UNIVERSAL WATER REGISTRY

UWR Rainwater Offset Unit Standard
(UWR RoU Standard)

Concept & Design: Universal Water Registry
www.uwaterregistry.io

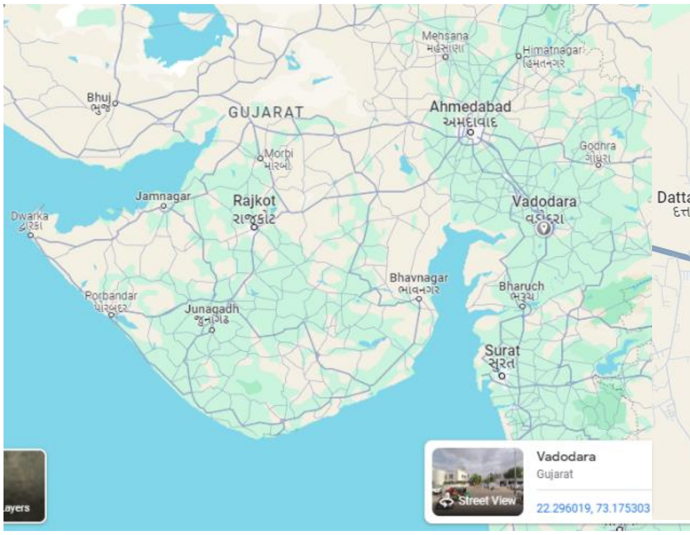
Project Concept Note & Monitoring Report (PCNMR)

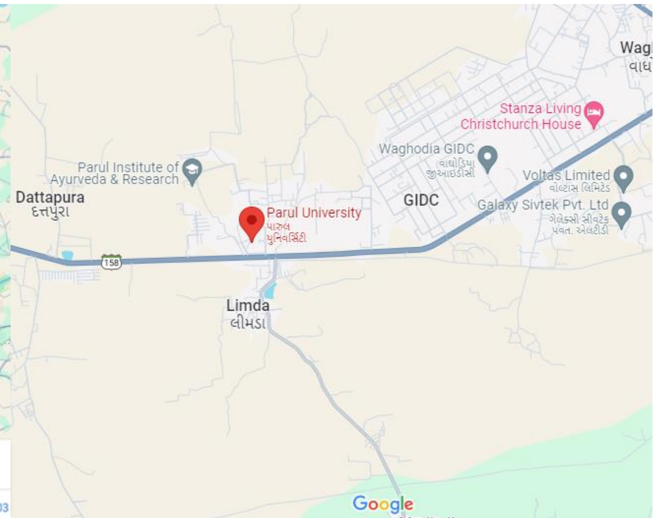
Project Name: STP Wastewater Recycling and Gainful Reuse by Parul University, Vadodara, Gujarat, India
PCNMR Version 1.0
Date of PCNMR: 30/09/2024
UWR RoU Scope: Scope 4
1st RoU Crediting Period: 01/10/2022 to 31/07/2024 (01 year, 10 months)
1st RoU Monitoring Period: 01/10/2022 to 31/07/2024 (01 year, 10 months)
UNDP Human Development Indicator: 0.644 (IND)
National Water Security Index: 2 (IND)
RoUs Generated During 1st Monitored Period: 1166565 RoUs

A.1 LOCATION & DETAILS OF PROJECT ACTIVITY

Title	STP Wastewater Recycling and Gainful Reuse by Parul University, Vadodara, Gujarat
Address of Project Activity	**Village**: Limda, **Taluka**: Waghodia, **District:** Vadodara, **State:** Gujarat
Type and Scope of RoU Project Activity	Small Scale Project Type Scope 4: Conservation measures taken to recycle and/or reuse water, spent wash, wastewater etc. across or within specific industrial processes and systems, including wastewater recycled/ reused in a different process, but within the same site or location of the project activity. Recycled wastewater used in off-site landscaping, gardening or tree plantations/forests activity are also eligible under this Scope.
Country	India
Block Basin/Sub Basin/Watershed	Dhadhar Basin
Project commissioning date	09/07/2022
Lat. & Longitude	22°17'51.1"N 73°22'09.1"E
Rivers and water bodies near the project activity	Limda Lake
Climatic Conditions	Annual Mean Maximum Temperature: 39°C Annual Mean Minimum Temperature: 12°C Annual Mean Maximum Rainfall: 722 mm
Predominant HydroGeological Formations	Hydrogeological formations include shallow alluvial deposits in unconfined aquifers and deeper confined aquifers beneath impermeable clay layers. Groundwater recharge is mainly driven by rainfall and seepage, while quality varies due to salinity in certain areas.
SDG Impacts	SDG 3 Good health and well-being SDG 4 Quality Education SDG 6 Clean Water and Sanitation SDG 11 Sustainable Cities and Communities SDG 13 Climate Action SDG 12 Responsible Consumption and Production
RoU Monitored Period (MP-01)	**01/10/2022 to 31/07/2024**
Calculated RoUs per year	

Year	RoUs (1 RoU = 1000 liters)
2022	176022
2023	601771
2024	388772
TOTAL	1166565





* STP Wastewater Recycling by Parul University

A.2. PROJECT OWNER INFORMATION, KEY ROLES AND RESPONSIBILITIES

Project Proponent and Owner (PP)	Parul University, Vadodara, Gujarat
UWR Project Aggregator	Yojan Solutions Pvt. Ltd.
UWR Project Aggregator ID	577644419
Project Aggregator Address	17-18, Nilamber Bliss, Gotri Sevasi Road, Vadodara 390021, Gujarat, India
Date PCNMR Prepared	30/09/2024 (version 1)
PROJECT NAME	STP Wastewater Recycling and Gainful Reuse by Parul University, Vadodara, Gujarat
UWR Scope:	Scope 4

Parul University (Project Proponent or PP), owns and operates the project activity located at **Village**: Limda, **Taluka**: Waghodia, **District:** Vadodara, **State:** Gujarat, **Country:** India. The project activity by the PP is a critical water management initiative utilizing treated wastewater from its Sewage Treatment Plant (STP). The STP, with a capacity of 3.5 MLD (million liters per day), treats wastewater generated from various campus activities, including process washings, utilities, and domestic usage. This treated water is then redirected for use within the campus, significantly reducing the reliance on freshwater sources within the vicinity.

This approach mitigates the depletion of local groundwater reserves, a growing concern in the region. In the absence of this project, bore wells would have been required, potentially exacerbating the area's water scarcity. By reusing treated water, the university not only addresses water conservation but also contributes to groundwater recharge, further supporting the local ecosystem.

This initiative has helped the PP avoid extracting an estimated 1.2 MLD of groundwater, easing pressure on local water resources. Through these measures, the PP demonstrates a data-driven, resource-efficient approach to water management, showcasing a model that other institutions can replicate.

The project activity is pre-approved under the UWR RoU program for the following scope:

- Scope 4: *Measures that remove bacteriological and other impurities from contaminated water bodies or unutilized water, so that water is made suitable for re-use and/or recycling purposes.*

A.2.1 UWR RoU Scope & Project Details

<table>
<tr><td>PROJECT NAME</td><td>STP Wastewater Recycling by Parul University, Vadodara, Gujarat</td></tr>
<tr><td>UWR Scope: RoU Scope 4</td><td>Conservation measures taken to recycle and/or reuse water, spent wash, wastewater etc. across or within specific industrial processes and systems, including wastewater recycled/ reused in a different process, but within the same site or location of the project activity. Recycled wastewater used in off-site landscaping, gardening or tree plantations/forests activity are also eligible under this Scope.</td></tr>
<tr><td>Area</td><td>26000 SQ.FT</td></tr>
<tr><td>Month and Year of Construction</td><td>28/03/2022</td></tr>
<tr><td>Month and Year of Commissioning</td><td>09/07/2022</td></tr>
<tr><td>RoU Crediting Period</td><td>01/10/2022 to 31/07/2024 (01 year, 10 months)</td></tr>
<tr><td>Total RoUs Generated for the Monitored Period</td><td><table>
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</table></td></tr>
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The PP is a private university in Vadodara, Gujarat and was established in 2009 as Parul Group of Institutes in Vadodara, Gujarat. It was ranked among the top 50 universities by NIRF Innovation Rankings 2023. The university has 32 institutes that offer over 450 UG, PG, diploma, and PhD.

The project activity involves the STP owned and operated by the PP involving similar wastewater recycling treatment technologies and gainful end use of the treated water. In the absence of the project activity, the PP could have installed bore wells that would have depleted the local groundwater resources and/or continued to use existing drinking water resources in the surrounding area and/or discharged the STP without recycling the same for gainful captive purposes.

The following are the key details of the project activity:

Location	**STP Plant Parul University**
STP Capacity	3.5 MLD
Quantity Sewage water recycled and reused	2022: 176022KLD 2023: 601771KLD 2024: 388772KLD
Gainful End Use	Gardening and Campus toiletries,

The PP generate wastewater from various sources, including process washings, utilities, domestic use, and other activities within the campus. The STP includes equalization tanks where wastewater undergoes primary, secondary, and tertiary treatment processes. The treated effluent is then further purified and reused within the university's facilities, demonstrating a commitment to water conservation and sustainable practices. This approach aligns with the UWR RoU program as the university has implemented effective measures for recycling and reusing wastewater for beneficial purposes.

