AMRIT
Smart Water Management system
VerteX
Solar Solutions Pvt. Ltd.
Smart Water Supply
Measurement and Quality
Monitoring System

AMRIT
Smart Water Management system

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Amrit is an IoT-based system for real-time monitoring of quality and quantity for potable water. The system has an interactive dashboard for data visualization with node's hierarchy. A user can manage the faults in water distribution network, demands, bills and supply schedules.

Challenges & Requirements

	Raw water intake well	Water treatment plant	ELSR/GLSR	DMA	House hold
CHALLENGES	Sessional variation of water quantity & quality needs different filtration needs	Varying raw water quality needs diffe rent filtration/chemical mixing needs	• Timely filling & distribution • Ensure water quality before distribution	• Timely distribution • Leakages/Theft • Water pollution	• Timely distribution • Leakages • Water pollution • End mile availability
PARAMETERS TO MONITOR	1. Turbidity 2. pH 3. Water Level at source 4. Out flow 5. Pressure 6. Pump Efficiency	1. Turbidity 2. pH 3. Chlorine 4. Level at filter beds 5. Out flow 6. Pressure 7. Pump Efficiency	1. Water Level 2. Inflow/Out Flow 3. Chlorine	(at strategic points) 1. Flow 2. Pressure 3. Chlorine	(at strategic points) 1. Flow 2. Pressure 3. Chlorine
CONTROLS REQUIRED	1. Pump ON/OFF 2. Valves automatic Open/Close	1. Filter bed Valve open/close 2. Backwash Pump ON/OFF 3. Chlorine Dozing	Valves automatic Open/Close	Valves automatic Open/Close	Valves automatic Open/Close

Smart Water Management

- Aims to provide Quality and Quantity by effective management of water distribution network.
- System monitors & controls water distribution network from central place using IoT based Sensors, (i.e flow, level, water quality, valve actuators..etc) deployed along distribution and household connections.

Objectives:

- Right quantity at Right time of water distribution
- Right quality of water
- Reduce Wastage of Water

Water Measurement and Quality Monitoring System

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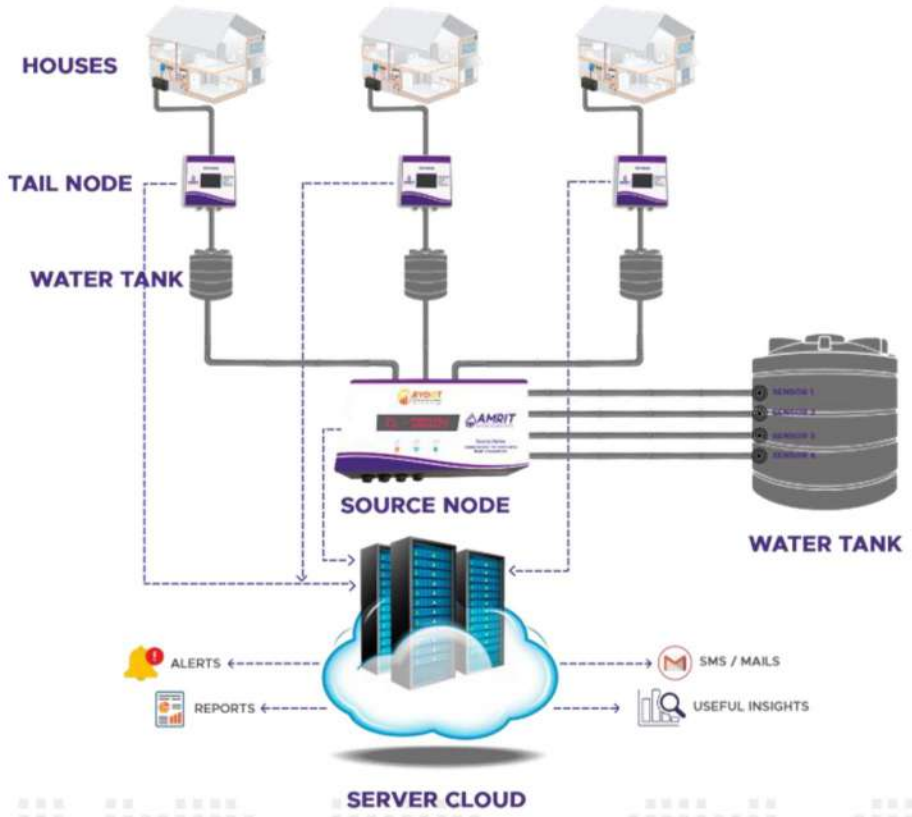
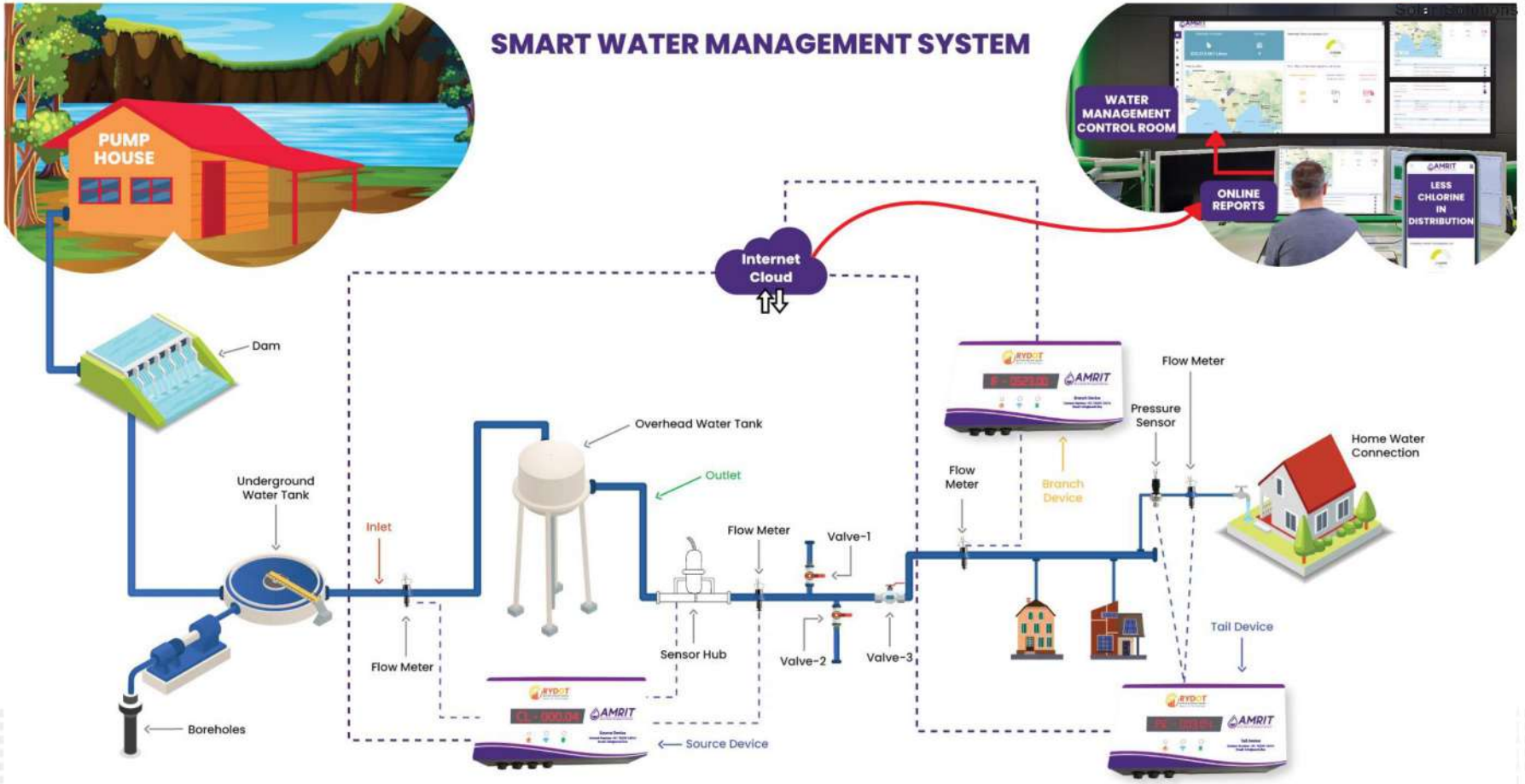
- Collecting real-time water quality and quantity parameters using IoT and harnessing data for generating valuable insights.
- The insights will be used to ensure “Har Ghar Jal” mission and will help taking decisions regarding predictive, maintenance and schedule optimization.
- The system will help monitoring real-time water consumption and quality.
- Insights can be visualize in an easy to understand way using interactive dashboard.
- The system is based on cutting edge technology's like IoT, AI and Bigdata analytics and will improve water distribution.

Commercial House/ Design Scheme Architecture



Village Design Scheme Architecture



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Amrit IoT Device

AMRIT IoT Device

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Device Features

- Multiple Connectivity Options
- Remote Data Access
- Standalone Sensors
- Monitor Multiple Equipment's
- Customizable
- Battery Backup
- GSM / LoRa Technology
- Water Flow Sensor
- Local Live Monitoring Solution
- Flow Totalizer Display
- Local Software Access
- Water Control/Pump Control
- E-mails, SMS, Report
- Global Live Monitoring Solution

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Key Features

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- Users can download all kinds of analytical graphs anytime, anywhere with just a single click.
- Receive SMS and email notifications
- Real time pH, TDS, Nitrate, Residual Chlorine, Fluoride monitoring system
- Full visibility of your system's technical and financial performance, including interactive charts and site layout
- Visualization of Sensor Data, Future Predictions, Leakage detection, Water flow etc.
- Data presentation at the module-level, string-level and system level
- Comparative analysis diagnostics
- Mobile and web-based monitoring
- Ease of use and control from anywhere in the world
- Easy control over complex systems like pump control, water level control
- Remote Connectivity
- Water level indicator system

USP

- Low cost
- Quick installation
- Tampered detection
- Low power (15-20 ma idle consumption)
- Plug & play sensor connectivity
- 2g/4g / lora / wi-fi connectivity ip65 standard
- 48 hrs to 180 days power backup
- Microcontroller
- Portable
- Remote calibration and device management
- Compact size
- Data communication as per user define
- Live display of data on led screen
- Power on solar
- Data storage till 1 year on device

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Specifications

Category			
Voltage	12-24V DC		
Current	2A		
Battery capacity	12V 3500mAh		
Quality Sensors	Range	Resolution	Accuracy
pH	0-14	0.01	(+-)1
TDS	0-5000 mg/litre	1	(+-)2
Chlorine	0-5 mg/litre	0.01	(+-)0.05
Nitrate	0-500 mg/litre	0.1	(+-)5
Fluoride	0-20.0 mg/litre	0.1	(+-)0.5
Quality Sensors			
Flow Meter	Bulk Flow Meter		
Pressure Sensor	Upto 5 bar		

Connectivity Options	
	• GSM Enabled
	• GPRS Enabled
	• 4G Volte Enabled
	• Wi-Fi Enabled
	• LORA Enabled
	• LAN Enabled
Features	
	• Up to 8 sensors can be attached
	• Upto 5 solenoid Valve control
	• 3.5 inch LCD Display
	• Cortex A-5 ARM processor
	• Linux OS Enabled
	• IP68 housing

Amrit Platform

Platform Independent System

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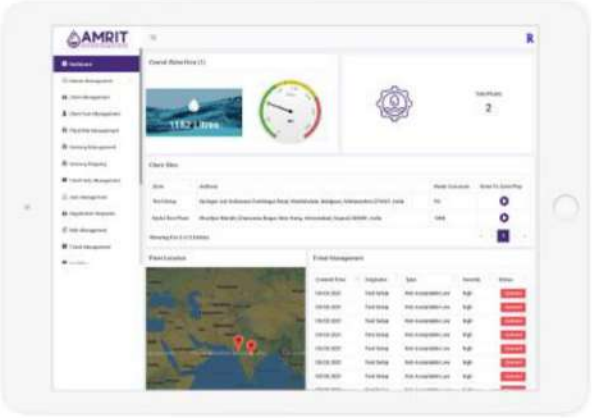

