KRITI'25

WATER WISE CONSULTING

Executive Summary

Project Overview

Situation

IIT Guwahati faces water scarcity due to a decline in Brahmaputra River levels, affecting **drinking water quality** and hostel supply. A **sustainable** and **efficient** water management approach is **urgently** needed.

Objective

To Develop a broad and comprehensive strategy to tackle **water scarcity** and ensure **water purity** at IIT Guwahati, leveraging analytical, innovative, and technological solutions while considering **environmental**, **financial**, and **logistical** factors.

Case Study Breakdown

- **Root Causes** of Water Scarcity
- Identifying **Inefficiencies in the Purification** Process
- Implementing **short term smart water-saving measures**
- Provide the **technical** and **financial feasibility** of the solution.

Procedure Breakdown

Identify the Key problems faced

FInd specific Root Cause behind the issues faced

Curate short term and Lang term sustainable solutions

Implementing frameworks keeping in mind of the environmental and financial constraints.

Analysis Breakdown

- **Declining Brahmaputra River** water levels during the dry season **(Nov–Mar)**.
- Significant water loss due to **pipeline leaks**.

- Conduct **field visits** to WTP and STP to analyze their operational models.
- **Consult professors** with in-depth knowledge of IITG's water systems.

- Efficient Fixtures: Installing **dual-flush toilets.**
- Optimized **Cleaning Methods**
- Improved **Irrigation** Practices

- **Water conservation**: Utilize treated sewage, etc
- WTP upgrade: A third **flocculator**
- STP Upgrade: **MBR and UV** technology

Problem Analysis

Major Concerns

Poor Water Quality

- Multiple **complaints of health issues,** including nausea and stomach problems

Unhygienic Storage

- No supervision or records of **water cooler cleaning**.
- **Contaminated** hostel water tanks.

Irregular Supply

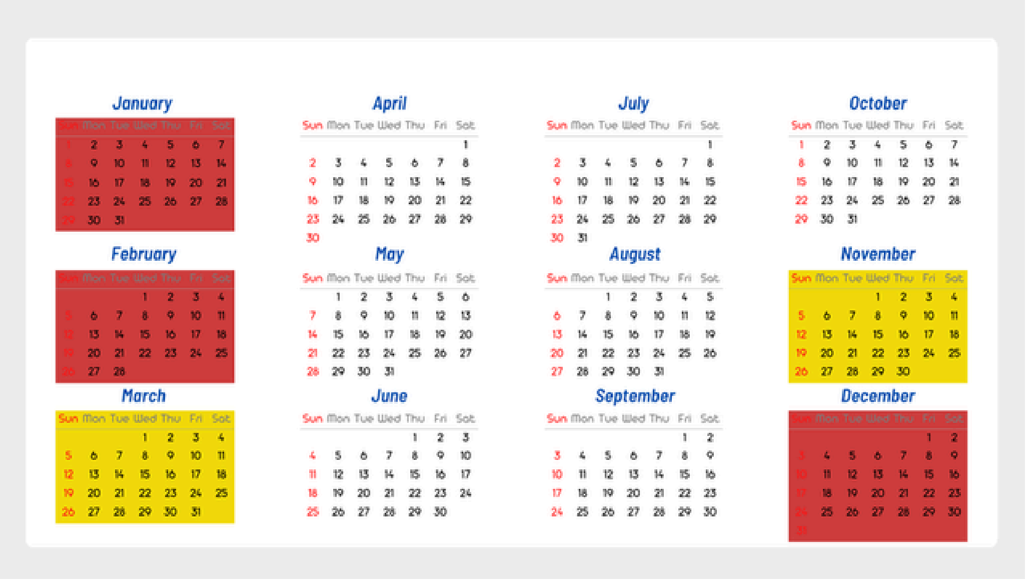
- **Seasonal shortages** in dry season.
- **Demand exceeds supply**, leading to shortage.