In India, wastewater represents a significant but underutilized resource. Utilizing 80% of untreated wastewater from 110 major cities could meet 75% of the projected industrial water demand by 2025 (source: Whitepaper "Urban Wastewater Scenario in India," August 2022, by IITB, AIM-NITI Aayog, ICDK, and NMCG). The project activity by the PP embodies an integrated approach to wastewater treatment, source reduction, and process water reuse, setting a precedent for other universities.

The advanced treatment technologies employed in this project activity reduce the PP's freshwater demand and addresses the broader need for efficient water management. By generating and selling water credits, the PP can offset implementation costs, facilitating the expansion of similar conservation projects.

India's wastewater challenge is compounded by the water consumption of thermal power plants (TPPs), which use substantial quantities of water for cooling. While once-through cooling systems consume around 100 liters of water per KWh of electricity, inefficient systems may use up to 200 liters. In contrast, closed-cycle systems, eligible for UWR RoU credits, require only 2-3 liters per KWh. This project highlights the need for improved water recycling technologies, particularly in power generation, where future water consumption is expected to increase significantly if current practices persist.

The project activity by the PP exemplifies best-in-class wastewater treatment technologies that replace freshwater needs for non-potable purposes, enhancing the recycling and safe reuse of wastewater. It serves as a model for local stakeholders and educational institutions, demonstrating sustainable water conservation. By avoiding extensive use of borewells, which could exacerbate groundwater shortages in village Limda and nearby villages, the project contributes positively to local water resources.

The project is on the positive list of pre-approved activities under the UWR RoU program under Scope 4: "Measures that remove bacteriological and other impurities from seawater, sewage, wastewater, contaminated water bodies, or unutilized water, making it suitable for reuse and/or recycling."

The STP has a **3.5 MLD capacity**, employing advanced treatment technology to recycle wastewater for various non-potable uses such as gardening and flushing.

In the absence of this initiative, the university would have relied entirely on fresh water sources, further depleting local groundwater resources. The STP system, therefore, not only meets the university's growing water needs but also contributes to overall water security in the region by alleviating pressure on potable water supplies.

Daily Water Requirement by the PP:

Source of Wastewater	Total Consumption (KLD)	Sewage Generation (KLD)	STP Treated Water Reused (KLD)
Shakuntala Bhavan	200	140	100
Boys Hostel (Azaad)	2100	1800	850
Sarojni Bhavan C	100	60	50
Garden	4000	0	1000
Total	**6400 KLD (~6.4 MLD)**	**2000 KLD**	**2000 KLD**

Technology description

UNIT DETAILS

TANK NO.	TANK NAME	TANK SIZE
0	COLLECTION SUMP	24.0 X 9.5 X 4.25m SWD + 2.55m FB
1	FINE SCREEN CHAMBER	3.0 X 2.0 X 1.5m SWD + 1.0m FB
2	OIL & GREASE TRAP WITH SKIMMER	3.5 X 8.0 X 2.9m SWD + 0.5m FB
3-1	OIL & GREASE TRAP ZONE-1	3.5 X 3.85 X 2.9m SWD + 0.5m FB
3-2	OIL & GREASE TRAP ZONE-2	3.5 X 3.85 X 2.9m SWD + 0.5m FB
4-1	ANOXIC TANK ZONE -1	3.5 X 8.0 X 4.7m SWD + 0.7m FB
4-2	ANOXIC TANK ZONE -2	3.5 X 8.0 X 4.7m SWD + 0.7m FB
5-1	AERATION TANK ZONE-1	14.6 X 8.0 X 4.4m SWD + 1.0m FB
5-2	AERATION TANK ZONE-2	14.6 X 8.0 X 4.4m SWD + 1.0m FB
6-1	SECONDARY CLARIFIER ZONE-1	11.5Ø X 2.70m SWD + 0.8m FB
6-2	SECONDARY CLARIFIER ZONE-2	11.5Ø X 2.70m SWD + 0.8m FB
7-1	INTERMEDIATE COLLECTION ZONE-1	7.0 X 7.0 X 3.35m SWD + 0.75m FB
7-2	INTERMEDIATE COLLECTION ZONE-2	7.0 X 7.0 X 3.35m SWD + 0.75m FB
8-1	SLUDGE SUMP-1	2.5 X 2.5 X 1.0m SWD + 0.2m FB
8-2	SLUDGE SUMP-2	2.5 X 2.5 X 1.0m SWD + 0.2m FB
9	SCUM TANK	1.35 X 4.0 X 1.0m SWD + 0.2m FB
10	FINAL COLLECTION TANK	6.0 X 9.5 X 5.8m SWD + 1.0m FB
	MCC ROOM	5.0 X 3.75 X 5.2m Height

The Sewage Treatment Plant (STP) at Parul University is designed to process 3.5 Million Liters per Day (MLD) of sewage, employing a comprehensive treatment approach to ensure the effective removal of contaminants. The facility integrates advanced biological and mechanical treatment processes, resulting in treated effluent that is safe for reuse in irrigation and toilet flushing. This plant not only addresses wastewater management challenges but also supports environmental sustainability initiatives.

1. Coarse Screening Technology

Technology: Coarse Screening

Description: Upon entry into the STP, sewage flows under gravity to the coarse screen chamber, where two parallel coarse screens operate to remove larger debris and inert materials such as plastic, wood, and rags. This initial screening is critical in preventing damage to downstream equipment and ensuring the efficient operation of the plant.

Cleaning Mechanism: Manual cleaning is currently performed on a daily basis to maintain optimal performance, with future plans to transition to a mechanical cleaning system to enhance efficiency and reduce labor costs.

2. Collection and Equalization

Technology: Submersible Pumping System

Description: Following coarse screening, the sewage is directed to a collection sump that serves as both a collection and equalization zone. Here, variations in flow are balanced, allowing for a steady and uniform input to the treatment process.

Pumping Arrangement: The sump is equipped with four submersible pumps (including one standby) designed to operate simultaneously and pump sewage to the STP at a fixed flow rate of 146 m^3/hr. This arrangement ensures reliability and reduces the risk of overflow during peak inflow periods.

3. Fine Screening Technology

Technology: Rotary Drum Screen

Description: After collection, the sewage is pumped into the fine screen chamber, which utilizes a rotary drum screen to remove finer particles and smaller inert materials. This step further enhances the quality of the sewage before it undergoes subsequent treatment processes.

Operational Efficiency: The rotary drum screen is designed for effective debris removal while allowing for easy maintenance, ensuring optimal functionality and reducing downtime.

4. Oil and Grease Separation

Technology: Baffle System for Oil & Grease Trap

Description: The sewage flows from the fine screen chamber into the oil and grease trap, which features a series of baffles designed to retain floating oils and grease in the first compartment. This separation is crucial for preventing the build-up of harmful substances in downstream processes.

Removal Mechanism: Floating oil is manually removed, and if excessive oil is detected, a trolley-type oil skimmer may be deployed in the central zone to enhance removal efficiency. Additionally, a bottom drain is provided to eliminate settled solids, allowing this zone to function as both an oil and grease trap and a settling chamber.

5. Anoxic Treatment Technology

Technology: Denitrification Process

Description: Effluent from the oil and grease trap is directed to two parallel anoxic tanks (Zone-1 and Zone-2), where biological treatment occurs in the absence of oxygen. This process, known as denitrification, converts nitrate (NO3) to molecular nitrogen (N2), effectively reducing nitrogen levels in the effluent.
Mixing Mechanism: Each anoxic tank is equipped with an agitator mechanism that facilitates gentle mixing of the sewage, promoting optimal biological activity and ensuring uniform conditions throughout the tank.

6. Aerobic Biological Treatment

Technology: Activated Sludge Process
Description: Following the anoxic treatment, the effluent flows to the aeration tanks, which are divided into two zones (Aeration Tank Zone-1 and Zone-2). Here, aerobic microorganisms consume organic matter in the presence of oxygen, significantly reducing Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), and ammoniacal nitrogen.
Aeration System: The tanks are equipped with diffused aeration systems utilizing tubular fine bubble diffusers, which provide efficient oxygen transfer and enhance microbial activity. Retrievable diffusers allow for easy maintenance, ensuring continuous and reliable operation.
Flow Management: The aeration tanks are designed with inlet baffles and outlet launder systems to maintain uniform flow and prevent short-circuiting, thus optimizing treatment performance.

7. Secondary Clarification

Technology: Mechanical Clarification
Description: The biologically treated effluent flows from the aeration tanks to two secondary clarifiers (Secondary Clarifier-1 and Secondary Clarifier-2), which are designed to provide adequate settling time for the mixed liquor suspended solids (MLSS). The circular design facilitates efficient sedimentation.
Sludge Management: Settled MLSS is recirculated back to the respective aeration tanks, ensuring that a portion of the active biomass remains in the treatment process. Any excess sludge is directed to the sludge sump for further processing.
Clarification Mechanism: Each clarifier features a mechanical scrapper at the conical bottom to facilitate the collection of settled sludge, which is easily withdrawn for further treatment.

8. Filtration and Polishing

Technology: Multi-Stage Filtration System
Description: Treated effluent from the secondary clarifiers flows into intermediate collection tanks (Intermediate Collection Tank-1 and Tank-2) before undergoing polishing through pressure sand filters.
Filtration Process: The sand filters are equipped with multi-grade sand, effectively removing remaining suspended solids and enhancing the overall quality of the treated water. The effluent from the sand filters is then directed to activated carbon filters to eliminate residual organics.

