation involves applying electrical currents to water, electric currents destabilize suspended particles, emulsified oils, and other contaminants, allowing them to aggregate and be separated.

Electrocoagulation (EC) treats wastewater by using an electric field to neutralize charges, enhancing coagulation and removing colloidal particles. It produces clear, odorless water and generates sludge that is more settable and easier to dewater than conventional methods, as metallic oxides/hydroxides lack residual charge.

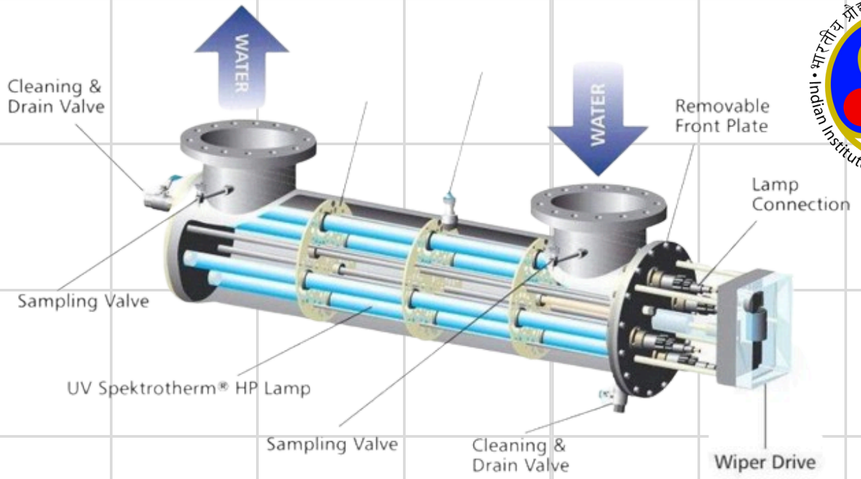
The initial setup cost is estimated to be approximately 30 lakhs, with a daily operational cost of around 1 lakh.

Short Term Solutions To The Problem

Ultraviolet (UV) Disinfection

Overview

Ultraviolet (UV) water treatment is a chemical-free process using UV-C light (~254 nm) to destroy bacteria, viruses, and protozoa by damaging their DNA/RNA, preventing reproduction and infection.



Advantages

- Chemical-Free: UV treatment neutralizes microorganisms without altering water taste Highly Effective: Eliminates up to 99.99% of bacteria, viruses, and protozoa.
- No Byproducts: Unlike chemical treatments, it's environmentally friendly.
- Low Maintenance: Easy to install, energy-efficient, and requires minimal upkeep.

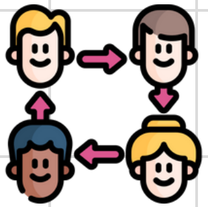
Cost

The estimated cost of the UV water treatment machines for a capacity for iit guwahati is 80 thousand INR

IPM SECTION

The Infrastructure Planning and Management (IPM) section at IIT Guwahati is responsible for overseeing the institute's infrastructure development, planning, and management. This includes the construction and maintenance of academic buildings, hostels, laboratories, and other campus facilities.

THE WATER POLICY OF IIT GUWAHATI



Water Conservation Committee

Include faculty, students, and administration for collaborative decision-making.

Automated Water Tank Systems

24/7 monitoring of water levels to prevent overflow.
Automated pumps and float valves ensure efficient water use and prevent wastage

Water-efficient Infrastructure

Use low-flow taps, dual-flush toilets, waterless urinals, and drip irrigation to minimize water waste

Student-led Initiatives

Encourage student participation in water-saving projects

Annual Water Report

Track water usage and progress annually to identify areas for improvement.

Collaborate with Experts

Work with government agencies and NGOs to adopt best practices.