USP

- Analytics & insights of raw data
- Real-time device and data monitoring
- Remote calibration and device management
- IoT configuration
- Alert ticket management about quality control and flow control
- Email, SMS alert
- Reports
- Compare plant performance
- Security user wise and role wise.
- Device health (Battery, Power) monitoring
- Remote device configuration and control.
- Dashboard with various KPI.
- Deploy on any cloud or on premises data center.
- Container base.
- Onboarding user or device using RPA in auto mode.
- Al chatbot support for ticket, information etc.
- Geo tagging of device display

Monitoring Dashboard

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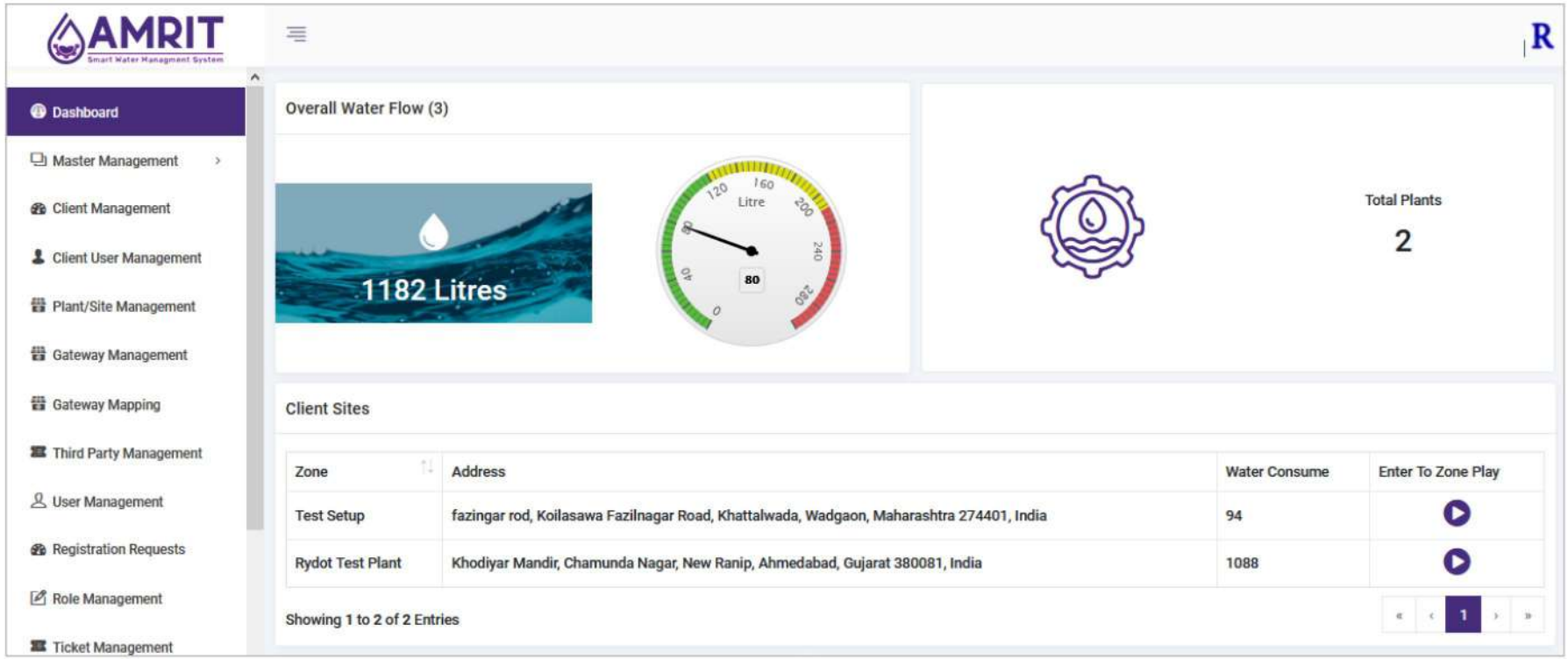

Analytics Dashboard

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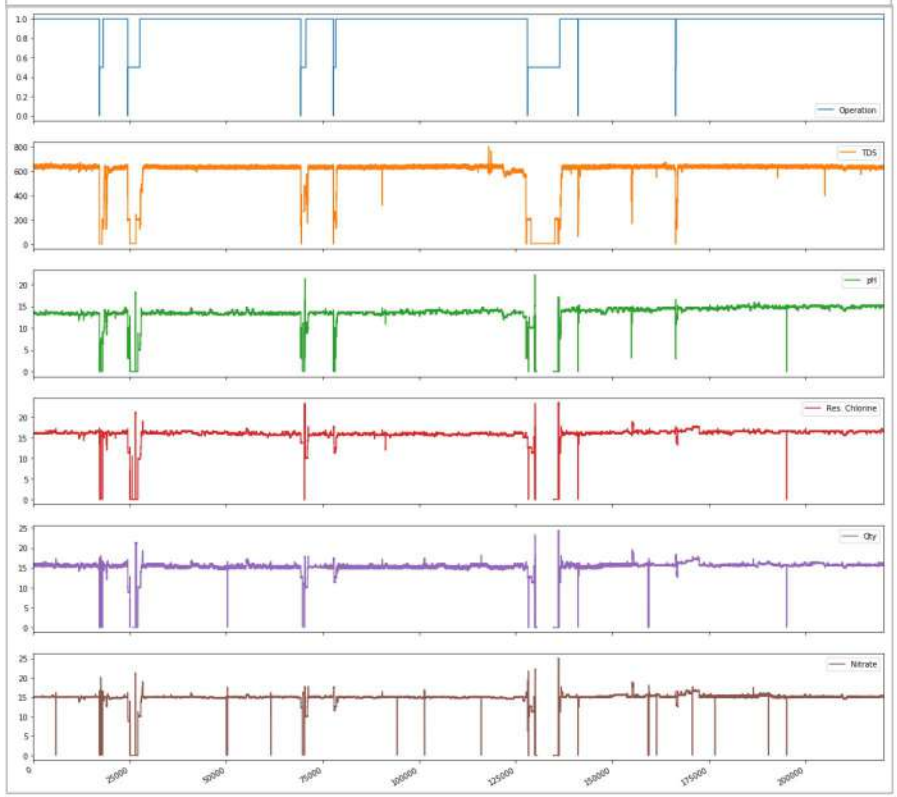
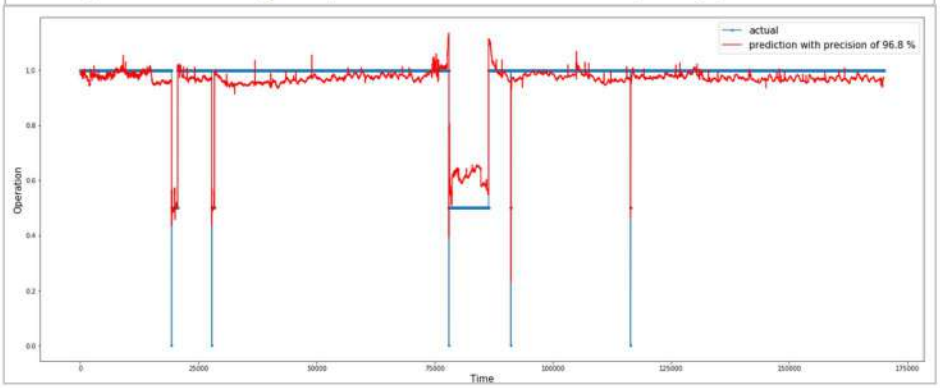
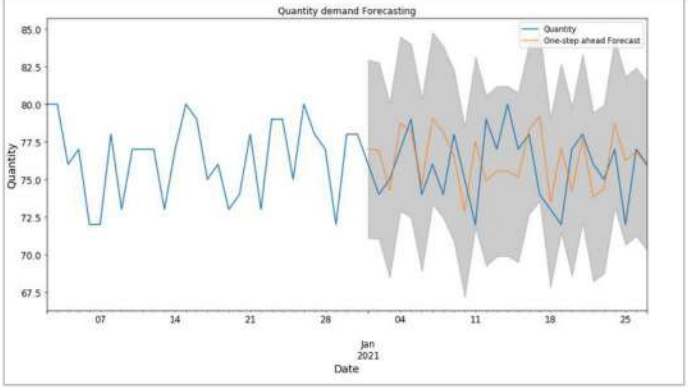
Operation vs different sensors readings (Visualization effect of sensors on operation)



Fault prediction using deep neural network and comparing prediction



Water Quantity Demand Forecasting



Note: These plots are generated with synthetic data for displaying the fault detection using real time and historical data.

Billing, SMS, Email & Real Time Ticket Generation For Error Detection

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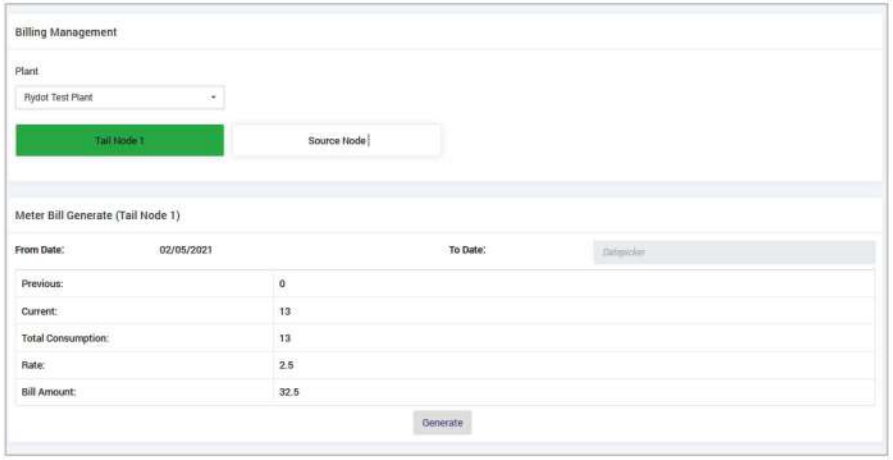

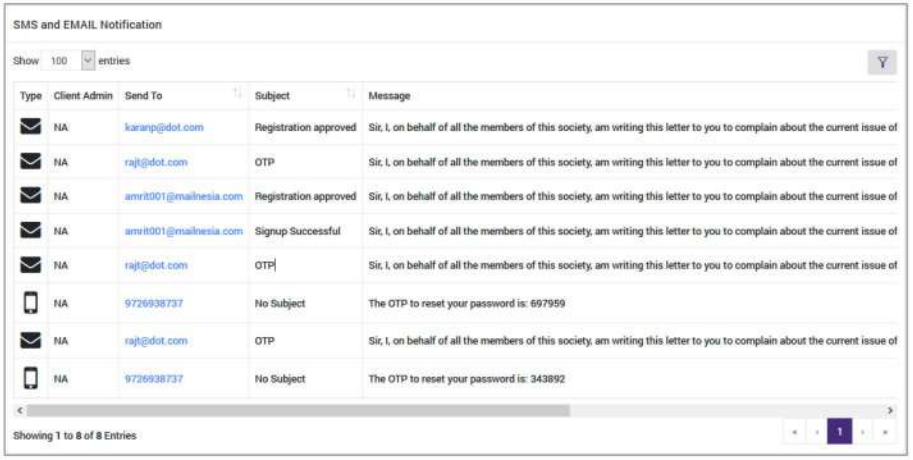

Analysis Reports

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SENSOR RAW REPORT

Plant: Test Setup | Gateway: Source Node | Select a Date Range: 02/04/2021 - 02/05/2021 | Generate Report