Environmental Impact

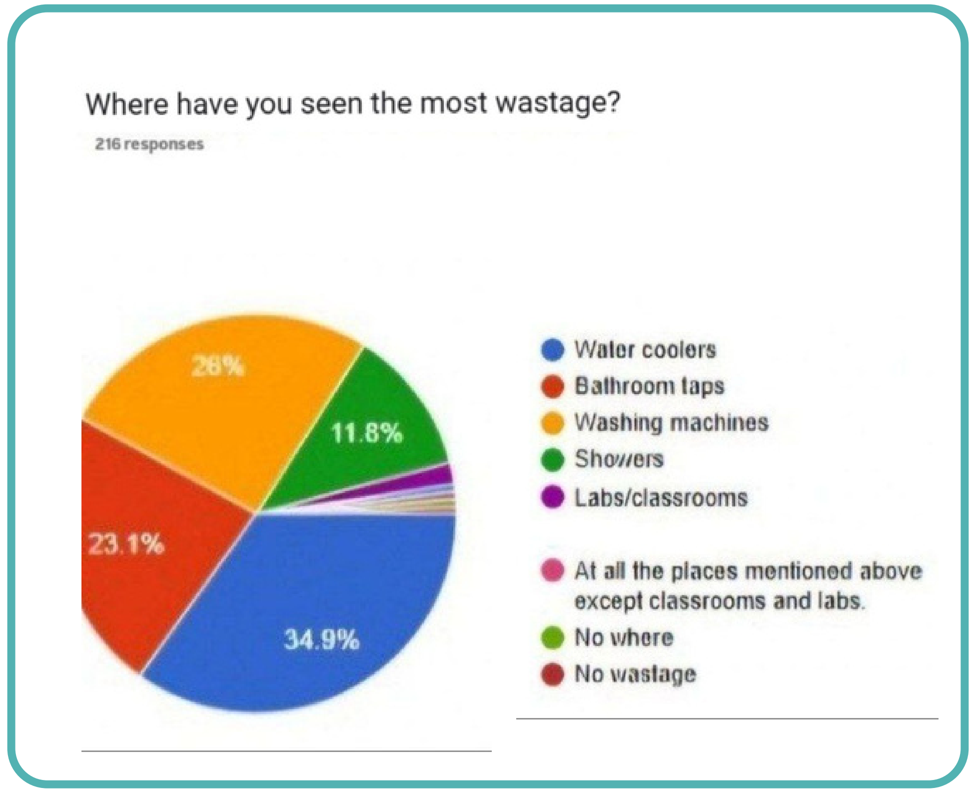
- Water wastage from **leaks and cracks** in washing machine sand pipes.
- **Lack of monitoring** in water usage.

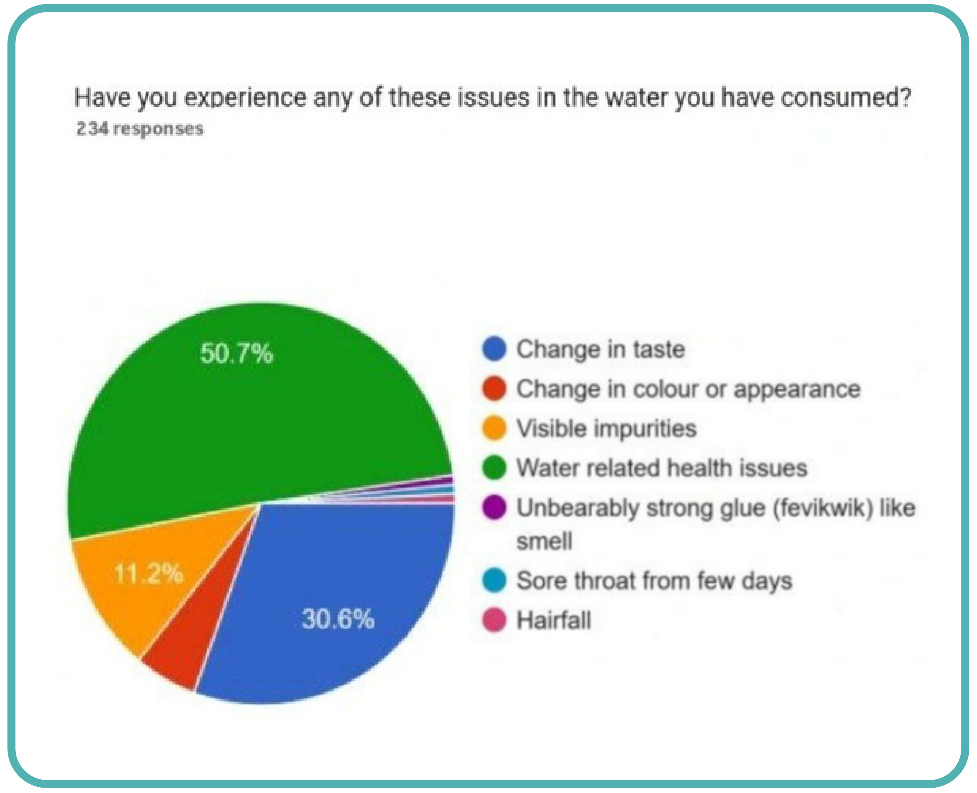
Approximately 50% of the Campus Junta faced Water-related Health issues