9. Disinfection

Technology: Chlorine Dosing System
Description: To ensure that the treated sewage is safe for reuse, sodium hypochlorite is dosed at the outlet of the activated carbon filters. This disinfection step eliminates pathogenic organisms and ensures compliance with health and safety standards.

10. Sludge Management

Technology: Dewatering Mechanism
Description: Two sludge sumps are constructed to collect the biological sludge for dewatering. The sludge is pumped from the sumps to a filter press mechanism for dewatering, where excess water is removed from the sludge.
End Use: The filtrate from the dewatering process is returned to the aeration tanks for treatment, while the dried sludge can be utilized as organic manure in gardening and landscaping applications, promoting a circular economy approach.

The Sewage Treatment Plant (STP) utilizes an advanced integrated circuit system powered by a 220 ± 10%, 50 Hz single-phase supply. It features selectable ranges for Total Dissolved Solids (TDS) measurements (0-20 ppm, 200 ppm, 2000 ppm, and 200 ppt) and conductivity (0-20 micro/cm, 200 micro/cm, 2000 micro/cm, and 200 milli/cm). The system ensures measuring accuracy within ±1% of full scale and displays results on a 3.5-digit LED screen. With single-point manual calibration and a conductivity cell constant of approximately 1.0, the STP effectively monitors dissolved solids in treated effluent. Designed to operate in environments up to 50°C, the STP's features facilitate optimal treatment processes, ensuring high-quality effluent suitable for reuse in applications such as irrigation.

EIA Report

1. **DETAILS OF QUALITY TRADE EFFULENT**

Date of Collection: 11/11/2022

Mode of Collection: Grab

Sr. No.	Parameters	INLET OF STP mg/lit	SECONDARY CLF-1 mg/lit	SECONDARY CLF-2 mg/lit	OUTLET OF STP mg/lit	GPCB Norms mg/lit
1.	pH	7.4	7.8	7.8	7.9	6 to 9
2.	TSS	64	32	26	58	100
3.	TDS	1236.8	1247	1227	1191.5	-
4.	BOD	32	23	22	18	100
5.	COD	100	60	50	80	250

Date of Collection: 21/11/2022

Mode of Collection: Grab

Sr. No.	Parameters	INLET OF STP mg/lit	SECONDARY CLF-1 mg/lit	SECONDARY CLF-2 mg/lit	OUTLET OF STP mg/lit	GPCB Norms mg/lit
1.	pH	7.8	7.6	7.5	7.2	6 to 9
2.	TSS	56	46	35	25	100
3.	TDS	1240	1199	1180	1098	-
4.	BOD	46	38	36	12	100
5.	COD	122	105	62	51	250

Note:

1. All results are expressed in mg/liter except pH, BDL: Below Detection Limit

Date of Collection:27/12/2022 Mode of Collection: Grab

Sr. No.	Parameters	INLET OF STP mg/lit	SECONDARY CLF-1 mg/lit	SECONDARY CLF-2 mg/lit	OUTLET OF STP mg/lit	GPCB Norms mg/lit
1.	pH	7.6	7.4	7.3	7.1	**6 to 9**
2.	TSS	65	51	38	42	**100**
3.	TDS	1150	1080	991	980	-
4.	BOD	42	38	36	32	**100**
5.	COD	128	122	98	41	**250**

Parameters	Aeration Tank-1	Aeration Tank-2
MLSS	2600	1120
MLVSS	1060	960

EIA DATA REPORT 2023

1. **DETAILS OF QUALITY TRADE EFFULENT**

Date of Collection: 30/01/23 Mode of Collection: Grab

Sr. No.	Parameters	INLET OF STP mg/lit	SECONDARY CLF-1 mg/lit	SECONDARY CLF-2 mg/lit	OUTLET OF STP mg/lit	GPCB Norms mg/lit
1.	pH	7.5	7.4	7.5	7.25	**6 to 9**
2.	TSS	100	80	55	40	**100**
3.	TDS	1156	1059	994	960	-
4.	BOD	60	55	30	20	**100**
5.	COD	130	115	88	45	**250**

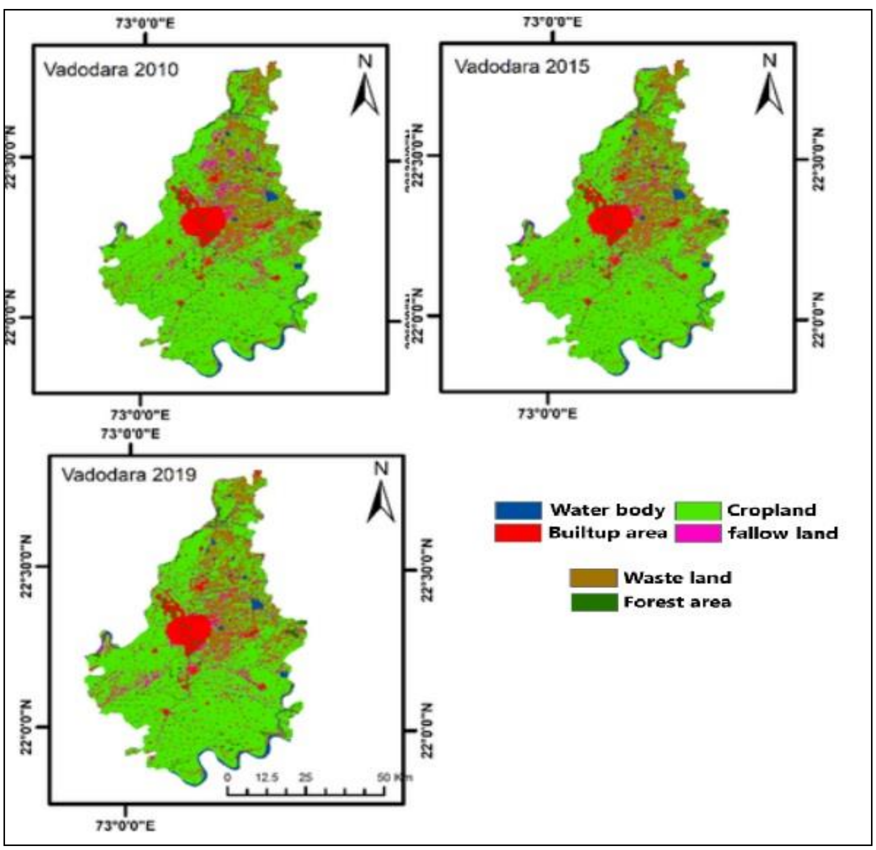
Parameters	Aeration Tank-1	Aeration Tank-2
MLSS	2268	1220
MLVSS	1454	992

A.3. Land use and Drainage Pattern

Land Use Pattern:

The land use break-up of the Vadodara city provided equal share of land for residential purposes. However, the industrial area has reduced considerably from 18.02% to 4.31%, which also substantiates the decline in industrial activity. At the same time, the area under government land has increased to 7%, which implies a shift towards the service sector. The share of recreation area has also reduced by 1.17% from 2.58% and is far below the norms of 10%. The area under roads is adequate, around 15.35%; VMC however, needs to focus on improvement in the riding quality of these roads. In the last 30 years, the population of the city has almost doubled, but the recreational facilities have not proportionately increased. The growing urbanization and the demand for more housing and transportation have led to a decline in urban greens and water bodies. A similar situation exists with the water bodies; these have reduced nearly by half, from 4.38 sq. km in 1991 to 2.77 sq. km in 2005, causing concern. The increase in slum population has also led to a proliferation of illegal encroachments on public and open spaces, reserved land and recreational land. If this trend continues, i.e. if the recreational areas, water bodies, and greenery reduce, the city would deteriorate both in terms of the quality of life index as well as on environmental parameters. It is thus imperative to strike an ecological balance by taking appropriate steps to rejuvenate the greenery and recharge the water bodies of the city.

Land use land cover (LULC) map of Vadodara



Sl	Land use	Existing in 1991		Current (2005)	
		Sq.km	%	Sq.km	%
1	Residential	41.07	37.83	52.45	35.25
2	Commercial	1.51	1.39	4.95	3.33
3	Industrial	19.57	18.02	6.41	4.31
4	Government	0	0	10.73	7.21
5	Recreational	2.8	2.58	1.74	1.17
6	Restricted area	6.33	5.83	6.76	4.54
7	Road	32.89	30.32	22.84	15.35
	Total Developed area	**104.17**	**95.97**	**105.89**	**71.16**
8	Government Restricted	0	0	3.99	2.68
90	Agriculture	0	0	16.07	10.80
Sl	**Land use**	**Existing in 1991**		**Current (2005)**	
		Sq.km	**%**	**Sq.km**	**%**
10	Other vacant land	0	0	20.09	13.50
11	Water bodies	4.38	4.03	2.77	1.86
	Total	**108.55**	**100.00**	**148.81**	**100.00**

Source: Central Ground Water Board. *Vadodara District Report*. Available at: Vadodara District Report PDF.

A3.7 Land Use Changes

1. **Agricultural Land Conversion**:

- A study published in 2021 found that Vadodara city will expand its built-up area by 25 square kilometers by 2031, with a significant portion coming from agricultural land. Areas like Bhayli, Kalali, Atladara, Sayajipura and Waghodia, where Parul University is located, are projected to see explosive growth.