Reports | Plant x Gateway x +7 | Download

Plant	Gateway	Flow Total	Flow	pH	Nitrate (Milligram/Litre)	Residual Clorine (Milligram/Litre)	TDS (Milligram/Litre)	Created At
Test Setup	Source Node	0	0	3.88	5.15	3.79	6.33	05/02/2021, 09:57 PM
Test Setup	Source Node	0	0	3.76	5.14	3.8	6.33	05/02/2021, 09:57 PM
Test Setup	Source Node	0	0	3.36	5.15	3.79	6.33	05/02/2021, 09:56 PM
Test Setup	Source Node	0	0	2.8	5.11	3.76	6.42	05/02/2021, 09:39 PM
Test Setup	Source Node	0	0	2.7	4.82	3.55	6.06	05/02/2021, 09:38 PM
Test Setup	Source Node	0	0	1.33	2.57	1.89	3.23	05/02/2021, 09:38 PM

Showing 1 to 6 of 6 Entries

Configuration

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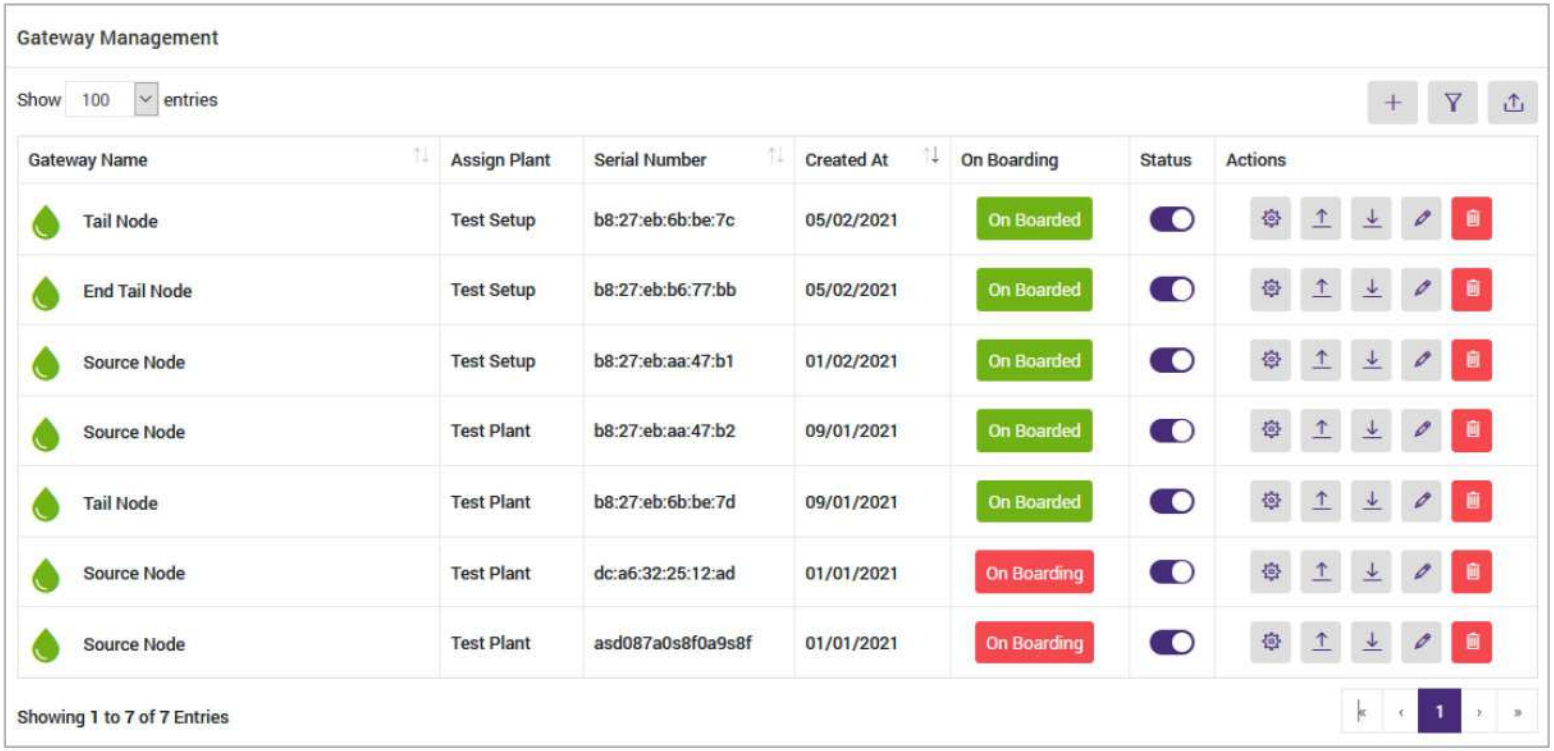


Key Benefits

Key Benefits and Social Impact

- The system provides real time monitoring which is far better than offline quality check in laboratories.

- Water contamination cause serious conditions such as cholera, diarrhea, typhoid, amebiasis, hepatitis, gastroenteritis, giardiasis, campylobacteriosis, scabies, and worm infections.

- Water contamination can be monitored in real time and authorities can take necessary action.

- Better policies and planning can be done by using the insights from data captured through the system.
- Good quality of drinking water available to citizens.
- No disturbance to present inventory.
- No distribution or manpower charges

Key Benefits and Social Impact

- Improved success rate of water supply schemes due to end-to-end visibility of water supply to village, district, state, and national level at near real-time (for quick response corrective actions)
- Equitable access to all sections of the society by monitoring water delivery across habitations
- Alleviation of issues (social, economic and health) in village resulting from in-accessibility to potable water in adequate quantity; improved transparency and accountability
- Reduced cost of operations and improved life of water supply schemes (e.g., leak detection, preventive maintenance, optimising resource requirements)
- Better customer satisfaction with improved service levels through faster response time and lesser number outages (e.g., remote dashboards across levels and preventive maintenance)
- Data-driven and evidence-based planning for new schemes/ modifications through advanced analytics (e.g., demand patterns, electricity reliability, source reliability, temporal water quality variation etc.
- Long term sustainability of water sources through improved source monitoring
- Efficient and responsible use of water by end customers by measuring quantity consumed

Recognition

Recognition

We are heartily thankful to Shri Gajendra Singh Shekhawat Minister of Jal Shakti and Team for providing us valuable guidance during the challenge journey.

We are heartily thankful to Mr. Pradeep Singh, Director of NJJM and Team for providing us valuable guidance during the challenge journey.

Recognition

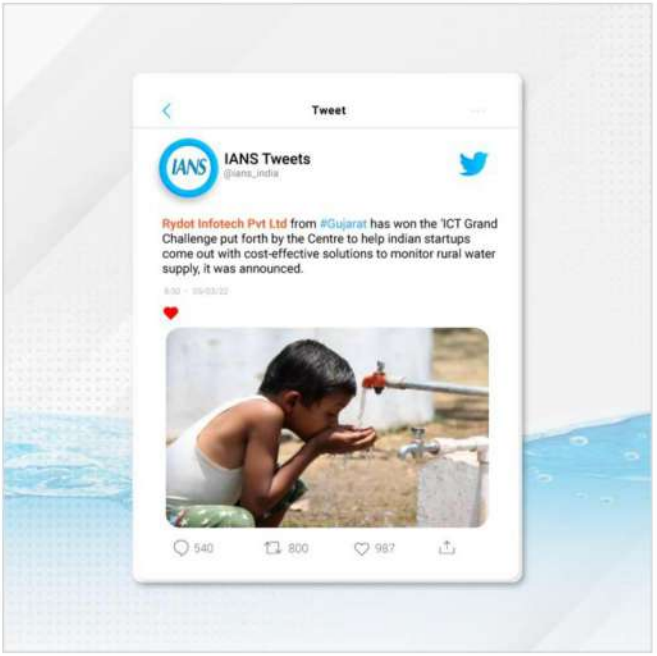
We are heartily thankful to Mr. Mahendra Mahour Rural Infrastructure Consultant, National Jal Jeevan Mission and Team (NJJM) for providing us valuable guidance during the challenge journey.

We are heartily thankful to Mr. Sanjeev & Mr. Abhishek (MeitY) and Team for providing us valuable guidance during the challenge journey.

We are heartily thankful to Ms Annie Joyce, Mr. Haribabu, Mr. S D Sudarsan and Team for providing us valuable guidance during the challenge journey.

Recognition

Vertex Solar Solutions Pvt. Ltd.