Months of Crisis



Our Survey





Supply and Demand Guesstimate

WATER USAGE

PERSONAL
- DRINKING 30KL
- SHOWERS 140kL
- FLUSHING 300kL
- TAP USAGE 20kL
- WASHING MACHINE 150kL

IRRIGATION
- SPORTS GROUND 191.5KL
- GARDENS 274KL
- KV GROUND + CHILDREN'S PARKS 33.5KL

CLEANING
- LIVING AREAS 634.5KL
- ACADEMIC AREAS 264KL
- COMMON AREAS 105 KL
- MISCELLANEOUS AREAS 106KL

FOOD
- MESS 30KL
- CANTEENS/ FOOD JOINTS 11KL
- MESS CLEAN 56KL

ASSUMPTIONS

Population Calculation

Total students= 8.6K
Faculty = 420
College staff = 575
Security = 150
Cleaners, mess workers etc= 300
TOTAL = 10,000 campus junta

1.5L water used to clean 1 sq. m. of tiled floor

5L water used to irrigate 1 sq. m. of grass area

Total Water Usage

≈ 23 LAKHS

Litres per day

Management Systems in IITG campus

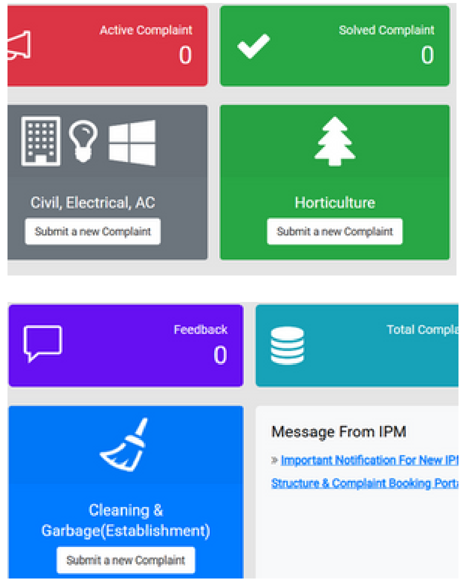
Water Treatment Plant

- The **WTP operates for 17 hours daily**, treating **60 lakh liters** of Brahmaputra River water.
- The key **treatment processes** include **Sedimentation, Pre-settling, Aeration, Chemical Treatment, Circulation, Filtration,** and **reservoir tank.**
- **Rapid-sand gravity filters** are used to remove impurities, with **ferriculum** added for flocculation and coagulation.
- **Sediment levels rise during the dry season**,(**turbidity >400 ntu**) requiring more frequent filter cleaning.
- **Pipelines distribute treated water** from the WTP to overhead tanks across campus.
- **Air-releasing valves** help maintain consistent water flow in the system.
- **Aging pipelines** degrade, often leading to cracks, which may result from **construction mishaps** or **natural calamities**.
- **Leaks cause water loss as well as pressure loss** , leading to increased motor runtime, chemical costs, and electricity consumption.
- Fixing these leaks would **reduce operational costs** and improve efficiency.

IPM Section

Functions

- Utilities Management
- Construction & Repairs
- Safety & Cleanliness
- Property Management
- Sustainability Initiatives



Inefficiencies

- **Delays**: Slow response times
- **Hassles**: Complex procedures
- **Over-Dependencies**: Reliance on external parties
- **Lack of Accountability**: Unclear responsibilities

Sewage Treatment Plant

Capacity of the plant:* *1.35 million litres per day

Type of process:* *Facultative Aerated Lagoon in Series Connection

Ideal Process

Aerated Lagoon (Primary Treatment): Oxygen is added to break down organic matter, **reducing BOD** and suspended solids.

Facultative Lagoon (Secondary Treatment): Aerobic and anaerobic processes **degrade pollutants** and facilitate nutrient removal.

Polishing Lagoon (Tertiary Treatment): Provides sedimentation and pathogen **removal, improving water quality** before discharge.

Primary Treatment → Secondary Treatment → ~~Chemical Treatment~~ → Water Release

What our campus follows

Major Inefficiencies

- **Incomplete removal** of suspended solids.
- **Limited breakdown** of organic

Insufficient treatment due to lack of tertiary stage.
- Potential for **residual organic matter** and nutrients.

No chemical disinfection to eliminate pathogens.

No final treatment or Polishing Lagoon for water quality improvement.

Root Cause Analysis

Shortage

Water levels in Brahmaputra are declining	Dry Season
Deforestation	Reduced inflow from tributaries
Erratic Rainfall	No rainfall
Rising global temperature	Sediment load increases
Erosion has deposited slit	Soil degradation

Inefficiencies

Issues	Consequences
Pipe Leakage	Undetected and Unfixed
Sedimentation (Dry Season)	Requires multiple washing of filters
Absence of tertiary step in STP	E. Coli Contamination
Lack of Supervision in drinking water filters	Frequent health issue complaints

Purity concerns

- **Contaminants**: Suspended solids, plastics, organic matter, pathogens.
- **Treatment Inefficiencies**: Incomplete disinfection, old infrastructure, no real-time monitoring.
- **Wastage**: Leaks, overuse of potable water, delayed repairs.