CHANGING LANDSCAPE (All figurs in sqkm) *Projection

Land use	2011	2021	2031*	Decadal change	
				2011-21	2021-31*
Built-up	91	102.1	127	▲11.1	▲24.9
Water body	9.5	9.3	8.7	▼0.2	▼0.5
Agriculture	257.9	252.9	240.1	▼4.9	▼12.8
Vegetation	89.3	88	86.5	▼1.3	▼1.5
Scrubland	182.9	180	175.2	▼3	▼4.8
Open land	75.1	73.4	68.1	▼1.7	▼5.3

- The establishment of educational institutions like Parul University towards the east and north-east of Vadodara has contributed to the conversion of agricultural land to built-up areas in Sayajipura and Waghodia.

Source: Vadodara Urban Development Authority (VUDA). (2021). Draft Development Plan for Vadodara 2031. Retrieved from VUDA

2. **Increased Built-Up Area**:

- Parul University occupies approximately 150 acres of land, contributing to the increase in built-up areas in the region.
- A study using remote sensing and GIS techniques found that the classification accuracy for detecting land use changes in Vadodara was 87.50% for Landsat-5 TM data from 1990 and 84.33% for Landsat-7 ETM+ data from 2001.

Source: Patel, R. S., & Patel, K. S. (2021). Land Use Land Cover Change Detection Using Remote Sensing and GIS Techniques: A Case Study of Vadodara City. International Journal of Advanced Research in Science, Engineering and Technology, 8(5), 1234-1240.

3. **Residential and Commercial Development**:

- The influx of students and faculty has led to a rise in residential developments around the university, including both on-campus accommodations and off-campus housing options.
- There has been an increase in commercial activities nearby, such as shops, cafes, and services aimed at students, indicating a transformation of land use from primarily agricultural or industrial to mixed-use developments.

4. **Infrastructure Improvements**:

- The establishment of Parul University has prompted improvements in local infrastructure, including roads, public transport facilities, and utilities, enhancing connectivity and accessibility in the area.

5. **Environmental Considerations**:

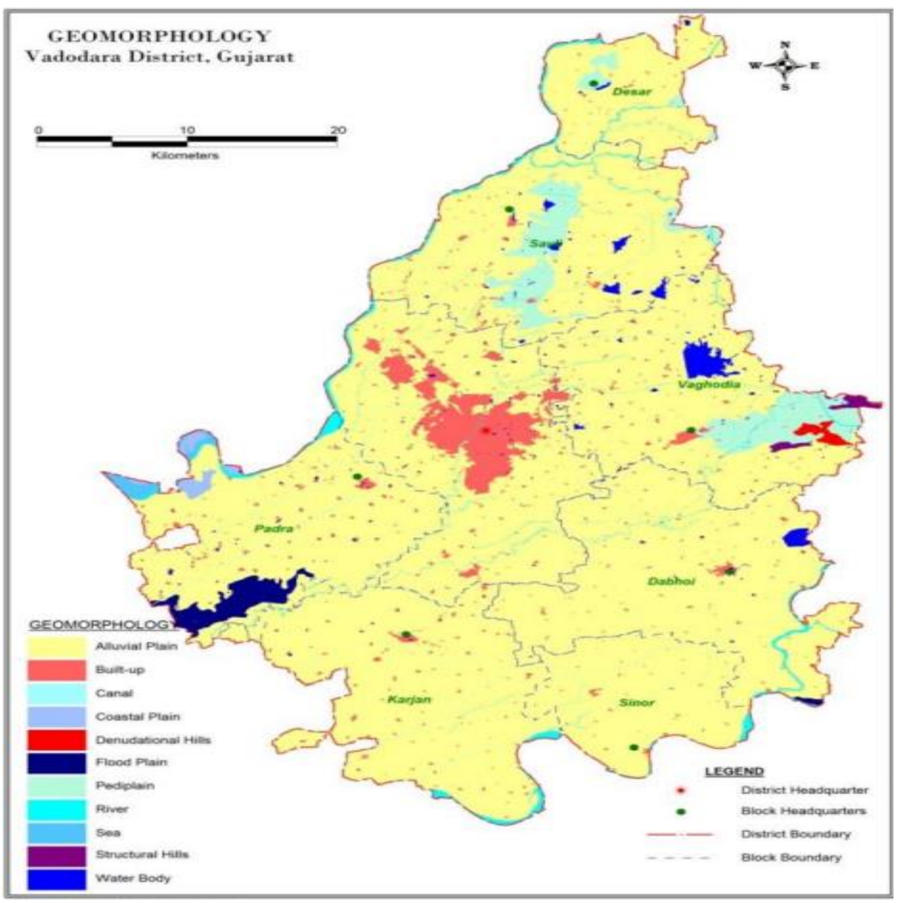
- As urbanization progresses due to educational institutions like Parul University, there are environmental implications, including potential loss of green spaces and agricultural land.
- However, the university also promotes sustainable practices through its infrastructure, which may mitigate some negative impacts associated with urban expansion.

Source: [Parul University. (2023). Sustainability Initiatives. Retrieved from Parul University]