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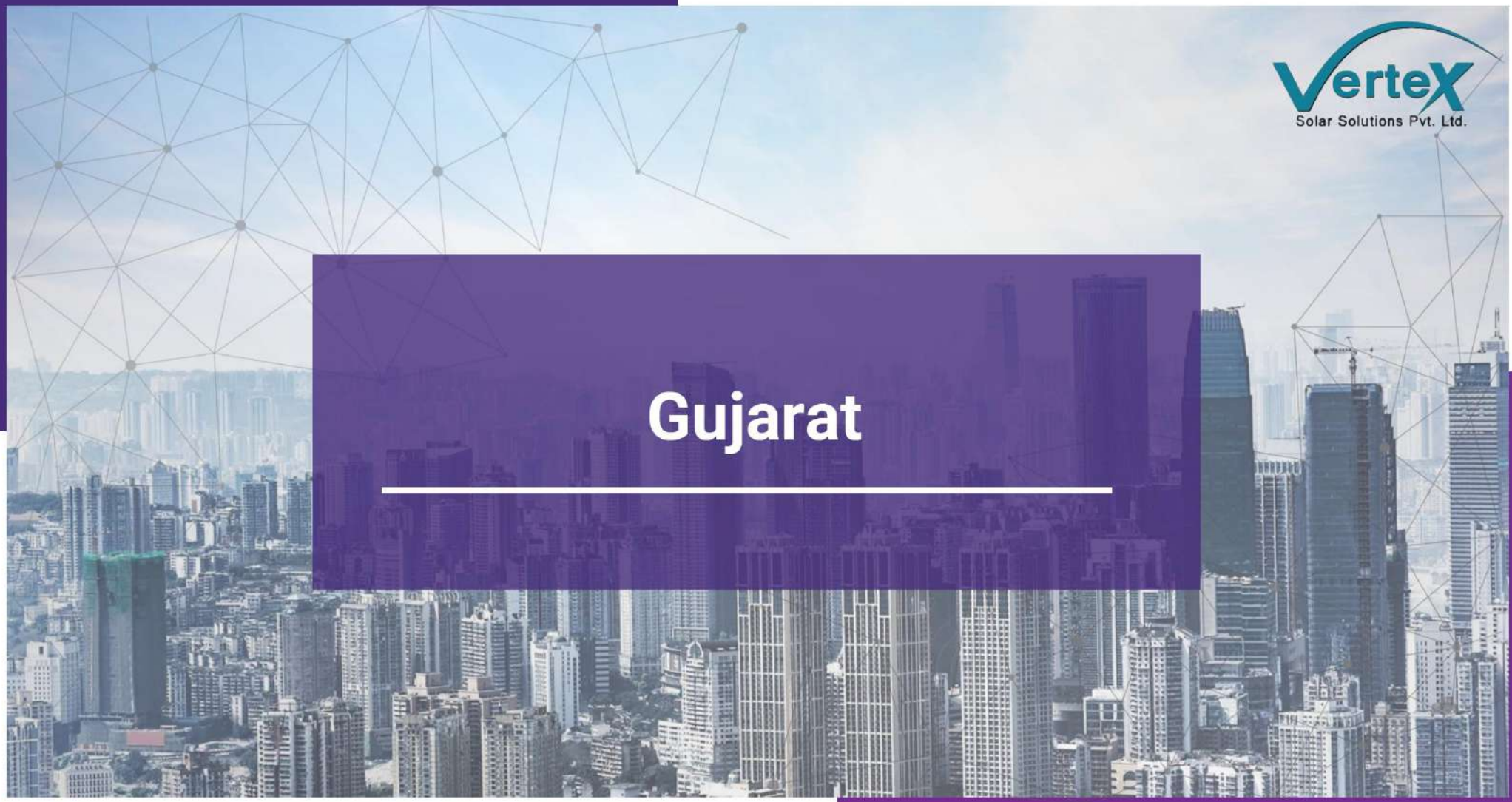
Amrit Till Date Installations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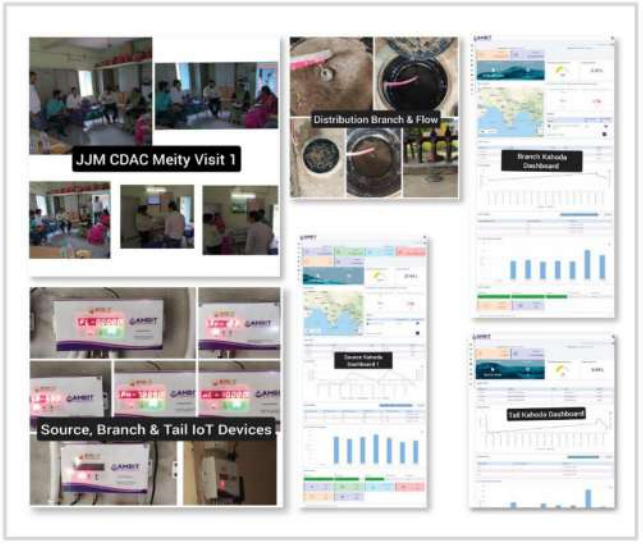
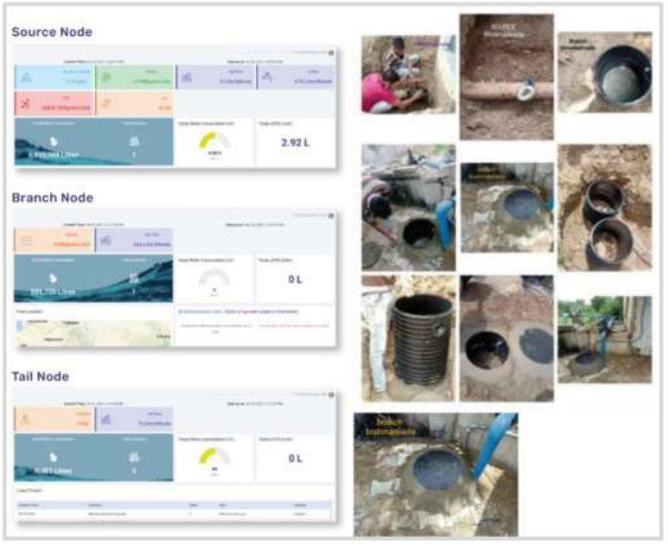
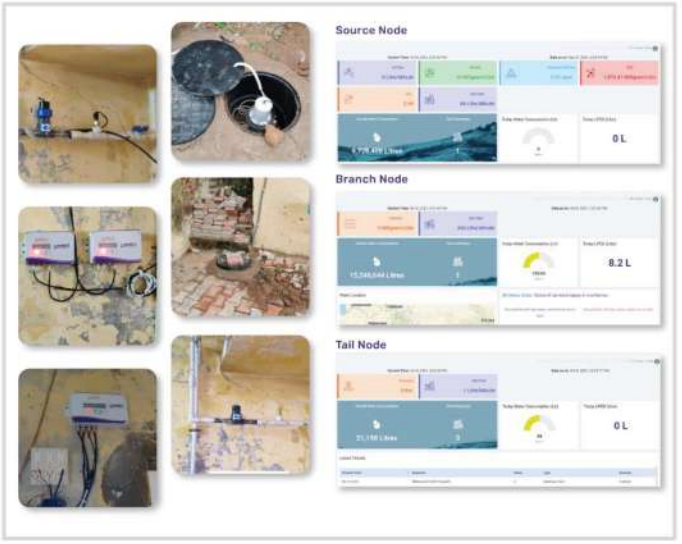
Gujarat

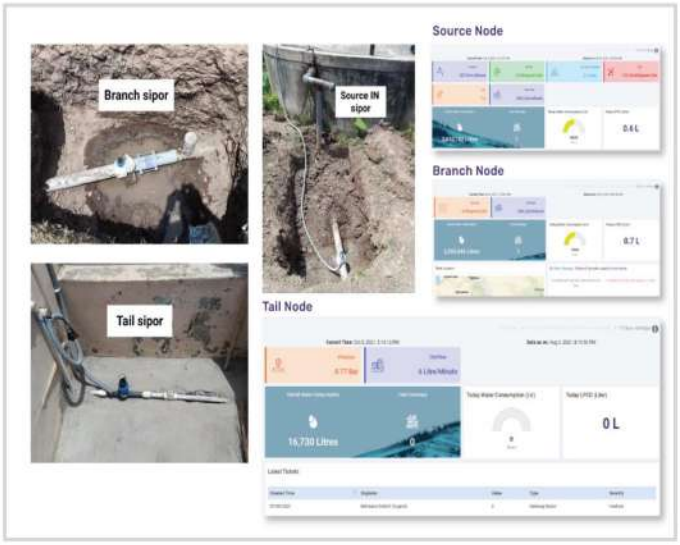
Gujarat – Mahesana 10 Village's

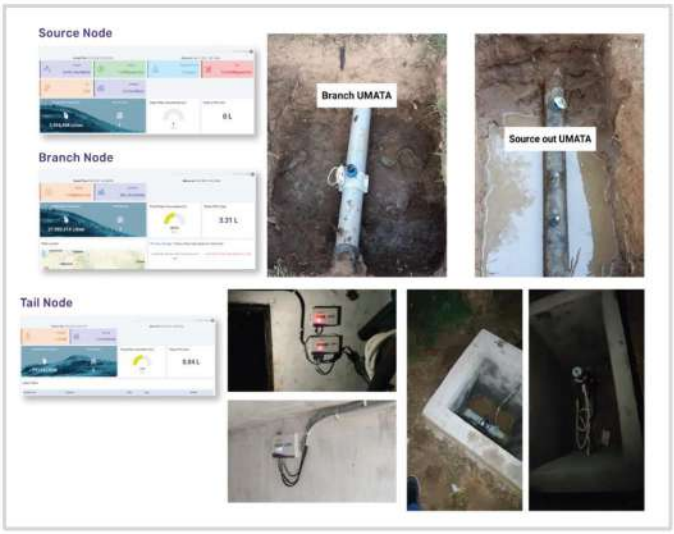






Gujarat – Mahesana 10 Village's





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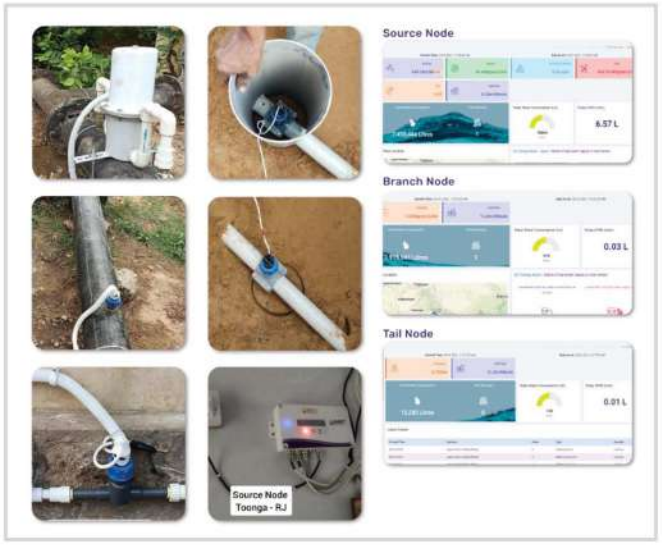
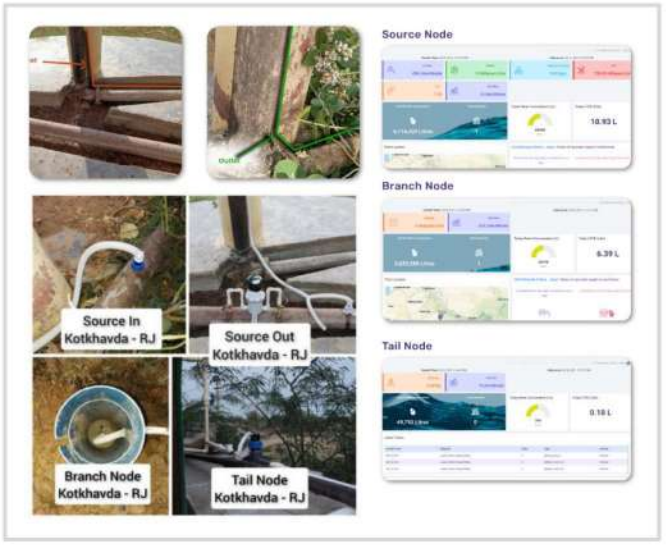
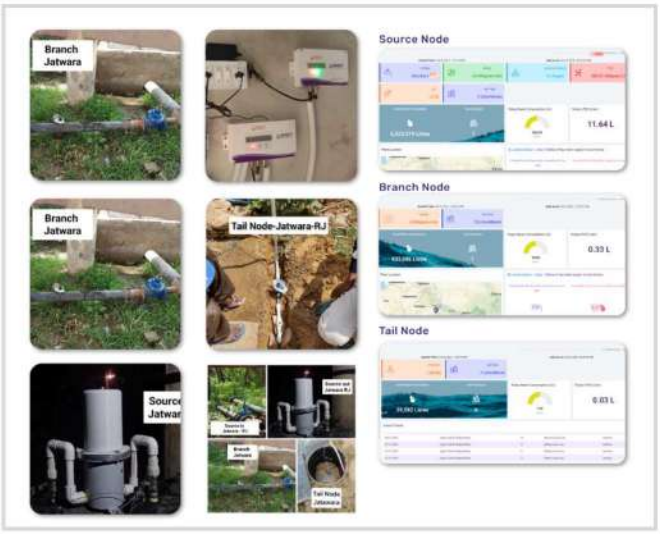
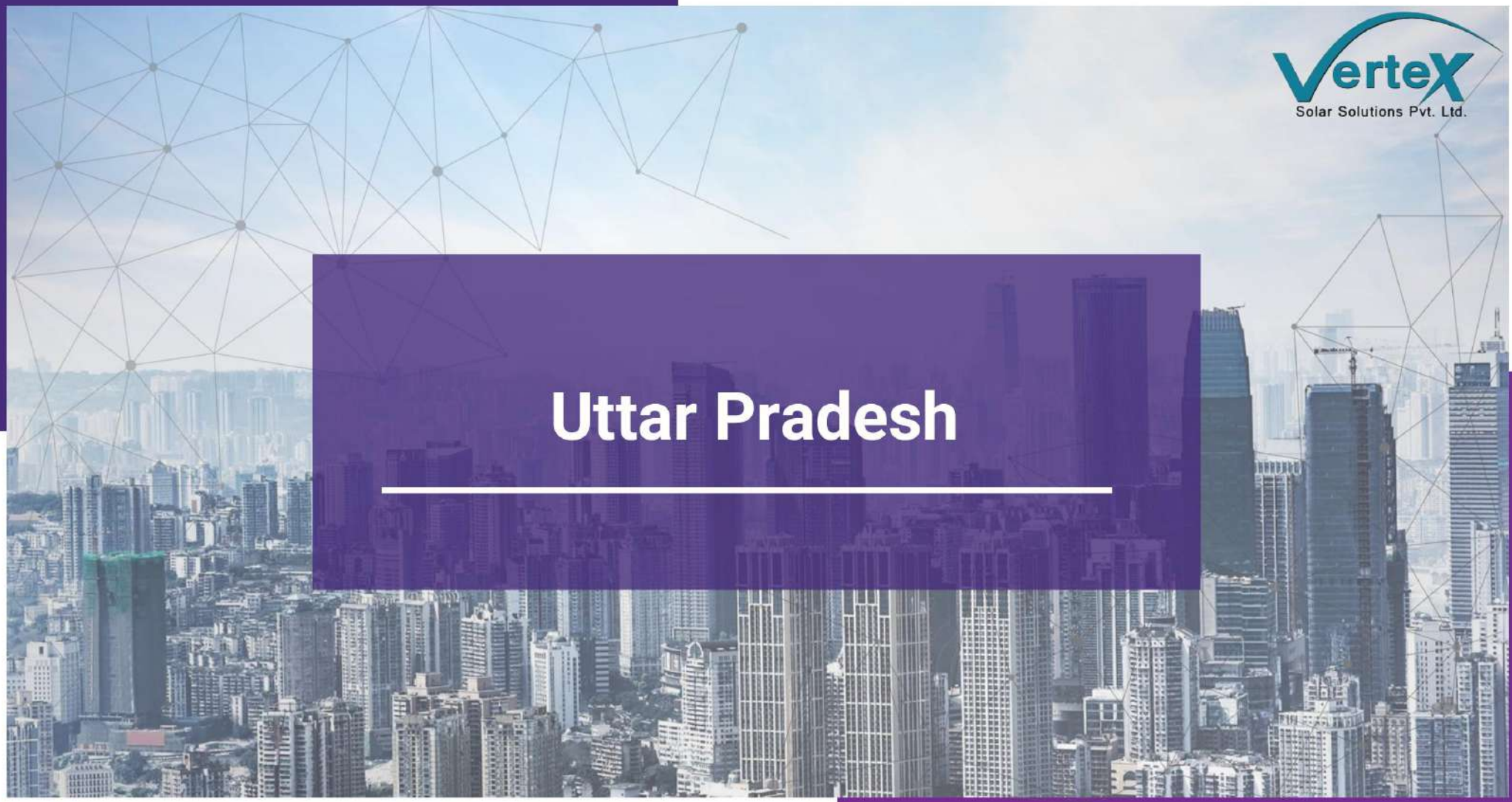
Rajasthan