Treated Water Reuse Circulation System at IITG

Assessment and Feasibility

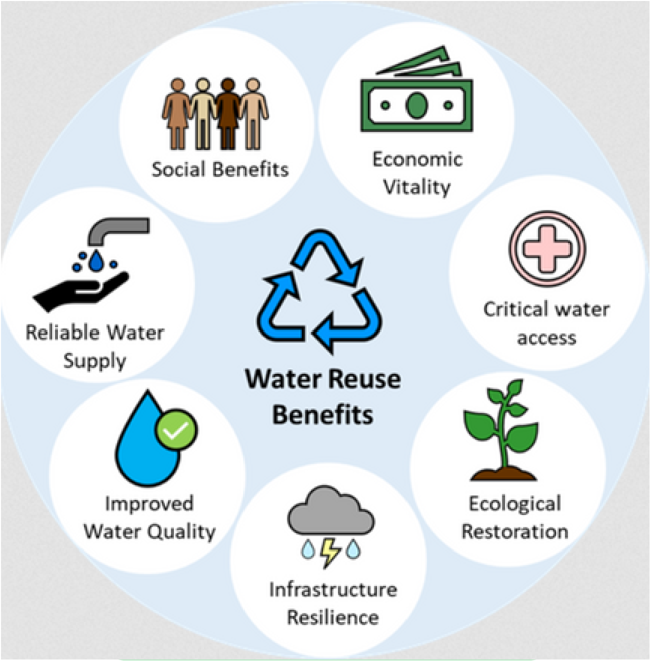
- **<u>Evaluate Water Sources:</u>** Assess availability of treated sewage, RO reject, AC condensate, and greywater
- **Demand Analysis**: Identify areas with high water use for non-potable purposes .
- **Cost-Benefit**: Reuse existing infrastructure to minimize costs.

System Design

- **Water Storage:** Use modular storage tanks for sources with basic filtration systems
- **Pipeline Network:** Install cost-effective HDPE pipelines to distribute water
- **Pump System**: Use small, energy-efficient pumps for water distribution with automatic control for demand-based flow.

Phased Implementation

- **Pilot Phase**: Test the system in a small area, integrating all water sources.
- **Scale-Up**: Gradually expand to other areas, depending on the success of the pilot.



Construction and Maintenance

- **Minimize Disruption**: Use trenchless technology to reduce campus disruption during installation.
- **Maintenance**: Regular checks on water quality and system performance with routine staff training.

Treated Water Reuse

Designing a dedicated system, including storage tanks and distribution network, to circulate treated water from the Sewage Treatment Plant to various parts of the campus for applications such as

- **Landscape Irrigation in Campus**
- **General Cleaning Operations**
- **Non Potable Applications**

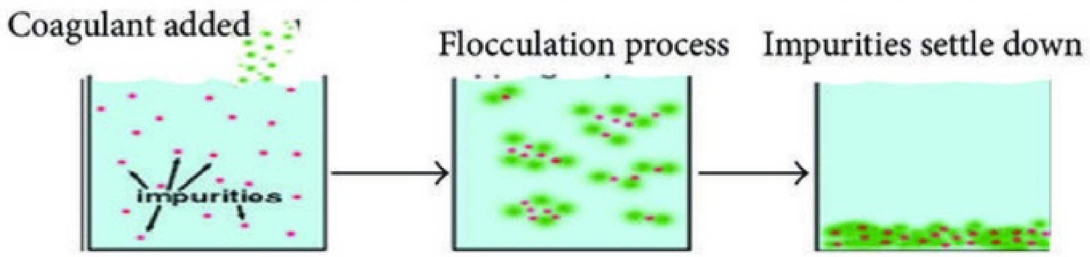
<u>Conclusion</u>:

The integrated water circulation system will conserve water, reduce operational costs, and minimize environmental impact by using treated sewage, RO reject water, AC condensate, and greywater.

Enhancements in Water Treatment Plant and Sewage Treatment Plant in Campus

Installation of an additional Flocculator (WTP)

- Water Treatment Plant in campus currently has two flocculators in operation.
- Addition of a third flocculator is projected to substantially enhance sediment deposition efficiency, resulting in water quality nearly equivalent to pre-filtered water.
- The addition of a third flocculator will help reduce the frequency of filter cleaning, which is usually four times or more a day during dry season.



Calculations

Currently
6 filter beds x 1.5L litres = 9L litres per cleaning

Normally: once a day = 9L per day
Dry season: 4 times a day = **36L per day**

After addition of a flocculator
Normal season : twice a week = 9L litres per week
Dry season : once a day = **9L litres per day**

Savings per week
In dry season, **savings=189L litres per week**
Normal season, **savings= 45L litres per week**

Saving
105L
litres per week

Upgraded Filtration Techniques (STP)

MBR Technology

- Membrane Bioreactor (MBR) uses **biological treatment**, breaking down organic matter, followed by **microfiltration**, which **separates suspended pathogens** and solids from water.
- **Bacteria Used**: Heterotrophic Bacteria, Nitrifying Bacteria, Denitrifying Bacteria, Protozoa, Fungi, Algae.