Hydrometeorology of Vadodara

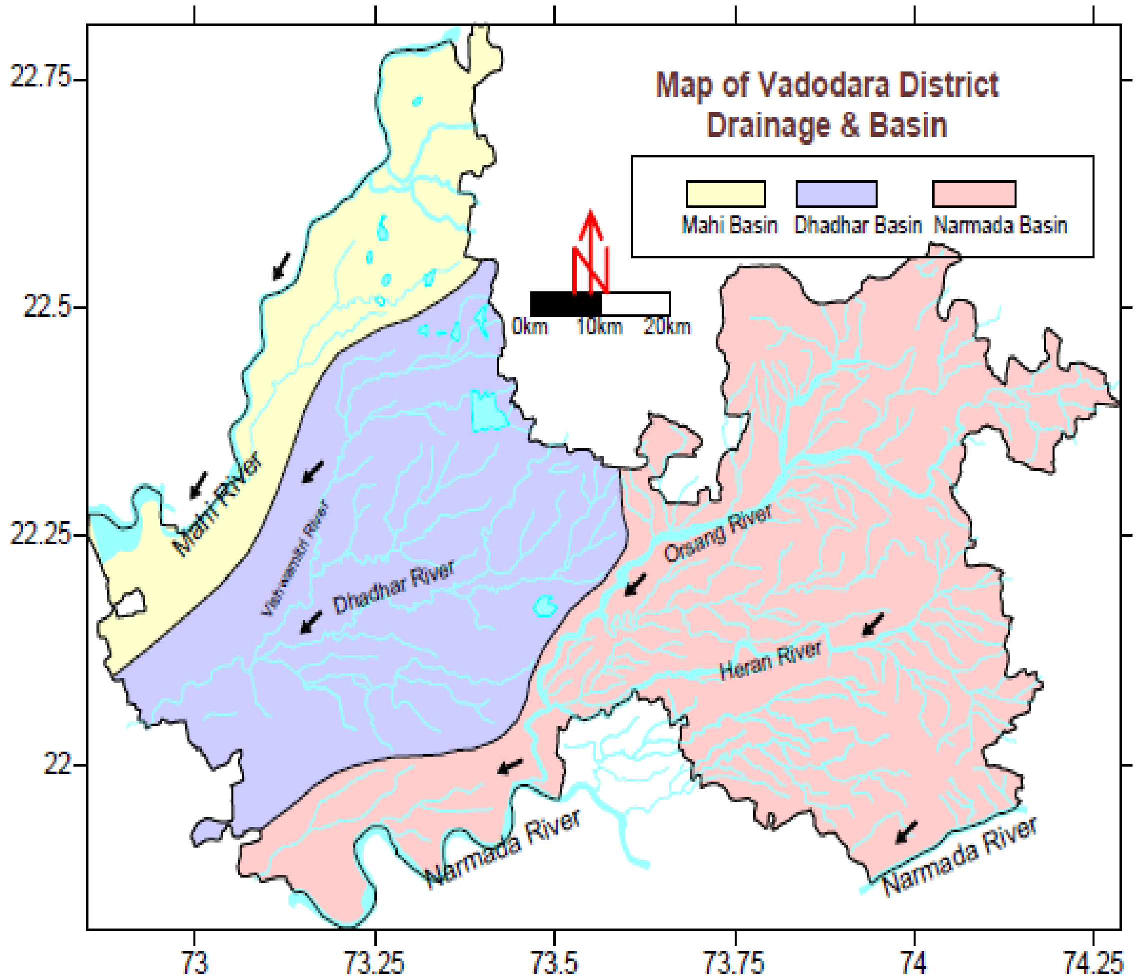
GEOMORPHOLOGY

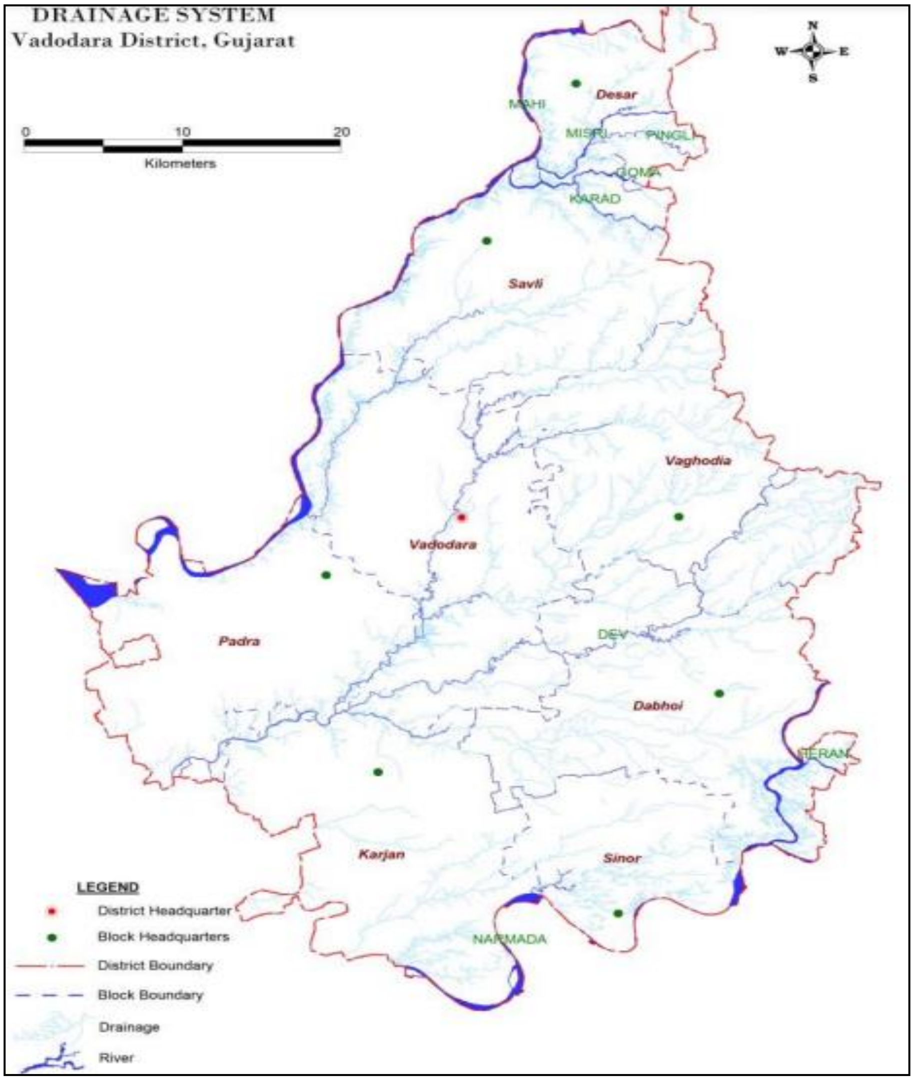
Physiography Vadodara district forms a part of the great Gujarat plain. The western & southern part, comprising of Mahi & Narmada Doab, is a level plain with gentle undulating terrain have elevation in range of 20 to 80 m amsl. There are some linear tracts, along Mahi, Viswamitre, Dhadahar and Orsang rivers, have ravine landforms, with typical head ward erosional featured gully formation in soft alluvium. The banks of the Mahi has high vertical cliff , 10 to 25 m height, generally on left bank; same way left bank of the Narmada also has high cliff of 10 to 20 m high on right bank. All such features of MahiNarmada Doab, like ravine features, high cliff along banks and entrenched meandering courses with dry and wide sandy river bed of intermediate independent river systems of the Dhadhar & its tributaries indicate mature river stage and also tectonic uplift of Doab portion in recent geological past.



DRAINAGE

The Narmada and the Mahi are the chief rivers of the district, flow along the northwestern and southern boundary respectively while independent small river system of the Dhadhar with its numerous tributaries flow in south central part of the district. Broadly, the entire district, as a River Basin is divided into these three basin, namely the Narmada, the Mahi Basin and the Dhadhar. The Mesari, the Goma and the Karad are the small rivers flowing northwest part of the district, are tributaries of Mahi River, and are part of the Mahi Basin. The Jambuva, the Surya, the Viswamitre and the Dhadhar, which flow through central part of the district and empty into the Gulf of Khambat, are part of the Dhadhar basin.



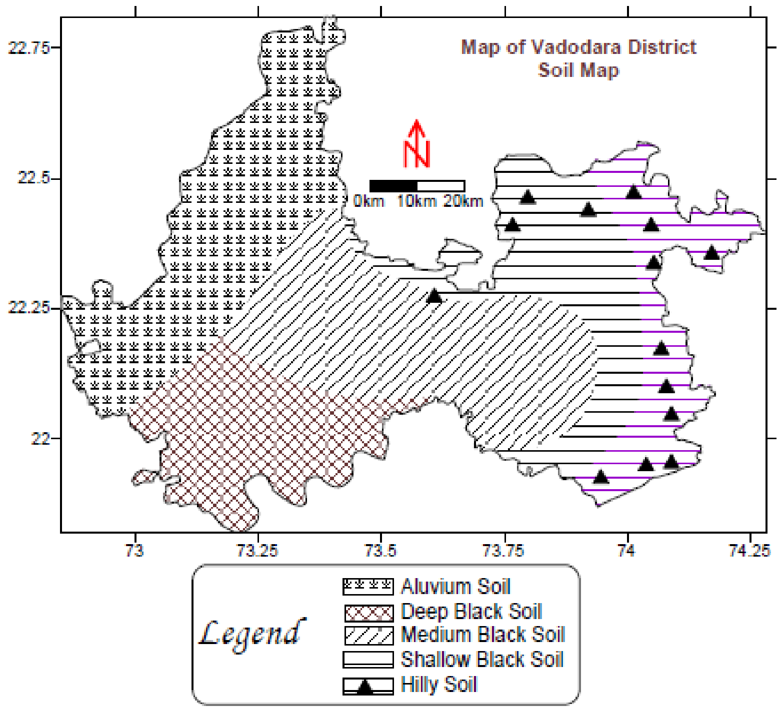


SOIL

The soils of Vadodara district can be broadly classified into three groups. They are black soils, alluvial soils and hilly soils. The soil is representative of the soils of the region, popularly known as "Goradu" soil. It is alluvial in origin and belongs to the order Alfisol. The texture of the soil is loamy sand. The soil is deep enough to respond well to manuring and variety of crops of the tropical and sub-tropical regions. The soil is low in organic carbon and nitrogen, medium in available phosphorus and available sulphur. Status of potassium was found high, while micronutrient status is found sufficient. The soil reaction is slightly towards alkaline having pH 7.7.

Soil properties

Type	Loamy sand.
pH	7.7
EC (1:2.5) at 25 C	0.19 dS/m
Organic Carbon	0.36%
Total N	0.031%
Available P2O5	40.18 kg/ha
Available K2O	450.0 kg/ha



References: Central Ground Water Board. *Vadodara District Report*. Available at: Vadodara District Report PDF.

A.4 RAINFALL

NA-The project activity is not a rainwater harvesting project

A.5. Alternate methods/Justification for current method selection to the Project Activity

Justification for Current Method Selection

The project proponent has chosen the STP wastewater recycling method at Parul University for several key reasons that reflect both the environmental needs of Vadodara and the university's commitment to sustainability:

1. **Effective Response to Water Scarcity**:

- Vadodara experiences significant water scarcity, particularly during peak summer months when demand surges. By utilizing a **3.5 MLD** STP to recycle sewage water, the university addresses this critical issue directly. The project successfully recycled **176022 KLD in 2022, 601771 KLD in 2023 and 388772 KLD in 2024** providing a sustainable alternative source of water for non-potable uses such as gardening and campus toiletries. This proactive approach reduces dependence on freshwater resources, which is essential in a region where rainfall averages only **722 mm annually**.

2. **Maximizing Resource Efficiency**:

- The selected method demonstrates exceptional resource efficiency by converting wastewater into valuable water resources. The STP's capacity currently utilized for recycling, there remains significant potential for increasing this percentage as operational efficiencies improve or demand for recycled water rises. This capacity utilization underscores the university's commitment to optimizing available resources while minimizing waste.

3. **Enhanced Environmental Protection**:

- By treating and reusing wastewater, the PP minimizes the environmental impact associated with untreated sewage discharge. The project aligns with environmental regulations set forth by the Gujarat Pollution Control Board (GPCB), ensuring that recycled water meets safety standards before reuse. This commitment to environmental stewardship not only protects local ecosystems but also enhances the university's reputation as a leader in sustainable practices.

4. **Educational and Community Engagement Opportunities**:

- The STP project serves as a living laboratory for students, providing hands-on experience in water management and sustainability practices. It fosters awareness about water conservation among students and the local community, encouraging active participation in environmental initiatives. This educational aspect enhances the university’s mission to develop socially responsible leaders.

5. **Adaptability to Local Conditions**:

- Given Vadodara's climatic conditions—characterized by high temperatures and seasonal rainfall—the selected method is both adaptable and resilient. It effectively utilizes available resources while addressing challenges such as evaporation losses during hot months, ensuring that recycled water remains a viable resource year-round.

The selection of STP wastewater recycling as the primary method for the PP is driven by a comprehensive understanding of local water scarcity issues, regulatory compliance, environmental protection, and community engagement. This approach not only provides immediate benefits in terms of resource recovery but also establishes a framework for long-term sustainability and resilience in Vadodara. By integrating innovative water management practices into its operations, Parul University exemplifies leadership in promoting sustainable development while addressing pressing environmental challenges in the region.

Sources:

- World Water Summit. *A Study of Vadodara City*. Available at: World Water Summit PDF.
- Central Ground Water Board. *Master Plan for Artificial Recharge to Groundwater in India*. Available at: Master Plan PDF.
- Juniper Publishers. *Ground Water Quality Index of Growing Smart City of Vadodara*. Available at: Ground Water Quality Index PDF.
- Vadodara Municipal Corporation. *Infrastructure Assessment of Vadodara City*. Available at: Vadodara Municipal Corporation PDF.