Rajasthan – Jaipur 4 Village's





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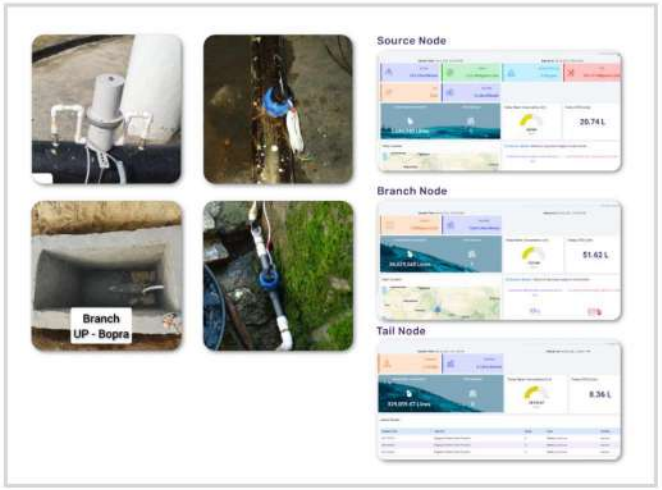
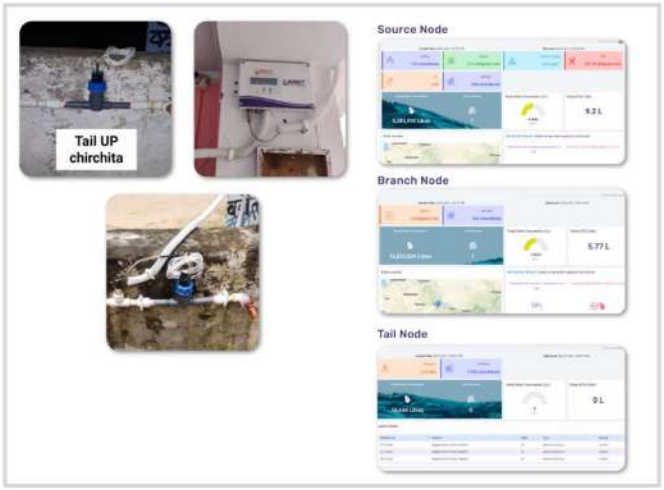
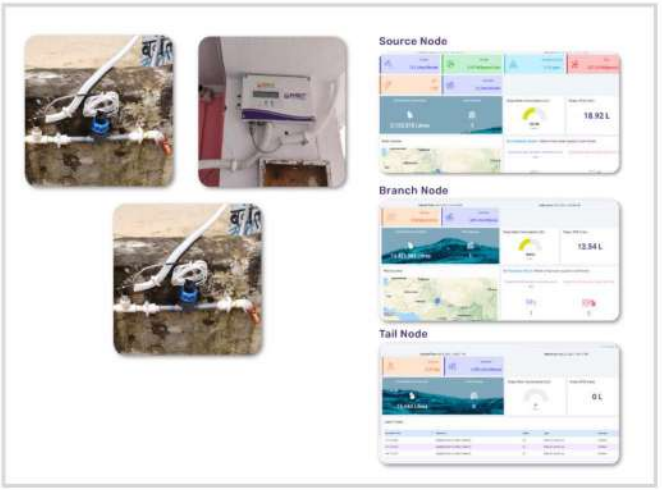
Uttar Pradesh

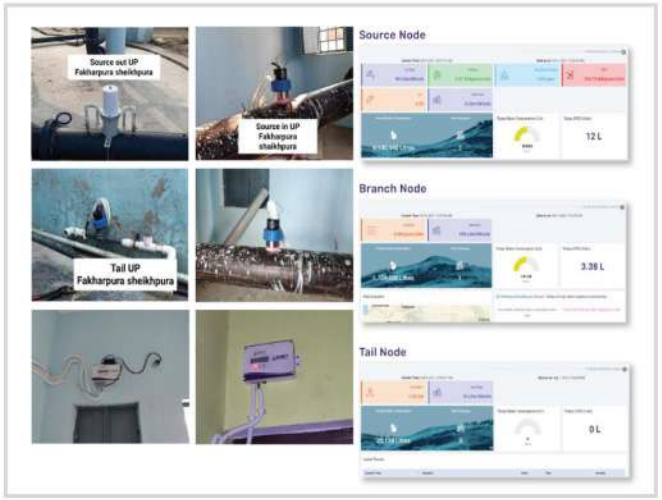
Uttar Pradesh 10 Village's

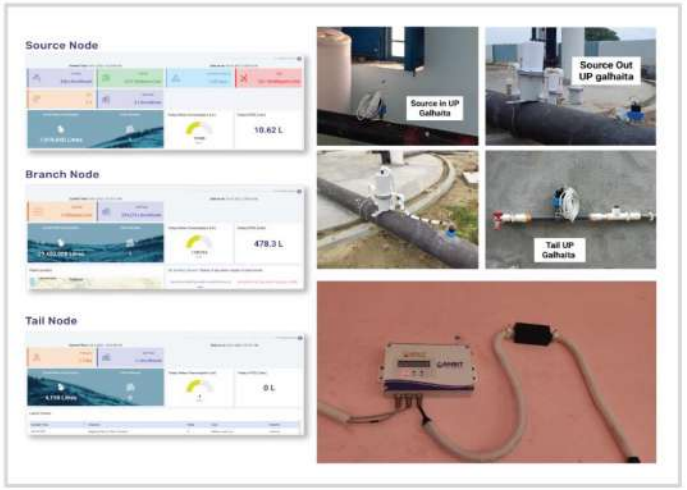


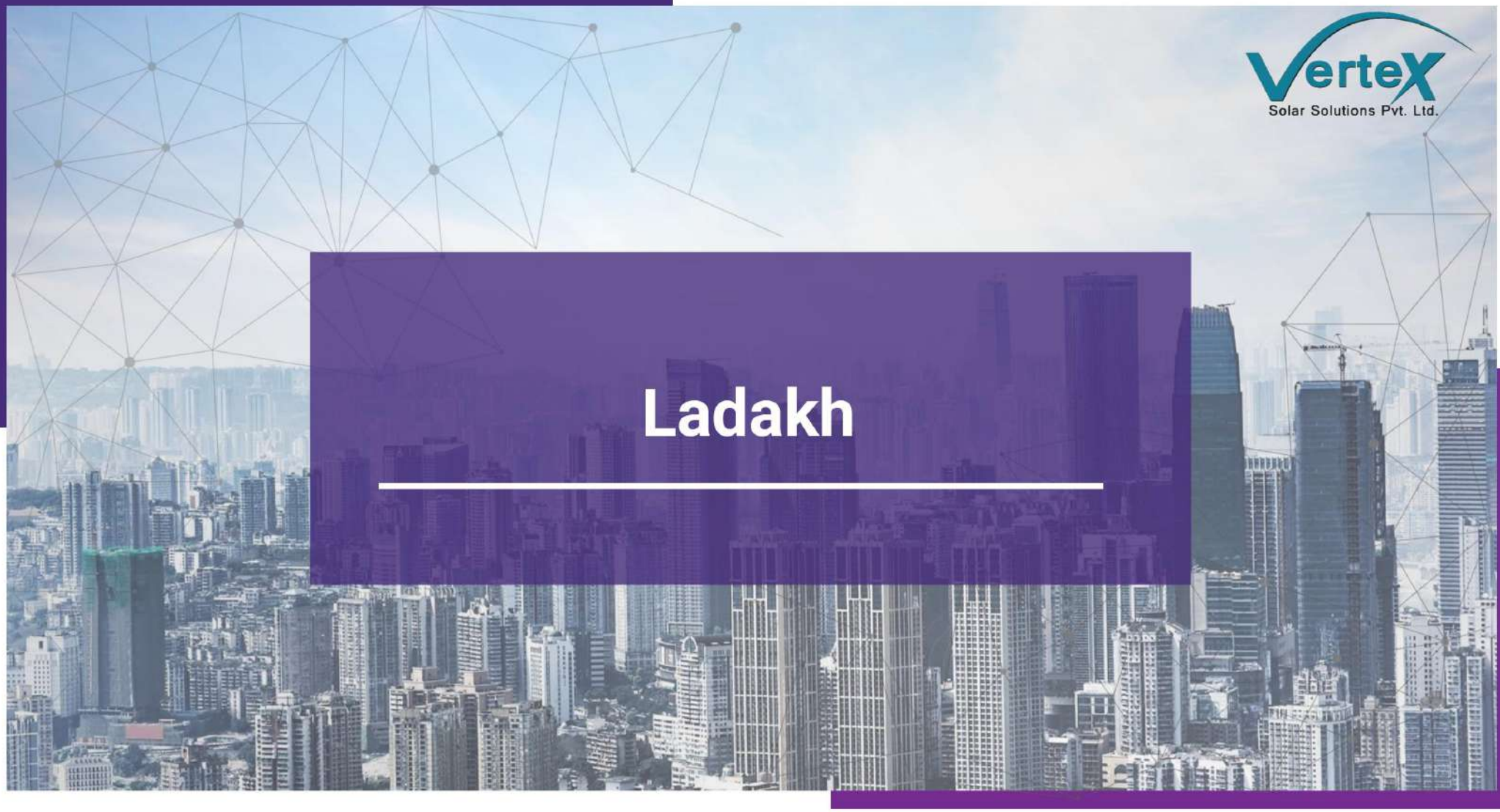




Uttar Pradesh 10 Village's



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Ladakh

Ladakh 1 Village

Source Node

Branch Node

Tail Node

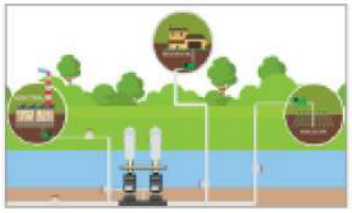
Benefits

Benefits

Smart Water Billing Systems

Smart Water Leakage And Flow Schedule Prediction

Sewage Treatment Plant Automation



Smart Water Distribution

Smart Water Level Controller

Water Level Indicator

Cost Benefit Analysis
(Based on survey conducted in pilot villages)

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- System is cost effective and it cost less than 0.2 rupee (20 paise) per capita per day for real time drinking water quality and quantity monitoring.