UV-based Treatment

- Uses ultraviolet light to **inactivate harmful bacteria,** viruses, and protozoa.
- No chemicals are used, **eliminating harmful chemical residues** in the treated water.
- Upon further treatment, water can be used as a **backup for potable uses.**
- Compact and easy to install.

Why this ?

- Effective in removing major problem-causing **pathogens like E. coli.**
- **Eco-friendly** treatment techniques, causing **no by-products** or residues (unlike chlorination).
- Minimizes frequent casualties and health problems around campus.

Smart Switches

Smart Water-Saving Solutions

Dual-Flush Toilets

Replace conventional toilets with dual-flush systems that allow users to choose between low (3-4 L) and high (10 L

SWAN-Neck Taps with Aerators

Prioritize toilets and taps in high-usage areas such as academic blocks, hostels, and administrative buildings.

(Begin with hostels and dining halls, then expand to all buildings.)

*Estimated Water Savings: Dual-flush toilets alone can save up to **1.5 lakh L/day.***

Efficient Cleaning Techniques

Spray Mopping

Uses a built-in spray system to dispense a controlled amount of cleaning liquid, reducing water wastage compared to traditional mopping methods.

Use spray mopping in classrooms, hostel corridors, and administrative offices.

Steam Mopping

Uses hot steam for cleaning and disinfecting without requiring large amounts of water or soap.

Deploy steam mopping in high-traffic areas like dining halls and washrooms.

Mulching for Moisture Retention

Applying mulch around plants helps retain soil moisture, reduces evaporation, and suppresses weed growth, minimizing the need for frequent watering.

Deployment Strategy:

- Use organic materials such as bark, straw, and leaves as mulch.
- Apply mulch around trees, shrubs, and garden plants on campus.

Implementation Locations:

- *Campus gardens and green spaces.*
- *Flower beds and plant near library.*

Awareness Campaigns

SAVE WATER

Partner with the **Prakriti Club** to create and share water-saving **posters around campus** to raise awareness and encourage conservation.

Partner with various **Departments or sustainability-focused student clubs** to organize **events** specifically about water conservation.

Something fun

Host a "**Water Saving Challenge**" where students track and compete to reduce water usage, with rewards for the top performers.

Water Pipeline Leak Detection and Management

Objective

Implement a cost-effective and efficient system to detect and manage water pipeline leaks at IIT Guwahati, focusing on high-risk and secluded areas to conserve water, minimize environmental impact, and ensure uninterrupted campus operations.

Assessment and Planning

Infrastructure Analysis: Assess the campus's water distribution network to identify areas prone to leaks.

Prioritization: Rank these areas based on pipe age, material, historical leak data, and accessibility to determine sensor placement priorities.

Technology Selection

Choose **Acoustic Leak Detection Sensors** for their cost-effectiveness and efficiency in identifying leaks by detecting sound waves from escaping water.

Strategic Deployment

- **High-Risk Areas:** Main pipeline intersections, joints, and past leak sites.
- **Secluded Zones:** Hard-to-access areas difficult for manual inspection

IWMA Integration

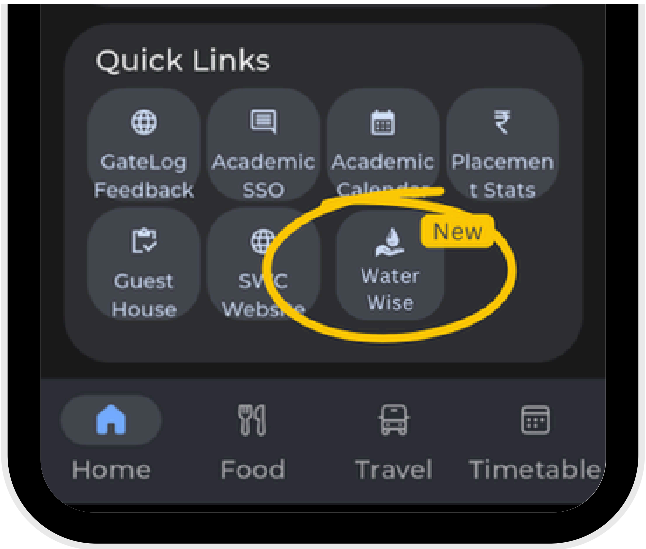
Integrate sensor data into our IWMA database for real-time monitoring and automated alerts to maintenance teams upon leak detection.