Awareness Campaigns

Organize events to educate the campus community on water conservation

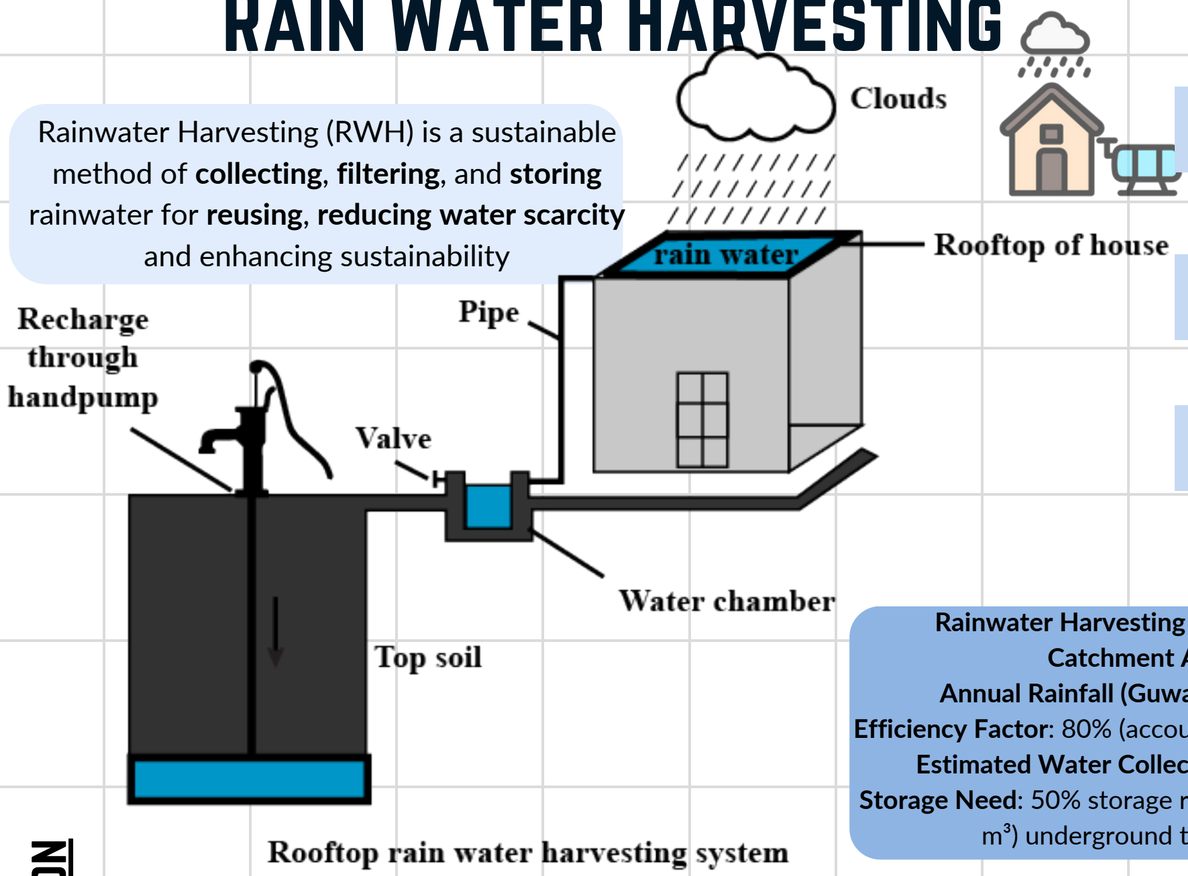
Incentive Programs

Recognize hostels or departments that reduce water consumption

Long Term solution

RAIN WATER HARVESTING

Rainwater Harvesting (RWH) is a sustainable method of **collecting**, **filtering**, and **storing** rainwater for **reusing**, **reducing water scarcity** and enhancing sustainability



Rooftop rain water harvesting system

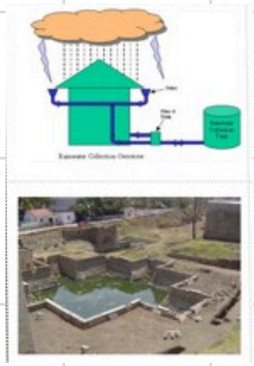
TYPE OF CATCHAMENTS

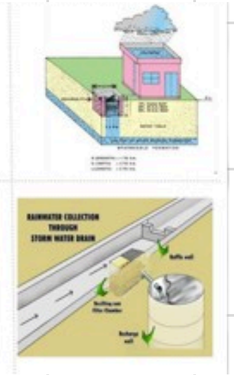
ROOF TOP RAIN WATER HARVESTING

SURFACE RUN OF RAINWATER HARVESTING

TYPES OF COLLECTION SYSTEM

STORAGE	STORAGE WITH GROUNDWATER RECHARGE	GROUNDWATER RECHARGE ONLY
for direct consumption	*surplus water recharged in ground for future use*	





Rainwater Harvesting – FOR LARGE HOSTEL
Catchment Area: 9032 m²
Annual Rainfall (Guwahati): 1600 mm (1.6 m)
Efficiency Factor: 80% (accounts for evaporation & spillage).
Estimated Water Collection: *1.15 crore liters/year*
Storage Need: 50% storage requires a 57.5 lakh liter (5,750 m³) underground tank for dry months.