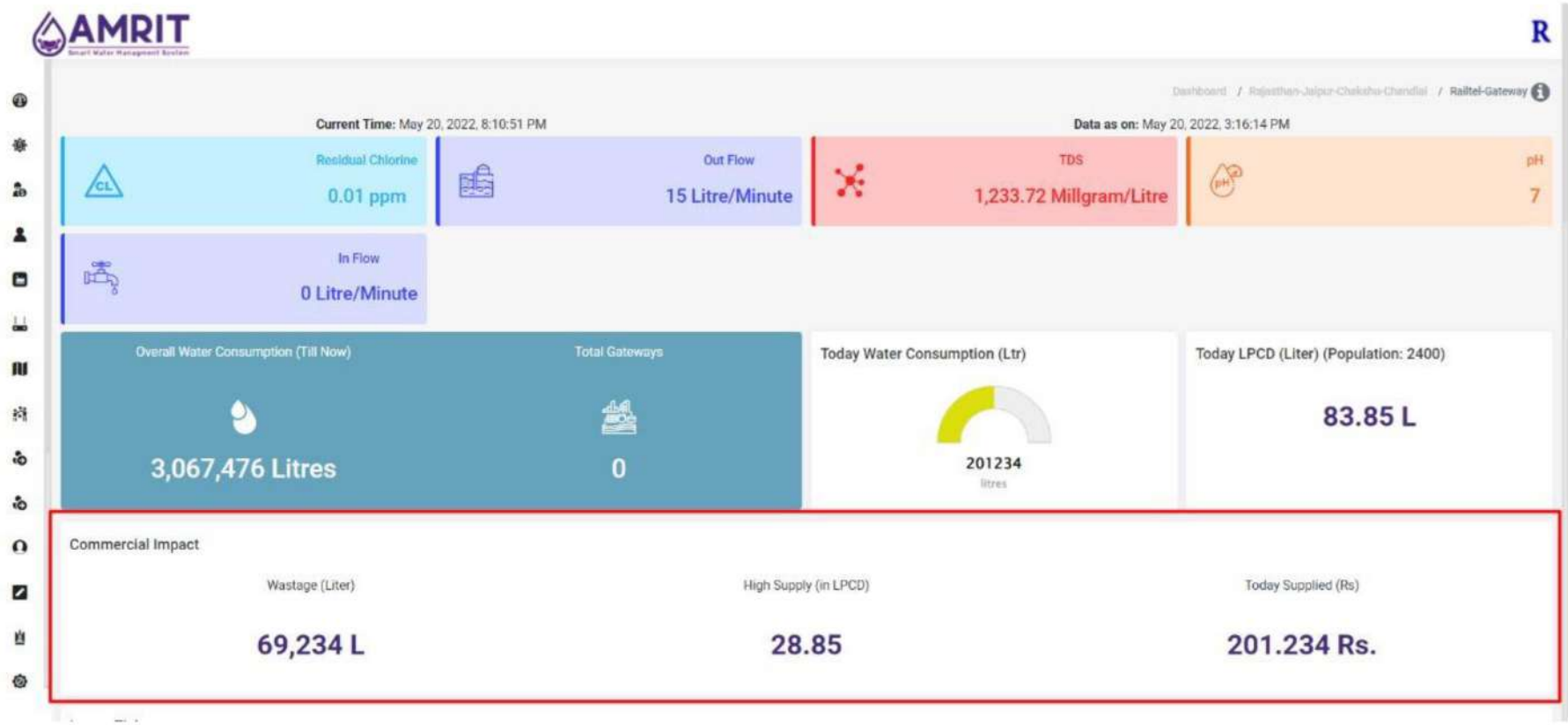
Cost per capita per day = (Installation cost + Maintenance cost + Computation cost)/ 3* Population Coverage

- We have analyzed the cost per capita based on observations from 25 villages.
- Water wastage can be monitored and corrective actions can be taken by concerned authorities.
- The average saving on medicines will be more than the cost of system installation (Based on the survey from 25 villages where we installed the system, regarding drinking water and expenses on health).We have used the statistical techniques for hypothesis testing on survey data.
- System has 100% ROI within one year.

ROI = Water saved + Saving on medicines and health care + Saving electricity bill (Auto cutoff)

Cost Benefit Analysis
(Based on survey conducted in pilot villages)

Solar Solutions Pvt. Ltd.



Features

- Centralized monitoring & controls powered by advanced data analytics for effective water management.

Continuous monitoring

High accuracy measurements

High Sampling rate

1 million events storage

Advanced Analytics

Interactive Dashboards

3G/4G/LTE, Wi-Fi

Real time alerts

GIS representation

Automatic Valve Control

Automatic Pump Control

Project Outcomes

ROI

- Over Flow cost of 1 Reservoir / Year = Rs 3.38 lakhs (~5K USD)
- Line Leakage cost of 1 Reservoir / Year = Rs 9.45 lakhs (~14K USD)
- Total Revenue loss due to leakage = Rs 12.83 lakhs (~19K USD)

Note : Production cost per Kilo liter is considered as Rs 6/-

Estimated revenue loss for total 59 reservoirs = 59 x 12.83 Lakhs
= Rs. 757 lakhs

Total Solution Cost is 25 % less than revenue loss of one year

Objectives Achieved

- Schedule and duration adherence is improved **> 90%**
- **150 LPCD** supplied as per standards
- Actual water supply which was **24 MGD** before installation improved to **33 MGD** within couple of months with net **9 MGD increase**

Smart Water Case Study

Results

- Over Flow cost of 1 Reservoir / Year
  = Rs 3.38 lakhs (~5K USD)
- Line Leakage cost of 1 Reservoir / Year
  = Rs 9.45 lakhs (~14K USD)
- Total Revenue loss due to leakage
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Note : Production cost per Kilo liter is considered as Rs 6/-

Estimated revenue loss for total 59 reservoirs = 59 x 12.83 Lakhs = Rs. 757 lakhs
(~1.12 million USD)

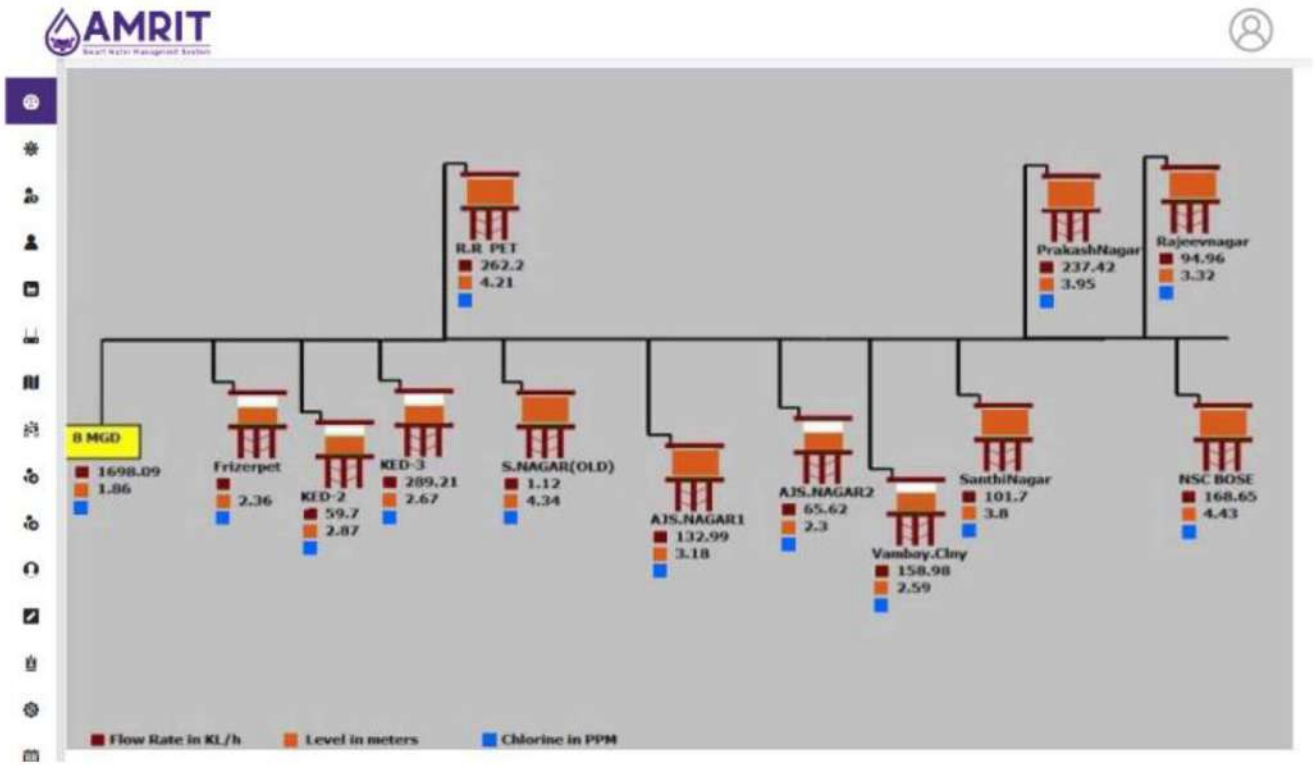
Total Solution Cost is 25 % less than the revenue loss for one year

Case Study

- Schedule and duration adherence is improved **> 90%**
- **150 LPCD** supplied as per standards
- Actual water supply which was **24 MGD** before installation improved to **33 MGD** within couple of months with net **9 MGD increase**

Live Simulation at WTP

- Operations engineering team can view and live status during filling and distribution and real time alerts trigger immediate actions.