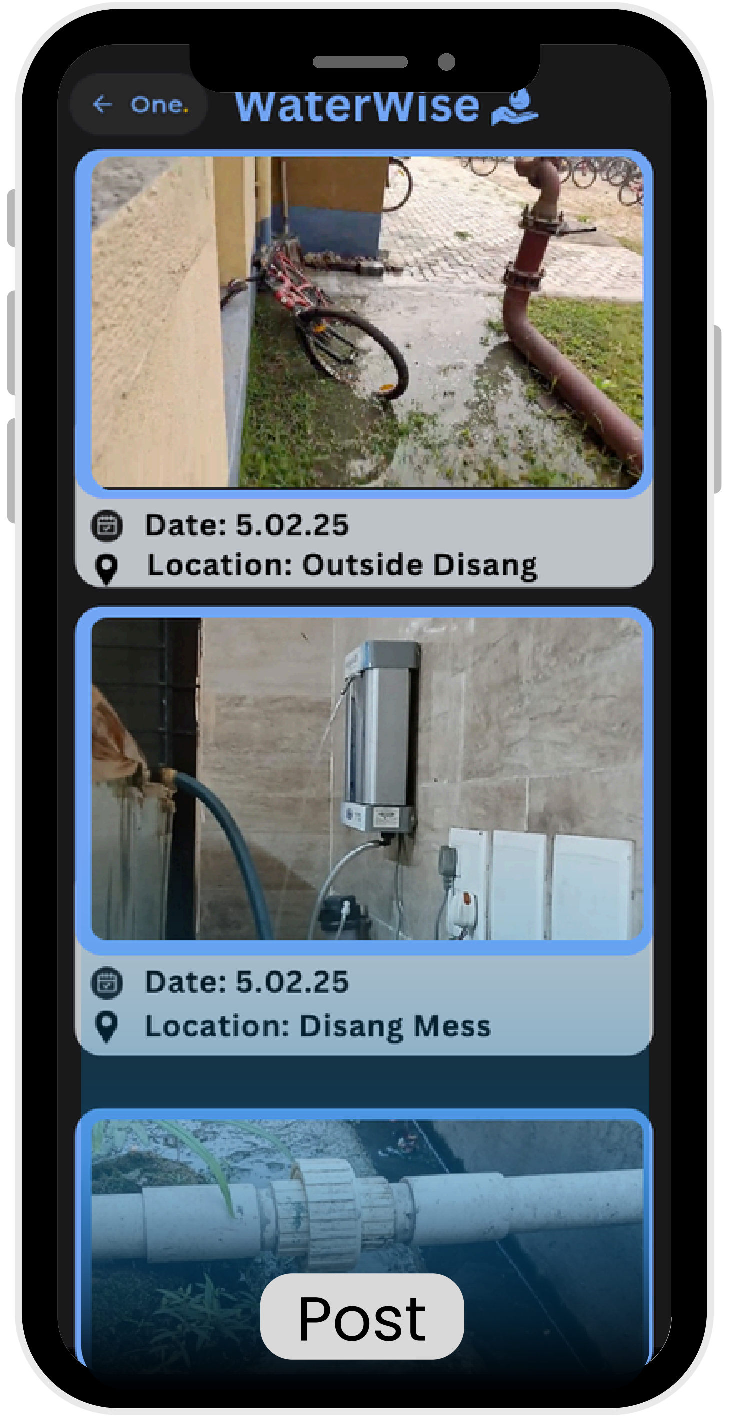
Maintenance and Optimization

- Conduct regular inspections to ensure sensor functionality.
- Analyze data to identify patterns and optimize sensor placement.

The "WaterWise" feature in OneStop. app

*The **"WaterWise" feature** allows IIT Guwahati users to instantly **report water-related issues with photos, location, and timestamps,** sending them directly to the **IWMA database**. This enables real-time action and boosts transparency, accountability, and campus participation in water conservation.*





IITG Water Management Authority (IWMA)

Structure & Responsibilities

The water management body will function as a specialized sub-unit under the IITG Infrastructure & Planning Management (IPM) section. It will consist of a core team, operational units, and student representatives to ensure effective execution and accountability.

1. **Chairperson (From IITG Administration/IPM Section)**
2. **Professors & Faculty Advisors (From Environmental Science, Civil Engineering)**
3. **Student Representatives (Hostel & Mess Committee Heads)**
4. **Finance & Audit Officers**

Organizational Hierarchy

Managing Body (Accountability & Decision-Making)

- Policy-making for sustainable water management.
- Approval of budgets for new installations, repairs, and upgrades.
- Monitoring performance reports and ensuring transparency.
- Coordinating with hostel representatives and faculty members for student concerns.
- Submitting quarterly reports to IITG administration for continuous improvements.