A.7. Design Specifications

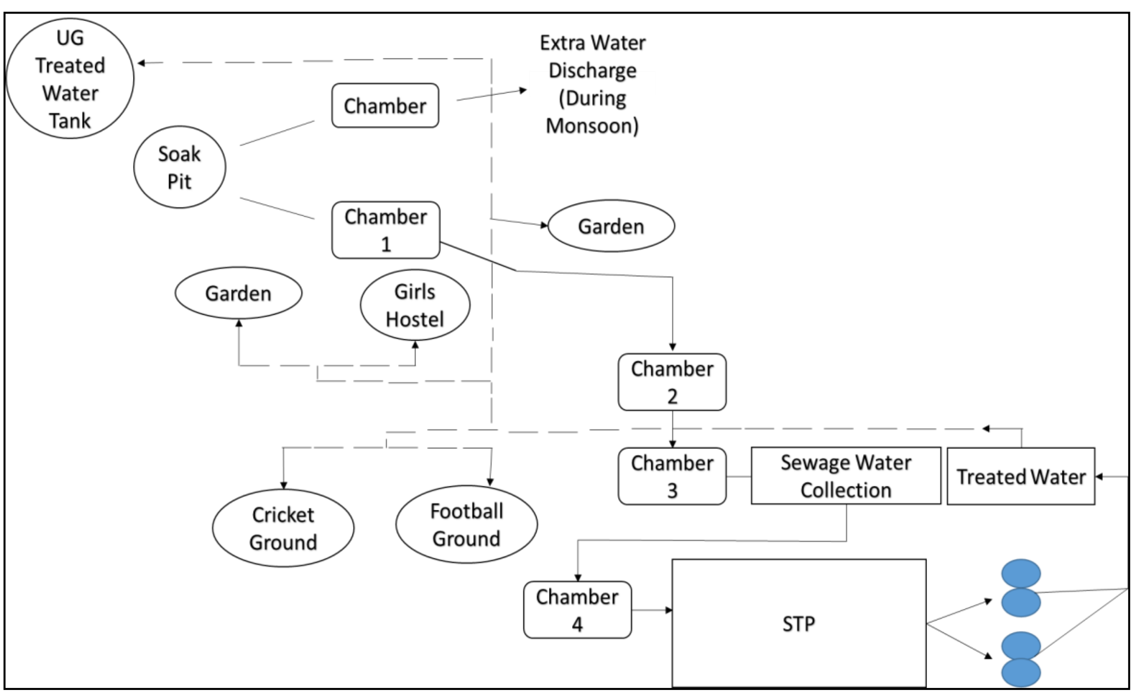
Sewage Treatment Plant (STP) as part of its commitment to sustainable water management and environmental stewardship. This STP underpins the university's efforts in recycling and reusing wastewater, adhering to the principles of the UWR RoU program.

Design and Process

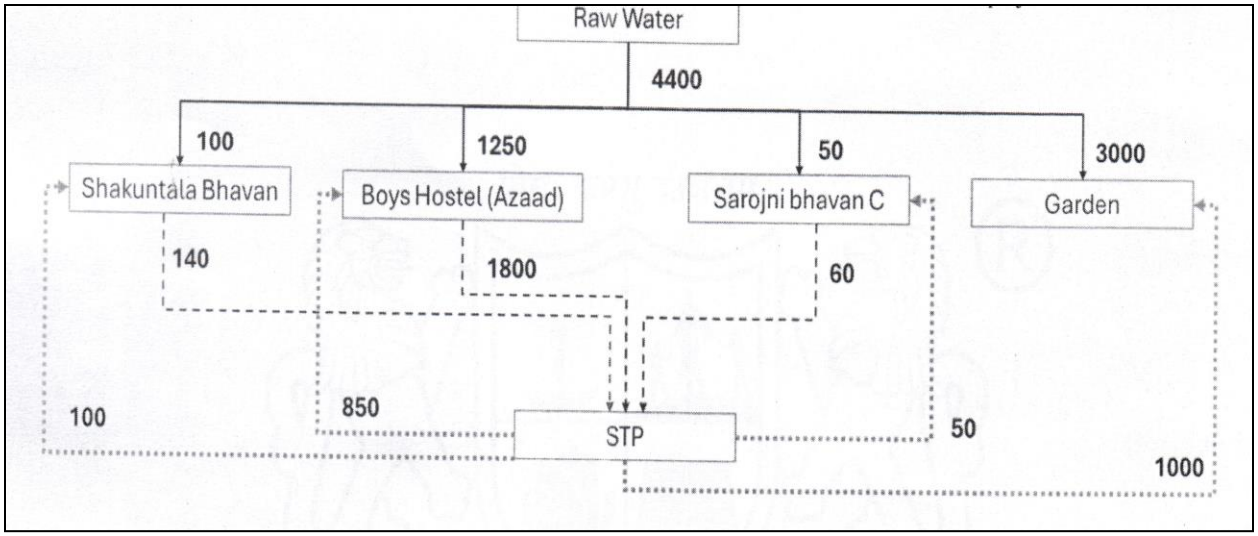
The STP serves multiple facilities within the campus, including Shakuntala Bhavan, Azad Boys' Hostel, and Sarojini Bhavan C, among others. The process involves the collection of sewage from these facilities, which totals to significant daily volumes:

- Shakuntala Bhavan contributes approximately 140 KLD of sewage.
- Azad Boys' Hostel adds about 1800 KLD.
- Sarojini Bhavan C provides around 60 KLD.

Flow Diagram



Water balance flow



Treatment and Reuse

The collected wastewater undergoes comprehensive treatment through primary, secondary, and tertiary processes, ensuring that it meets the quality standards for non-potable applications such as gardening and toilet flushing. The system reutilizes:

- 100 KLD in Shakuntala Bhavan,
- 850 KLD in Azad Boys' Hostel, and
- 50 KLD in Sarojini Bhavan C.
- 1000 KLD for garden purposes

This treatment facility significantly reduces the campus's freshwater demand by reusing treated water, thereby conserving valuable water resources.

The design incorporates several key structures and processes to ensure effective treatment and compliance with environmental standards.

FLOWTECH FLOW METER SPECIFICATIONS

CAPACITY (FAD)	31.80 - 318 m3/hr
SIZE	6"
FLUID	Sewage / Treated Sewage
DENSITY	1.05
OPER. PRESSURE	< 5 Kg/cm2
TYPE	Full Bore PTFE Lined
TUBE & MOC	SS 316 Seam with PTFE Lined
CONNECTION	ASA 150 # RF (150 NB)
FLANGES	C.S. (A-105) ANSI B 16.5 WIth PTFE Lined
ELECTRODES	S.S.316
HOUSING	Aluminium Die Cast Weather Proof IP-65
COIL HOUSING	Carbon Steel
OUTPUT	4 - 20 mA / RS 485 MODBUS / PULSE
FLOW TRANSMITTER	Integral With Display 4 Digit LCD for Flowrate & 8 Digit LCD for Totaliser
DISPLAY	1-Line Push Button
POWER SUPPLY	230 VAC X 5 Amp
MOUNTING	In-Line Horizontal
ELECTRICAL CONN.	Brass With Nickle Plated Gland.
ACCURACY	+/-1% on Current Reding

Key Components and Design Specifications

Coarse Screen Chamber (RCC)

- Sewage flows under gravity to the screen chamber. Here coarse screen has been considered to remove the inert material coming along with the sewage.
- 2 Nos of Screen to work in parallel have been considered.
- Screen has to be cleaned manually daily.
- From here the sewage flows under gravity to the Collection sump.

Collection Sump (RCC)

- Sewage from the Screen Chamber comes to this well under gravity.
- This well is used as collection cum equalization zone and from here sewage will be pumped to STP for treatment.
- 4 Nos of Submersible pumps (Working + Standby) have been considered at this point.
- From the collection tank the sewage will be pumped to the STP at a fixed flow of 146m3/hr.

Fine Screen Chamber (RCC)

- Sewage will be pumped from the collection Sump to the screen chamber. Here fine screen has been provided to remove the inert material coming along with the sewage.
- This will be provided with Fine Screen - Rotary Drum Screen.
- From here the sewage flows under gravity to the Oil & Grease trap provided in series.

Oil & Grease Trap (RCC)

• Sewage from the Screen Chamber flows under gravity to the Oil & Grease trap.
• This has been provided in the form of baffles to retain floating oil in the first zone.
• This oil to the removed manually.
• Trolley type Oil Skimmer can be provided in the central zone if oil coming is more.
• Bottom drain provided to remove settling solids in this tank. Hence this zone to work as Oil & Grease trap cum Settling Chamber.
• From here the sewage flows under gravity to the Anoxic Tank Zone-1 & Anoxic Tank Zone-2.

Anoxic Tank – Zone-1 & Zone-2 (RCC)

• Effluent from the Oil & Grease Trap flows under gravity to the Anoxic tank at a fixed flow of 73m3/hr as per design to Each zone.
• This is provided in Two Zones, Anoxic Tank Zone-1 & Anoxic Tank Zone-2 to work parallel to each other. Inlet Gate Arrangement provided to Isolate required Anoxic & subsequent Aeration tank.
• Here process occurs during depletion or deficiency of oxygen.
• Anoxic process is biological treatment process by which nitrate NO3 nitrogen is converted to molecular nitrogen gas in the absence of oxygen.
• Anoxic process is also known as denitrification.
• This is provided with Agitator mechanism for gentle mixing of the mass.
• From here the Effluent to flow under gravity to the Aeration Tank.