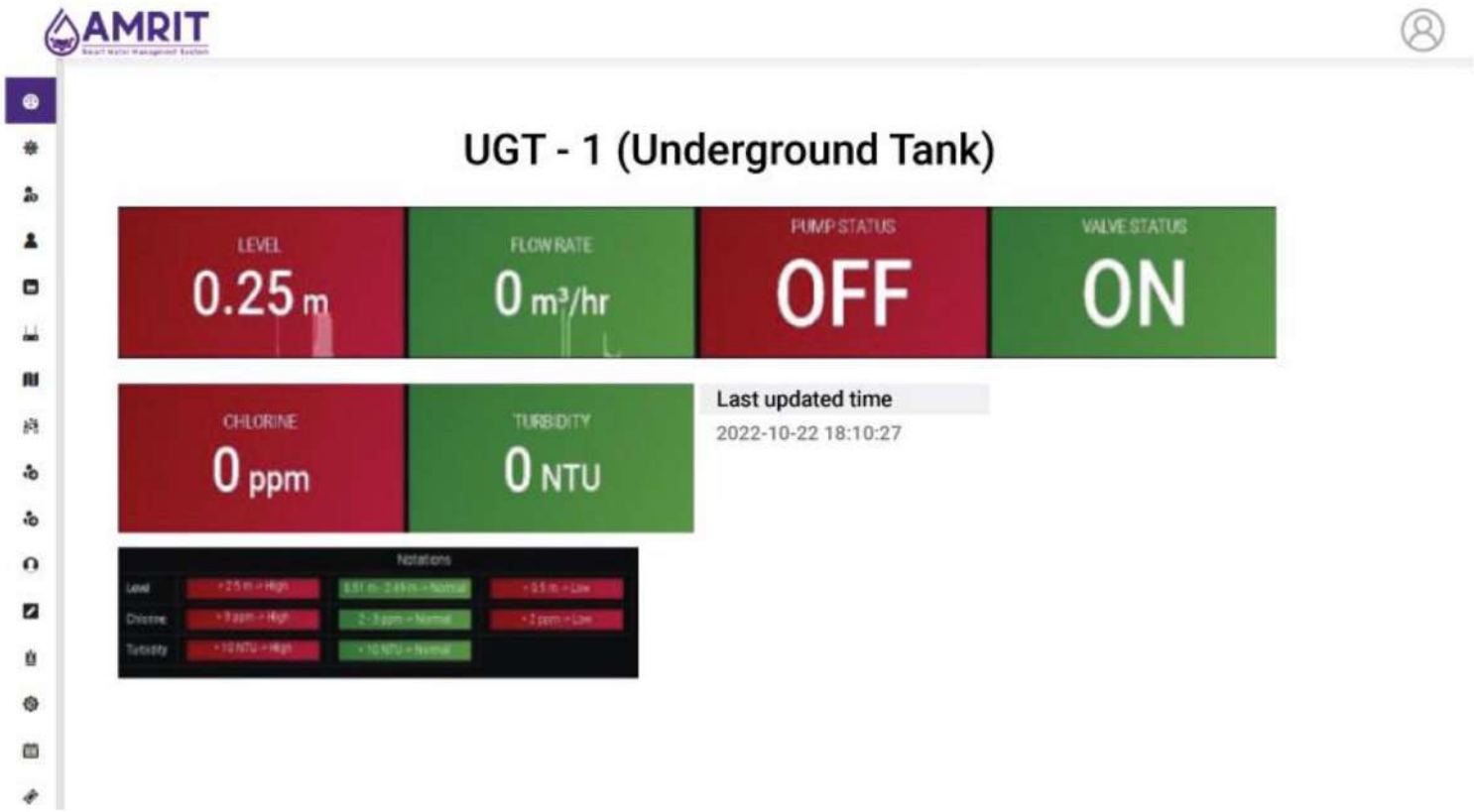


Pump Efficiency

- O&M engineering can continuously monitor, energy efficiency of motors along with power factor, active , reactive power. Accordingly, decisions of maintenance can be taken.

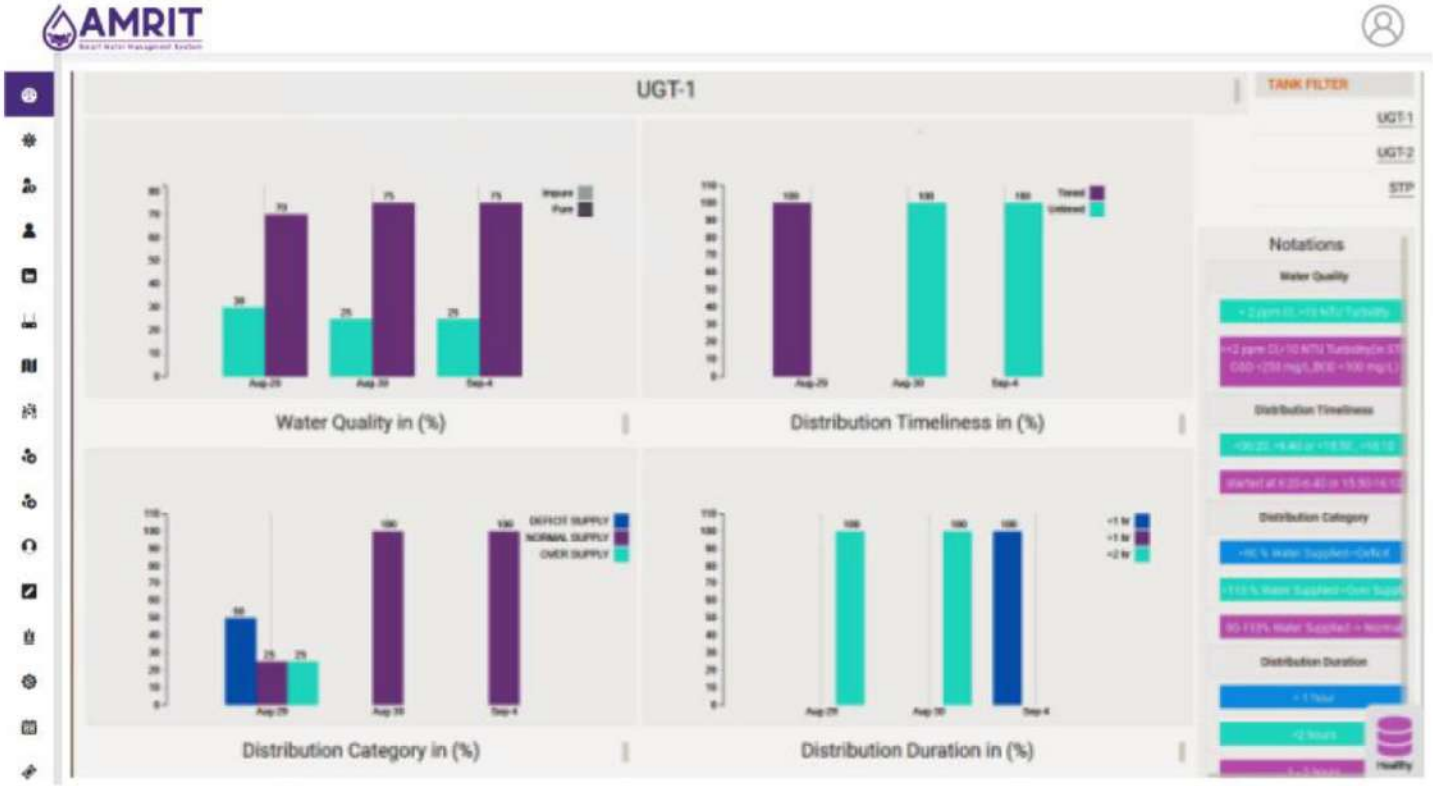
Live Dashboard

- Administration can view status from remote location via PC/Tab/Mobile



Daily/Weekly/Monthly Reports

- Administration can view reports on Water Quality, Timeliness , Duration from remote location via PC/Tab/Mobile



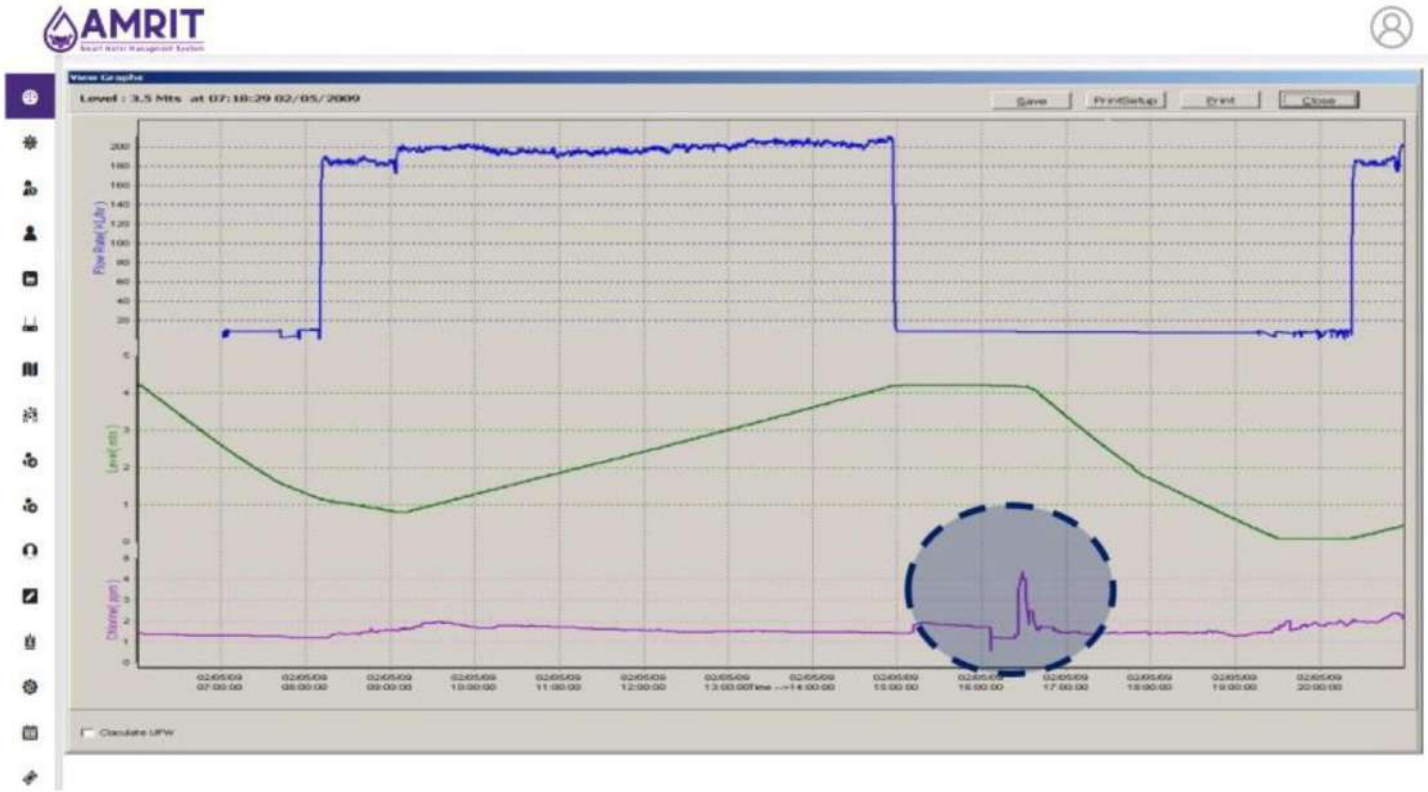
Arresting Overflows

- Real time monitoring of reservoir overflow actuate the alarm such that timely action is being taken by personnel or automatic controls

Ultrasonic Level Meter Installation at NTPC, at KAHODA, GJ

Live Chlorination Status

- With distance, condition of pipes chlorine gets decayed. Hence O&M team need to mix chlorine at ELSR/GLSR before water is distributed to public