ADVANTAGE & ESTIMATION

Enhances Groundwater & Reduces Dependency – Recharges groundwater levels and minimizes reliance on surface water
Prevents Flooding & Soil Erosion – Controls runoff, reducing soil erosion and flood risks.
Optimizes Drainage & Energy Efficiency – Decreases load on sewage systems while conserving energy.
Space & Cost Efficient – Requires minimal land and offers long-term ROI with access to high-purity water
Drinkable Water: the water obtained is very pure so it can be used for drining purpose

IMPLEMENTATION STRATEGY

Catchment Area Selection	Gutter & Downpipe Installation	Filtration Unit	Storage Tanks	Groundwater Recharge
Utilize hostel rooftops as the primary catchment area	Install gutters and pipes to direct water to storage tanks.	Use a first flush diverter to remove debris before storage.	Place underground or overhead tanks near hostels as per demand.	Design recharge pits if needed for sustainability.

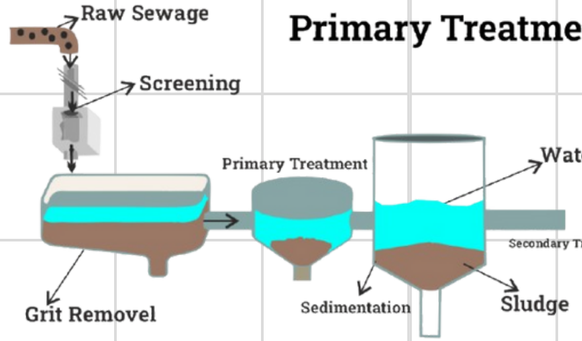
Long Term solution

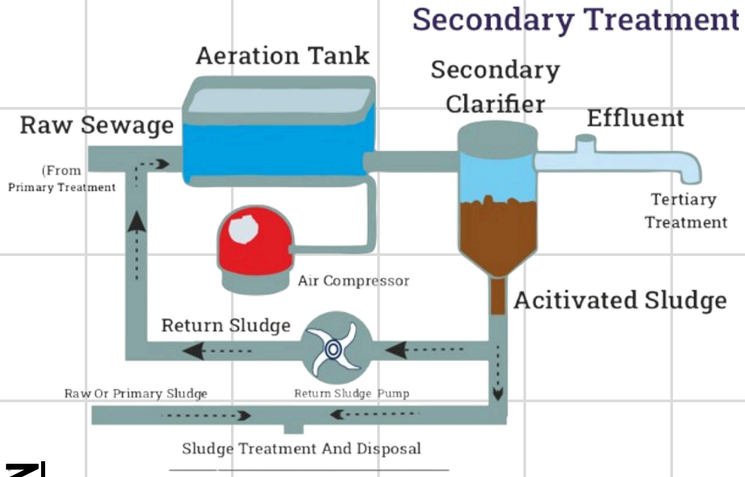
Existing Treatment Process at IIT Guwahati

Sewage Treatment Plant

1. Primary Treatment (Physical Treatment):

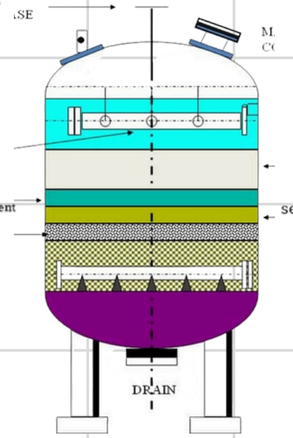
Screening & Grit Removal: Large debris, plastics, and sand are removed to prevent clogging.
Sedimentation: Heavier solids settle as sludge, while lighter materials are removed using skimmers



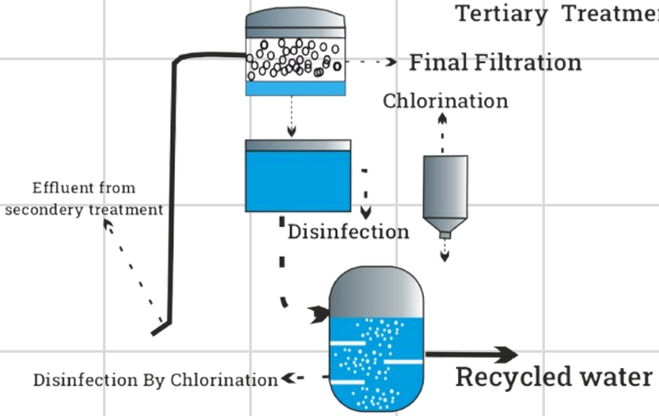


2. Secondary Treatment (Biological Treatment):

Activated Sludge Process (ASP): Microorganisms break down organic matter.
Aeration: Air is supplied to promote microbial growth.
Clarification: Settling tanks remove excess biomass.