Aeration Tank / Activated Sludge Process Zone-1 & Zone-2 (Biological Treatment) – (RCC)

• Aeration Tank has been proposed to facilitate the Activated Sludge Process.
• This is provided in Two Zones, Aeration Tank Zone-1 & Aeration Tank Zone-2 to work parallel to each other. Inlet Gate Arrangement to be provided to Isolate required Aeration tank.
• This works on Aerobic technology. The Microbes in the Activated Sludge Process (MLSS & Active Microbes MLVSS) shall consume the Organics in the wastewater in presence of Oxygen and hence result into reduction of COD, BOD & Ammonical Nitrogen.
• Diffused Aeration in the form of tubular fine bubble diffusers is provided.
• Retrievable type Diffusers installed for ease of maintenance.
• The Aeration tank is provided with inlet Baffle and Outlet Launder for uniform overflow to the Outlet of the tank. The baffle is provided to avoid short circuiting of the flow and to maintain the flow regime.
• Biologically treated effluent along with the biomass flows under gravity to the Secondary settling tank-1 from Aeration Tank Zone-1 & to Secondary Settling Tank-2 from Aeration Tank Zone-2 for settling of the biological sludge.

Secondary Clarifier-1 & Secondary Clarifier-2 – (RCC)

• This has been designed with adequate settling time for settling of the MLSS.
• MLSS settling at the bottom has to be recirculated back to the Aeration Tank / wasted to the sludge sump if in excess.
• Two numbers of Secondary Clarifier i.e. Secondary Clarifier -1 for Aeration Tank Zone -1 & Secondary Clarifier – 2 for Aeration Tank Zone – 2 provided to work parallel to each other.
• Two numbers of Horizontal Centrifugal pumps (Working + Standby) have been provided per Secondary Clarifier for recirculation of the MLSS to the respective Aeration tank Zone.

• This tank is circular with mechanical clarifier mechanism at the conical bottom to scrap the MLSS to the center of the tank for easy withdrawal.
• Inlet deflector box is provided to avoid short circuiting of the flow, outlet launder along the periphery for outlet of the clear effluent.
• Clear Waste water after settling of the sludge flows under gravity into the Intermediate collection tank for filtration & polishing.

Intermediate Collection tank – 1 & 2 – (RCC)
• Treated Sewage from the Secondary Clarifier-1 flows under gravity into the intermediate collection tank-1 & from the Secondary Clarifier-2 flows under gravity into the intermediate collection tank-2. This is provided to collect the treated wastewater before final polishing treatment.

Pressure Sand Filter – 2 Nos, 1 Nos for Each Zone (MS Epoxy Painted)
• This is provided as Polishing treatment for waste water.
• Multi Grade of sand provided for filtration and removal of suspended solids.
• Outlet of the Pressure Sand Filter will flow to the Activated Carbon filter placed in series.

Activated Carbon Filter – 2 Nos, 1 Nos for Each Zone (MS Epoxy Painted)
• This is provided as Polishing treatment for waste water.
• High Quality granular Carbon provided to remove the residual organics.
• Outlet of the Activated Carbon filter to flow to the final collection Tank.

Final Collection tank – (RCC)
• Treated Sewage from the Activated Carbon Filter after polishing to come to this tank.
• Final collection tank is utilized for Garden / Horticulture & Toilet Flushing.

Disinfection by Chlorine Dosing (Dosing pump and tank)
• Sodium Hypo dosing is done at the outlet of filter for disinfection of the treated Sewage.

Sludge Sump – (RCC)
• 2 Nos. sludge sumps are constructed for collection of the sludge for dewatering.
• From the sludge sump the sludge is be pumped to the Filter Press Mechanism provided for dewatering of the Sludge.
• Filter Press Filtrate goes to the Aeration Tank under gravity.
• Biological Sludge after drying is used in the Garden as Manure.

Parameters for Quantity Estimation

- The total sewage generated from various facilities is significant:
- Shakuntala Bhavan: ~140 KLD
- Azad Boys' Hostel: ~1800 KLD
- Sarojini Bhavan C: ~60 KLD
- Garden: ~1000 KLD

The STP is designed to treat this volume efficiently, ensuring that treated water meets quality standards for non-potable applications such as irrigation and toilet flushing.

Water Quality and Pretreatment

The source water quality is monitored, ensuring compliance with pollution control standards before entering the treatment process. Preliminary pretreatment involves screening and grit removal to eliminate larger solids that could disrupt subsequent processes.

Conveyance System
The conveyance system consists of gravity-fed channels and pumping stations that transport sewage from collection points across the campus to the STP, ensuring efficient flow management throughout the treatment process.

Describe the gainful end usage of STP treated water

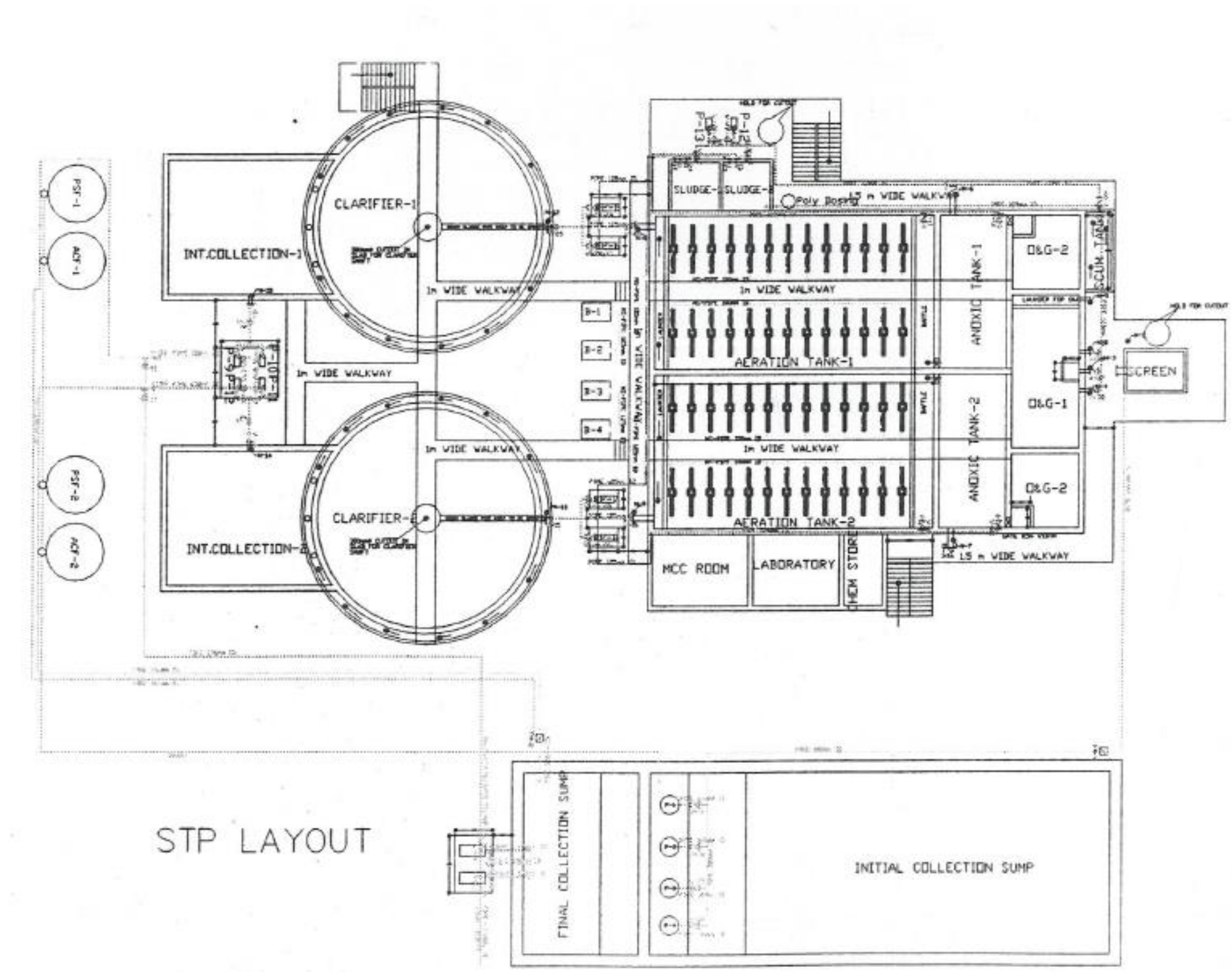
The gainful end usage of Sewage Treatment Plant (STP) treated water involves repurposing the treated wastewater for non-potable applications, thereby conserving freshwater resources and promoting environmental sustainability.

Two primary uses include:

1. Flushing: Treated STP water is used in toilet flushing systems, reducing the demand for fresh potable water in buildings and facilities. The treated water meets specific quality standards to ensure it is safe for this purpose, contributing to significant water savings and cost reduction.
2. Gardening and Landscaping: STP treated water is also used for irrigating gardens and landscaping areas. This application helps maintain green spaces without relying on fresh water, which is particularly valuable in summers. The nutrients present in the treated water can benefit plant growth, reducing the need for additional fertilizers.

These end uses of STP treated water align with sustainable water management practices, helping to reduce the environmental impact and support water conservation efforts.