Team	Installation & Repair Team	Cleanliness & Maintenance Team	Quality Check & Research Team	Monitoring, IT & Complaint Resolution Team
Responsibilities	• **Install & repair** pipelines, storage tanks, and filtration units. • **Fix leaks** and plumbing issues. • **Coordinate with vendors** for materials.	• **Clean water tanks, reservoirs**, and drainage systems. • **Maintain** sewage lines and mess **water systems.** • Coordinate with **sanitation staff.**	• **Test water quality** and ensure safety. • Improve **STP & WTP** operations. • Research **eco-friendly** water management **solutions.**	• Manage **sensor data** for leak detection. • Manage complaint portal & **Onestop Complaints**. • Source of **communication** between other teams
People	• Technicians & Plumbers (In-house or external contractors) • Engineers	• Sanitation & Cleaning Staff • Hostel & Campus Maintenance Workers	• Water Quality Engineers • Research Students • STP & WTP Operators	• IT (from IITG or external consultants) managers • Complaint Resolution Officers

Implementation

Timeline

Phase 1 (1-3 Months)

- **IWMA Setup**: Teams for maintenance & monitoring.
- **Awareness Drive**: Water conservation campaigns.
- **Water-Saving Measures:**
- Install efficient taps & toilets.
- Use spray/steam mopping.
- Apply mulching for irrigation.

Phase 2 (3-6 Months)

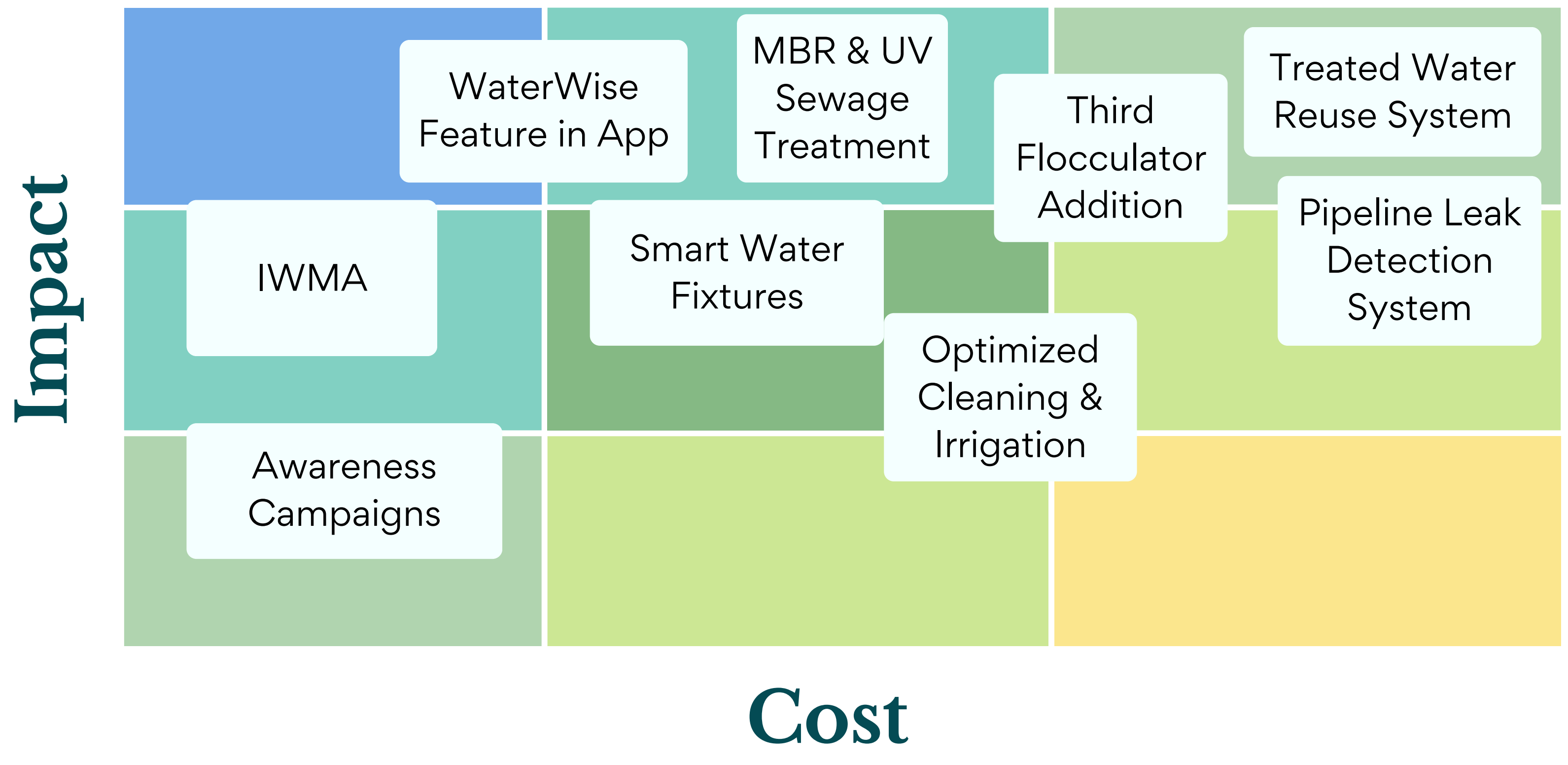
- **Leak Detection**: IoT-based sensors in high-risk areas.
- **Water Reuse**: Collect & circulate treated sewage, RO reject, AC condensate, and greywater.
- **STP Upgrade:** Install MBR & UV filtration for eco-friendly treatment.