Tertiary Treatment Methods



UV Disinfection: Uses UV light to eliminate harmful particles, making water safer.
Ion Exchange: Replaces calcium and magnesium ions to soften water.
Chlorination: A cost-effective method using chlorine to disinfect water.
Ozone Treatment: A chemical-free oxidizing process for water purification.
Membrane Filtration: Uses a semi-permeable membrane to filter impurities
Activated Carbon Adsorption: Removes odors and chemicals through adsorption for cleaner water.

Implementation Strategy

Site Assessment & Pre-Treatment Checkt

- Analyze STP outlet water quality (BOD, TSS, odor levels).
- Identify installation space near the STP outlet for ACF + UV system.

Install Activated Carbon Filtration (ACF) System

- Pre-filtration (if needed): Install a sand filter if TSS > 10 mg/L.
- Set up Activated Carbon Filters to remove odor, chlorine, and organics.
- Install backwashing system for periodic cleaning.

Install UV Disinfection System

- Install flow sensors & UV intensity monitors.
- Storage & Distribution
- Construct a separate treated water storage tank for flushing water.
- Lay dedicated pipelines to avoid contamination with potable Install flow meters and monitoring sensors

Eliminates Pathogens & Odors
Reduces Pollution Load
Meets Water Quality Standards
Promotes Sustainability
Water Can be used for flushing

Need for Tertiary Treatment

Testimonial

NAME : NARAYAN SHARMA
Designation: Engineer IPM Section

- Elaborated on the current water supply system.
- Mentioned issues in the current system such as pipeline leakages.
- Highlighted overpopulation as a factor affecting water supply.
- Informed about new measures planned by the IPM section.
- Mentioned the use of lake water in areas with minor water demands.
- Provided research reports on the current water system.
- Shared data on water demand analysis.

NAME : AJAY KALAMDHAD
Designation: Professor, Civil department

- Explained purity issues in the current water treatment system.
- Mentioned the system's inability to treat advanced pathogens like antibiotics and pesticides.
- Informed about high heavy metal levels in the Brahmaputra River.
- Suggested methods to address water scarcity issues.
- Recommended separating water used for flushing from water used for drinking and bathing.

NAME : ANONYMUS
Designation : Chemist at WTP

- Explained changes made at the water treatment plant.
- Highlighted areas for improvement at WTP.
- Provided information on basic laboratory tests at WTP.
- Chemicals used in treatment.
- Tests conducted at the plant.

NAME : CHITTA RANJAN MEDHI
Designation : Technical superintendent ,
Enviromental Engineering Lab

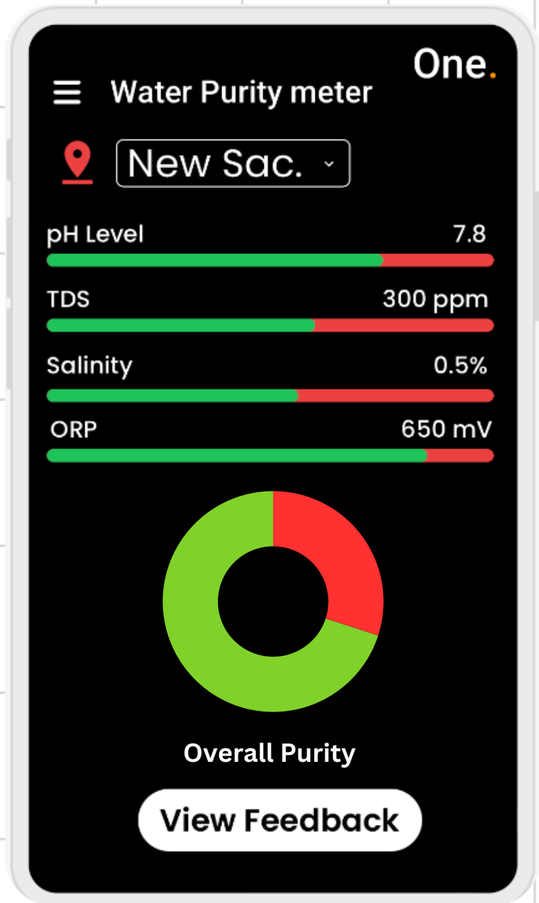
- Provided data on water testing results for 2023 and 2022.
- Report indicated high levels of heavy metals like iron in water.
- Helped track progress and changes in water quality over consecutive years.
- Included data on water quality checks at different campus locations.