pH, TDS, Chlorine, Nitrate Fluoride Installation at KAHODA, GJ

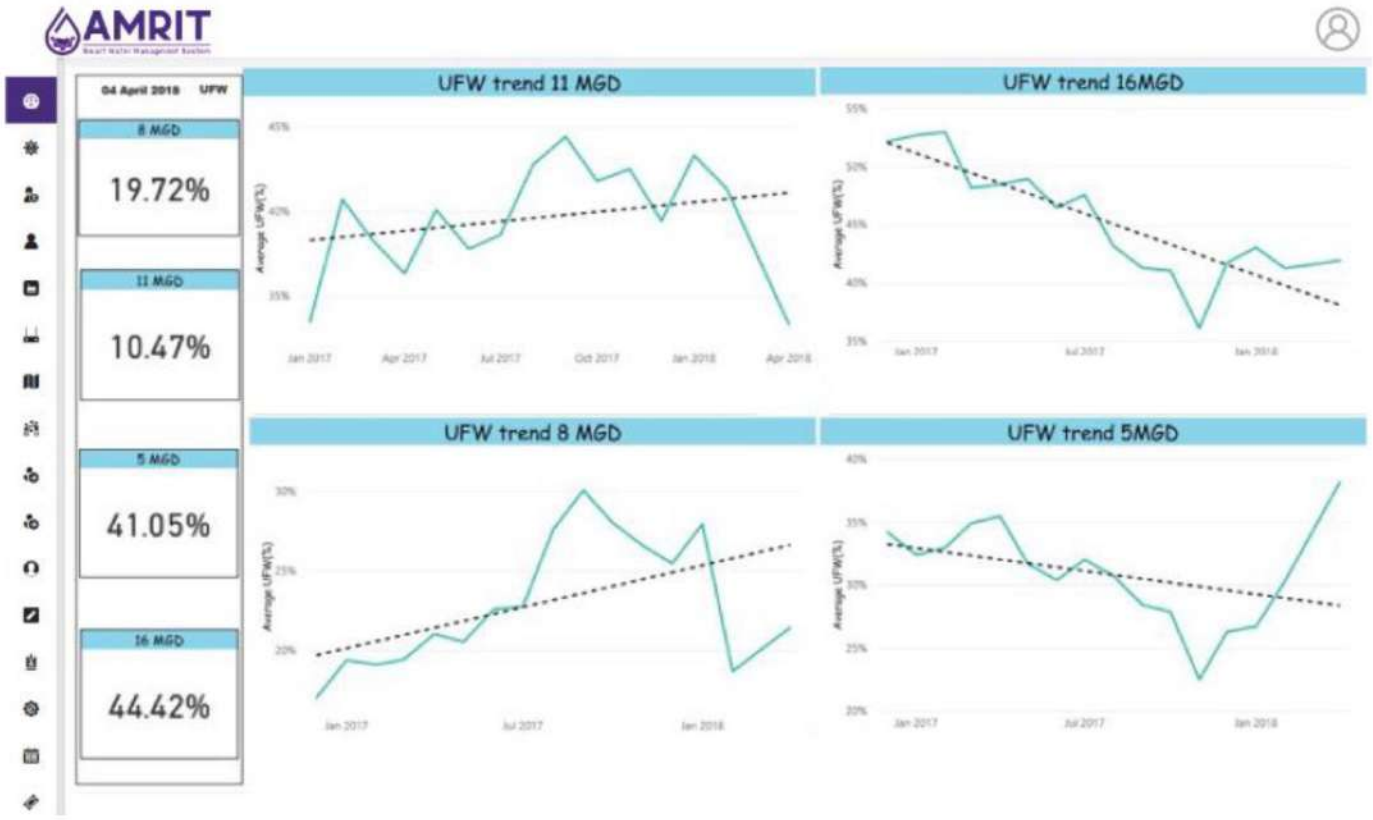
Cleaning of Reservoirs

- Periodically , O&M team need to clean reservoirs(ELSR/GLSR) by opening drain valve. Using level sensor data, this can be monitored

Installation at KAHODA, GJ

NRW-Estimation

- Based on inflow and out flows at WTP, ELSR and DMA areas, Non-Revenue Water is estimated



Paddle Wheel Flow meter Installation at KAHODA, GJ

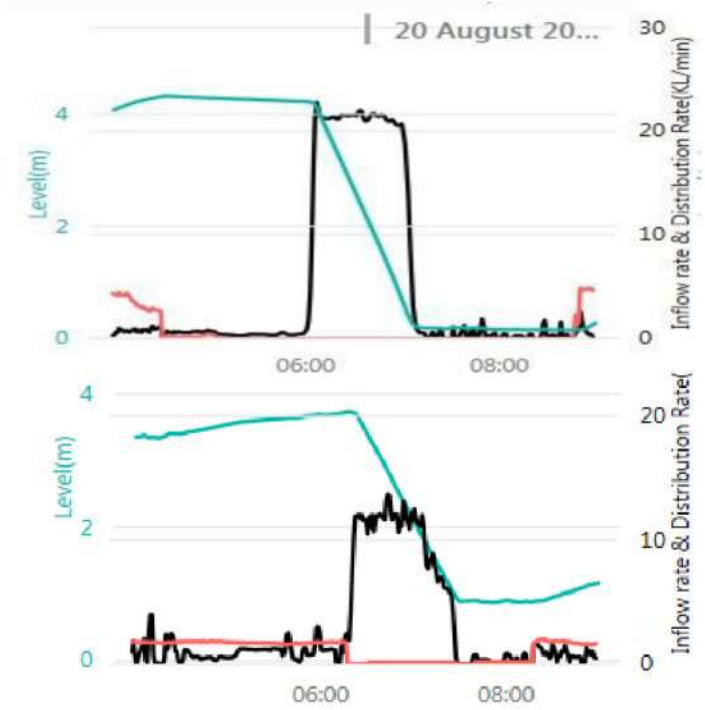
NRW-Reduction

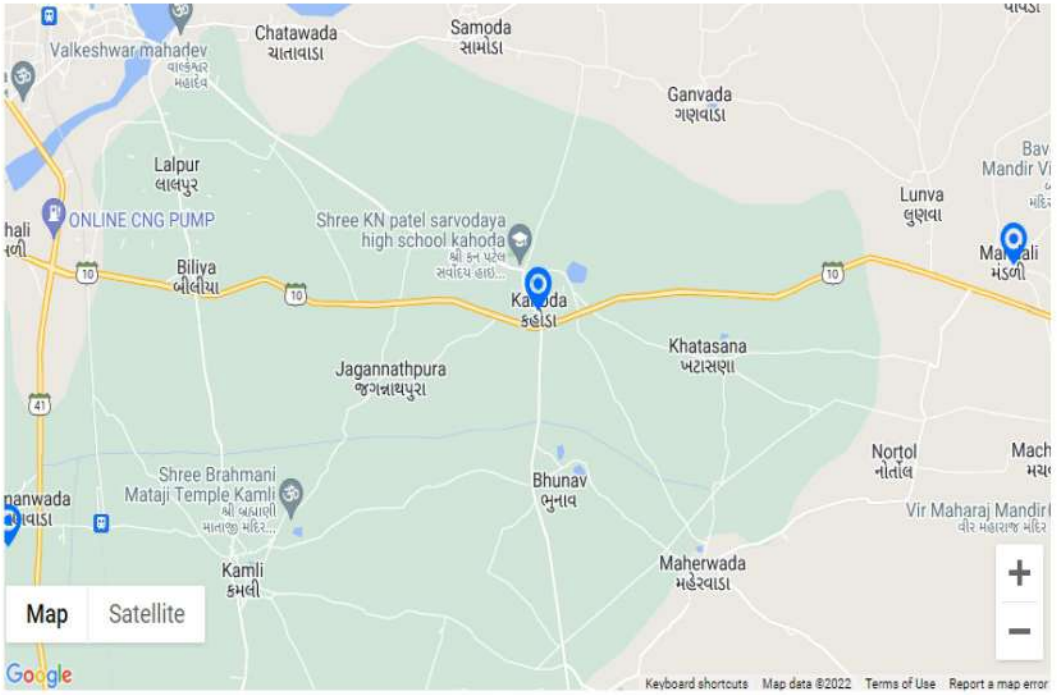
- After NRW was estimated, O&M engineering team took measures to close leaks and reduce wastage

Plant Outflow (MGD)	Sum of all the reservoirs	UFW per day (MGD)	UFW
8.52	5.77	2.75	32.3 %
8.41	5.96	2.45	29.1 %
9.15	7.24	1.91	20.9 %
8.80	7.07	1.73	19.7 %
9.13	7.33	1.80	19.8 %
8.01	6.59	1.42	17.7 %
5.10	4.27	0.83	16.3 %
8.15	7.39	0.76	9.4 %
7.51	7.09	0.42	5.5 %

ML Based Demand Estimation

- Machine Learning Algorithms based on past data, identified reservoirs with high and low demand. Based on this information, balancing of reservoirs is being done





Crisis Management

- During floods, with 50% of treatment capacity , total city was provided with drinking water

4 OCT 2009 TO 7 OCT 2009

Objective under flood situation :

- To provide safe drinking water
- To provide minimum water equally to everyone

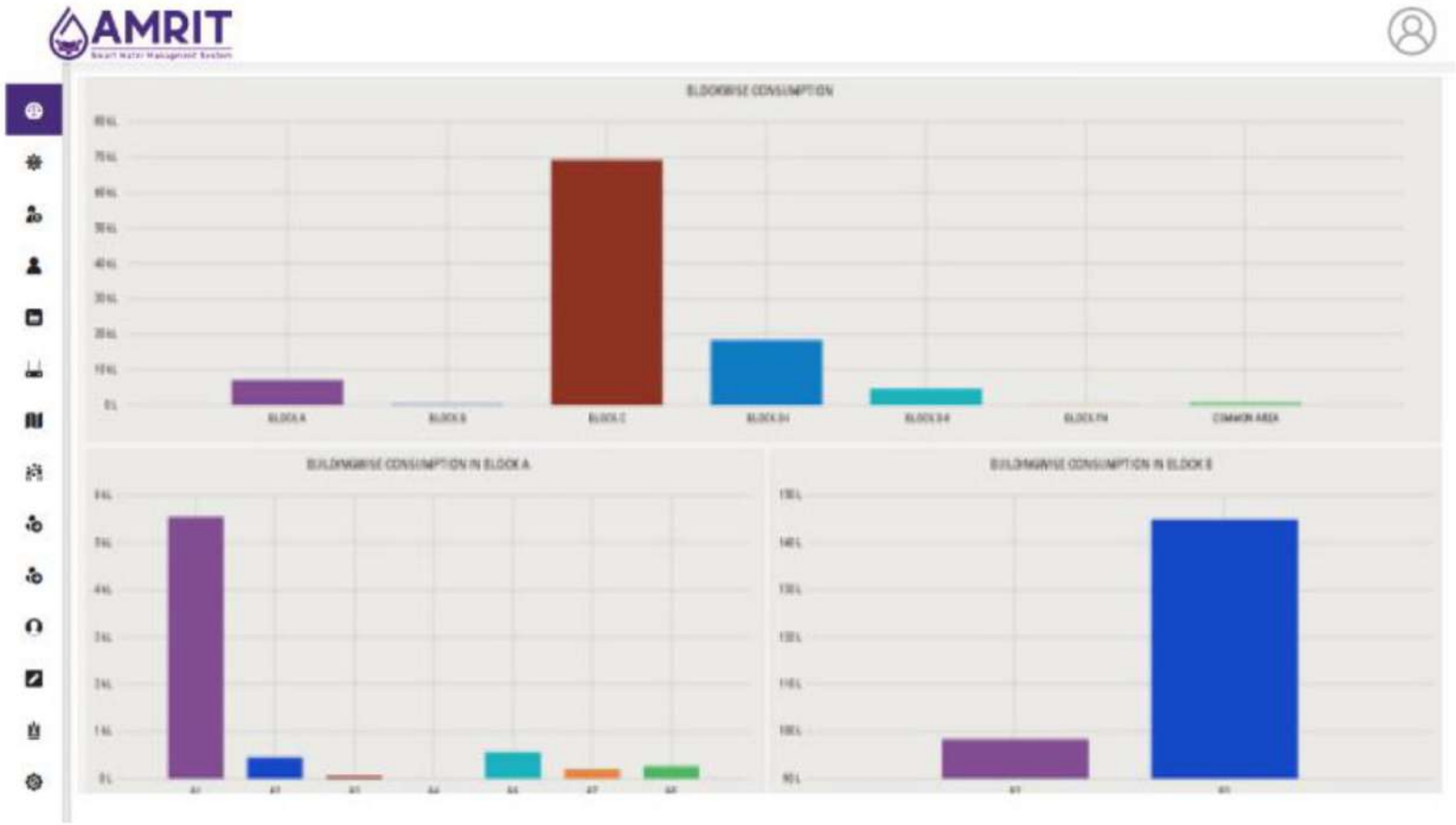
- Total installed capacity of Head Water Works - 40 MGD
- Treatment Plants shutdown due to flood - 19 MGD
- Operational capacity - 21 MGD
- Acute shortfall – ~50%

Timeliness Reports

- Based on filling and distribution data, system analyzes KPI of timeliness of delivery (WTP wise, , ELSR wise , DMA wise)

Area Wise Supply Reports

- Based on flow data, area/village wise quantity of water supplied and LPCD reports



Job Card

- O&M head, supervisor can assign works to concern and track their activity, automatically calculate MTTR, MTBF

Command Centers

- Centralized Control & Commands enable effective management of water distribution with minimal effort.
- Advanced analytics and data visualization provide transparency to administration

Command Centre