Phase 3 (7-9 Months)

- **Expand Leak Detection**: Increase sensor coverage.
- Scale Water Reuse: Extend pipelines for irrigation & flushing.
- **Enhance Quality Monitoring:** Smart tracking for real-time purity checks.
- **WaterWise Integration:** Add real-time leak & cleanliness reporting to Onestop app.

Phase 4 (10+ Months)

- **Install Third Flocculator:** Reduce filter stress & improve purification.
- **System Audits & Upgrades**: Assess & enhance filter house, flocculators, and STP.
- **Optimize IWMA Operations:** Improve complaint resolution, monitoring, and maintenance.



The plan balances **feasibility and scalability** by combining quick, **low-cost solutions** (WaterWise, smart fixtures) with **long-term infrastructure** upgrades (MBR-UV treatment, reuse system). **Short-term fixes** offer immediate impact, while phased deployment of major projects **minimizes disruption.** Scalable solutions ensure sustainable water management across campus

Financial Analysis

SOLUTION	ESTIMATED COST	ANNUAL SAVINGS	PAYBACK PERIOD	KEY BENEFITS
Treated Water Reuse System	20-30	10-15	2-3	Reduces potable water use by 30-40%, free irrigation & flushing water
Third Flocculator Addition	10-15	5-7	2-4	Reduces stress on filters, ensures water purity during dry periods
Sewage Treatment Upgrade (MBR & UV)	35-50	5	5	Eliminates chemicals, safer water, reduced chlorine costs
Pipeline Leak Detection System	25-40	10-12	4-5	Detects leaks early, prevents 25% water loss, cuts maintenance costs

SOLUTION	ESTIMATED COST	ANNUAL SAVINGS	PAYBACK PERIOD	KEY BENEFITS
IWMA (Water Management Body)	5-10 (Annual)	15	1-2	Improves issue reporting, speeds up repairs, increases accountability
Awareness Campaigns	2-4 (Annual)	Indirect	Immediate	Centralized monitoring, reduces emergency repairs
Smart Water-Saving Fixtures	10-15	8-10	2	Saves 20-30% per toilet/tap, reduces water bills
Optimized Cleaning & Irrigation	5-7	3-5	1-2	Saves 50% in cleaning water, mulching cuts irrigation demand

KPIs and Risk-Mitigations

Water Conservation:

- Volume of Water Saved: Measure the volume of water conserved through leak detection, reuse systems, and water-efficient fixtures.
- Percentage Reduction in Water Usage: Track overall reduction in campus water consumption, especially during dry months.

Operational Efficiency

- Response Time for Leak Detection: Track the time taken from reporting to resolution for leak-related issues through the WaterWise feature.

Maintenance Efficiency: Measure the percentage of reported issues resolved within a set time frame

Water Quality

- Water Purity Levels: Monitor the quality of treated water through regular testing of UV-treated sewage and the effectiveness of the flocculation process.

Reduction in Contaminants: Measure the reduction of pathogens and harmful chemicals, particularly with the new MBR and UV systems in the sewage treatment plant.

System Utilization

- WaterWise Engagement Rate: Track the number of active users and the frequency of issue reports via the WaterWise feature.

Sensor Coverage & Effectiveness: Measure the total area covered by leak detection sensors and their effectiveness in preventing water wastage.

Behavioral Impact

- Participation in Campaigns: Track the number of students and staff engaged in water-saving campaigns and the adoption of water-efficient habits.
- Feedback & Satisfaction Rates: Monitor user satisfaction with the water management features and systems through surveys.

RISKS	MITIGATIONS
Technical Failure of Detection System	Regular calibration and maintenance of sensors. Backup systems for early detection of sensor malfunctions
Insufficient User Engagement with WaterWise	Promote awareness campaigns and ensure easy-to-use functionality for reporting through the app. Incentivize participation
Disruption During Construction	• Plan construction and system upgrades during semester breaks or off-peak times to minimize disruption to campus life.
Budget Overrun on Upgrades	Prioritize high-impact, cost-effective solutions. Seek funding in phases, ensuring flexibility in budget allocations
Low Adoption of Water-Saving Practices	Conduct workshops, provide incentives, and display visible progress from the water-saving campaigns to encourage behavioral change
Lack of Coordination Between Teams	Establish clear communication channels between IWMA, campus facilities, and other stakeholders. Regular performance reviews and feedback loops

THANK YOU