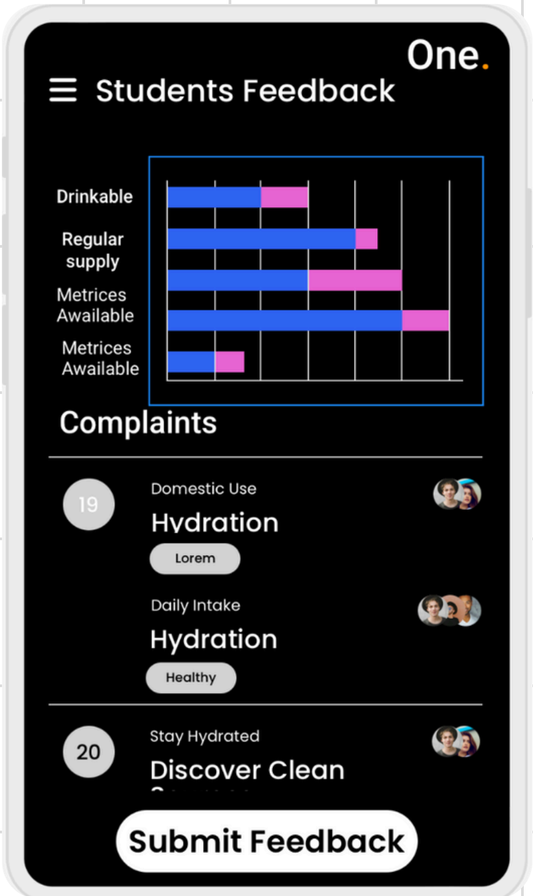
Feedback Mechanism

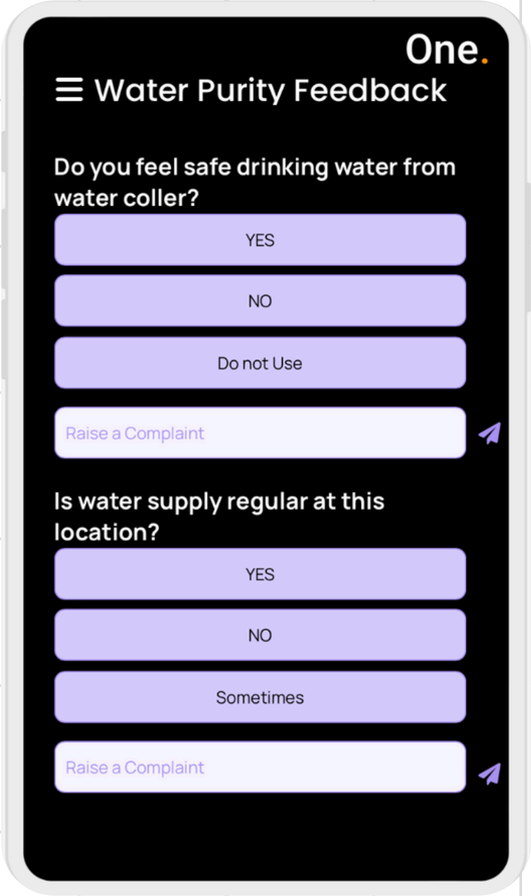
Multimeter Data Integration

Feedback Collection from Hostels and Common Areas

Complaint System







KEY FEATURES

- Real-time Monitoring
- Live Display
- Survey Feedback
- Seamless Input
- Actionable Insights
- Complaint System:
- Status Tracking

PRIORITY OF SOLUTIONS

FEATURE	REACH	IMPACT	CONFIDENCE	EFFORTS	SCORE
USE OF MULTIMETER AT HOSTELS	8	5	8	4	80
ELECTROCOAGULATION	7	8	7	6	65.33
ULTRAVIOLET (UV) DISINFECTION	8	9	8	8	72
RAIN WATER HARVESTING	8	7	8	5	89.6
SEWAGE TREATMENT PLANT	9	8	8	9	64

Top Priority: Rain Water Harvesting for its sustainability and long-term water availability benefits with minimal land requirement.
Medium Priority: Use of Multimeter at Hostels and Ultraviolet (UV) Disinfection, both effective for water quality management and safety, but requiring moderate to high initial investment.
Lower Priority: Electrocoagulation and Sewage Treatment Plant, both critical for water treatment but requiring high setup costs, complex infrastructure, and operational expenses.

Rain Water Harvesting → Use of Multimeter at Hostels → Ultraviolet (UV) Disinfection → Electrocoagulation → Sewage treatment plant

Implement smart sensors and IoT-based leak detection systems for real-time monitoring.
Regular pipeline inspection and maintenance schedules

Upgrade the WTP to handle a wider range of contaminants, including industrial waste and antibiotics.
Introduce advanced filtration and disinfection technologies, such as UV and ozone treatment

Switch to liquid chlorine or more efficient chlorine gas dosing systems.
Monitor chlorine levels continuously to ensure adequate treatment.

Implementing feedback mechanism in ONESTOP itself and transparency of water quality to increase trust on the water we are drinking

Implementing feedback mechanism in ONESTOP itself and transparency of water quality to increase trust on the water we are drinking

APPENDIX

BUYING LINKS

- https://www.indiamart.com/proddetail/electrocoagulation-system-11761566497.html?srsltid=AfmBOooicI3GXtUlwzPICmSmbmTQJSZTipZh5mVmLVP3N-oro0cXUV9t
- https://www.desertcart.in/products/632075940-bdjsn-8-in-1-water-quality-tester-ph-ec-tds-salt-s-g-cf-orp-temperature-water-quality-monitor-tuya-wifi-smart-wall-mounted-water-detector-for-fish-tank-aquarium-sea-water-swimming-pool
- https://www.indiamart.com/proddetail/industrial-uv-water-treatment-system-2853734184262.html

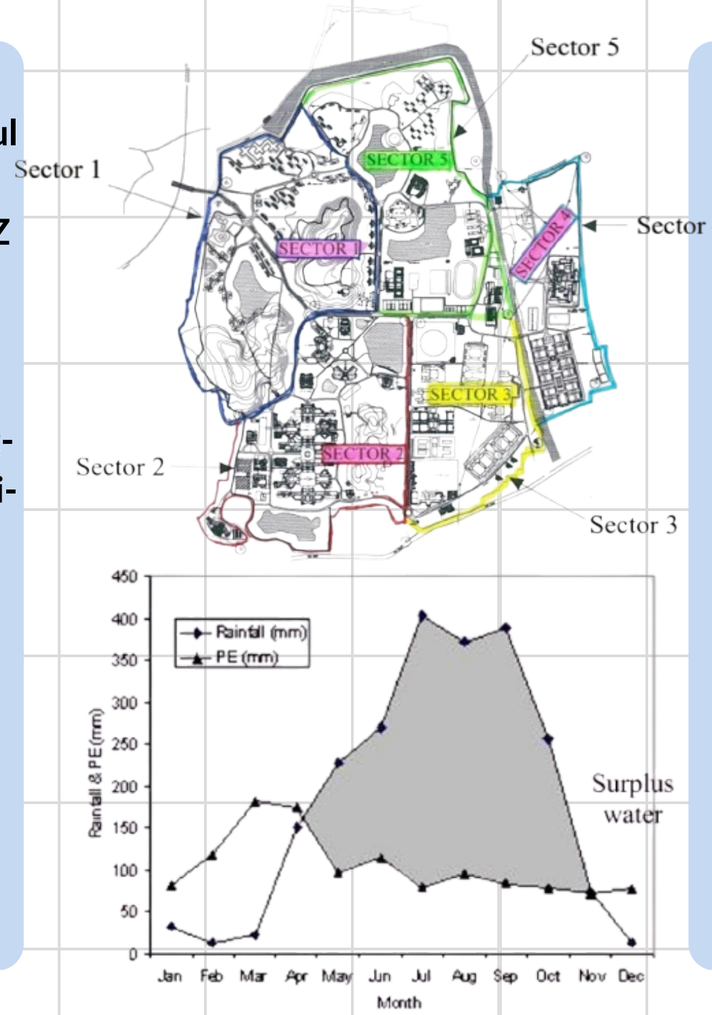


Fig. 2 Mean monthly rainfall and potential evaporation in the northeastern region.

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