2. No extra sewage is discharged from the system. All sewage generated is carefully managed and fully treated within the sewage treatment plant (STP). The treatment process ensures that every drop of sewage is processed to meet environmental and regulatory standards, eliminating the possibility of untreated or treated wastewater being released into the environment. The closed-loop system effectively recycles and repurposes the treated water, often for uses such as flushing and irrigation, thereby ensuring that the entire sewage output is contained and utilized responsibly. This approach underscores our commitment to sustainable water management and environmental protection.
3. Sludge Disposal | The Sewage Treatment Plant (STP) produces approximately 125 kg of sludge daily. This sludge is managed in two ways: sludge from the coarse and fine screen chambers is sent to a nearby solid waste treatment facility, while sludge from the clarifier and aeration processes is thickened using a filter press. After thickening, the sludge is dried under sunlight. Once fully dried, the 125 kg of sludge is repurposed as organic manure, contributing to sustainable waste management and agricultural practices.



Source: As per plant layout document.

A.8. Feasibility Evaluation

The installed STP and recycling systems by the PP are robust and can handle wastewater effluent fluctuations in load easily.

A.9. Ecological Aspects:

The project activity achieves the sustainable management and efficient use of India's natural resources since the PP had the option to install bore wells that would have depleted the local groundwater resources and/or continued to use existing drinking water resources in the surrounding area. The PP has instead chosen to treat and reuse the STP effluent, thus saving millions of liters of safe drinking water for the city.

The project activity also encourages educational institutions, especially large and transnational institutions, to adopt similar sustainable practices in regards to captive water requirements and groundwater management.

Ecological Issues addressed by the project activity in terms of:

Inundation of habitated land	The project does not lead to inundation of residential land.
Creation of water logging and vector disease prevention mitigation	The STP is a zero-discharge plant. Impervious flooring is done in STP area to avoid any type of leakage that can be percolated into the surrounding soil.
Deterioration of quality of groundwater	By avoiding the use of borewells the project activity does not deplete aquifers and hence prevents the depletion of groundwater resources.

A.9.1 Implementation Benefits to Water Security

The implementation of the 3.5 MLD Sewage Treatment Plant (STP) at Parul University significantly enhances water security on campus and contributes to sustainable water management practices. Here are the key benefits associated with this initiative:

1. **Water Reuse and Conservation**
    - The STP enables the recycling of treated wastewater for non-potable applications, such as gardening and toilet flushing. This reduces reliance on freshwater sources, thereby conserving valuable water resources.
    - The university effectively reuses approximately **100 KLD** in Shakuntala Bhavan, **850 KLD** in Azad Boys' Hostel, **1000 KLD** for garden purposes and **50 KLD** in Sarojini Bhavan C, significantly offsetting overall freshwater demand.

2. **Environmental Protection**
    - By treating sewage to meet the standards set by the Gujarat Pollution Control Board, the STP prevents untreated wastewater from contaminating local water bodies. This helps maintain the ecological balance and protects local ecosystems.
    - The project aligns with broader environmental goals, promoting a **green pollution-free environment** on campus through responsible waste management.

3. **Improved Campus Infrastructure**
    - The STP is part of a comprehensive infrastructure strategy that includes a water treatment plant and biogas facilities, enhancing the overall sustainability of campus operations.
    - With advanced treatment processes in place, the university can maintain a clean and hygienic environment for its students and staff.

4. **Educational Opportunities**
    - The STP serves as a practical learning resource for students, particularly those in environmental science and related fields. Educational visits to the facility provide hands-on experience with wastewater treatment processes, fostering a deeper understanding of environmental management.

- Programs like these enhance student engagement and awareness of sustainable practices, preparing them for future roles in environmental stewardship.

5. **Community Impact**
   - By demonstrating effective wastewater treatment and reuse strategies, Parul University sets an example for local communities and other institutions. This can inspire similar initiatives elsewhere, contributing to regional water security efforts.
   - The university’s commitment to sustainable practices supports community health by reducing pollution risks associated with untreated sewage.

A9.2 Objectives vs Outcomes

The PP has taken a significant step towards sustainable water management by establishing a 3.5 MLD Sewage Treatment Plant (STP) on its campus. This project aligns with the university's commitment to environmental stewardship and its participation in the UWR RoU program. The STP serves multiple facilities, including Shakuntala Bhavan, Azad Boys' Hostel, and Sarojini Bhavan C, treating a substantial volume of wastewater generated daily. By implementing advanced treatment processes, the university ensures that treated water meets the necessary quality standards for non-potable applications such as gardening and toilet flushing.

Objectives and Outcomes

The STP project at Parul University has set forth clear objectives and has successfully achieved measurable outcomes post-implementation. The key objectives and their corresponding outcomes are as follows:

Objective 1: Efficient Wastewater Treatment

- **Goal**: To treat sewage generated from various campus facilities to meet environmental standards.
- **Outcome**: The STP operates efficiently, treating 3.5 MLD of sewage daily, meeting regulatory standards set by the Gujarat Pollution Control Board.

Objective 2: Water Reuse and Conservation

- **Goal**: To promote sustainable water management practices.
- **Outcome**: The University effectively reuses approximately 1,000 KLD of treated wastewater across campus facilities, significantly reducing reliance on freshwater sources. This includes:
  - **100 KLD** in Shakuntala Bhavan
  - **850 KLD** in Azad Boys' Hostel
  - **50 KLD** in Sarojini Bhavan C
  - **1000 KLD** for garden purposes

Objective 3: Environmental Protection

- **Goal**: To minimize pollution and protect local water bodies.

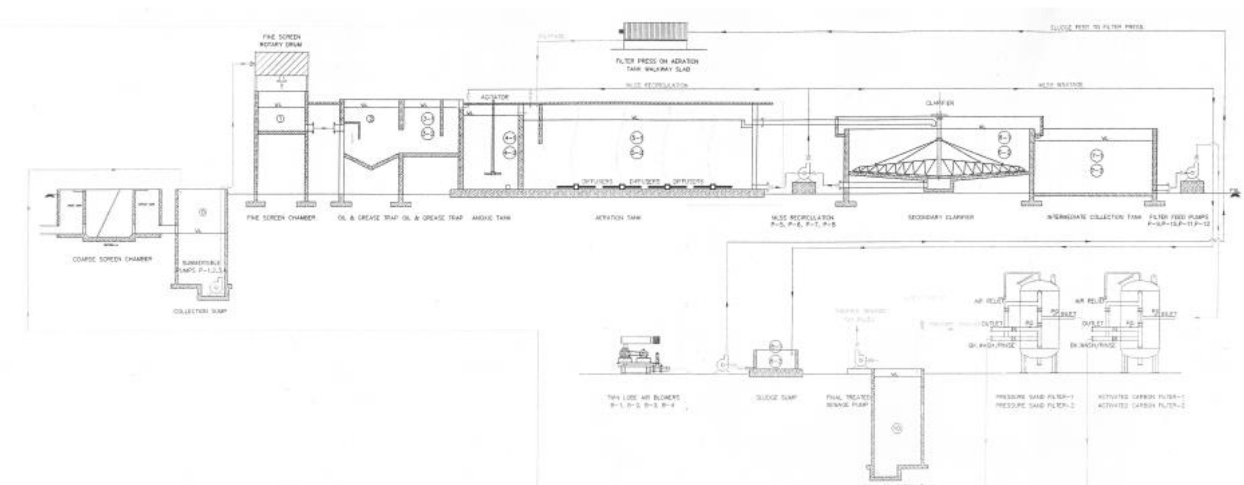
- **Outcome**: The project has effectively reduced pollution levels in local water bodies by ensuring that all sewage is treated before being released or reused, thereby protecting aquatic ecosystems.

Objective 4: Educational Resource

- **Goal**: To provide a practical learning platform for students.
- **Outcome**: The STP serves as an educational tool, allowing students to observe and learn about modern wastewater treatment technologies and sustainability practices firsthand, enhancing their understanding of environmental management.

Objective 5: Community Leadership

- **Goal**: To serve as a model for sustainable practices in the local community.
- **Outcome**: The successful implementation of the STP has positioned Parul University as a leader in sustainable practices within the region, encouraging local communities to consider similar initiatives and contributing to broader water security efforts.



Conclusion

The establishment of the 3.5 MLD Sewage Treatment Plant by the PP exemplifies its commitment to sustainable water management and its dedication to environmental protection. By aligning project objectives with measurable outcomes, the university has created a framework for effective wastewater treatment and reuse that can serve as a model for other institutions and communities. The STP project not only benefits the campus but also contributes to the overall well-being of the surrounding environment and community.

A9.3 Interventions by Project Owner / Proponent / Seller

The successful implementation of the 3.5 MLD Sewage Treatment Plant (STP) by the PP involved several strategic interventions carried out by the project owner. These interventions were crucial in achieving the desired outcomes of efficient wastewater treatment, water reuse, and environmental sustainability. The key interventions are as follows:

1. **Comprehensive Planning and Design**

- **Assessment of Wastewater Generation**: The project activity began with a thorough assessment of sewage output from various campus facilities, including Shakuntala Bhavan, Azad Boys' Hostel, and Sarojini Bhavan C. This data was vital for designing a treatment plant capable of handling the expected flow.
- **Detailed Engineering Design**: The STP was designed with multiple treatment components, such as coarse and fine screen chambers, oil & grease traps, anoxic and aeration tanks, secondary clarifiers, and filtration systems. Each component was tailored to address specific treatment needs and ensure compliance with environmental standards.

2. **Stakeholder Engagement**
    - **Partnerships with Experts**: The project activity involved collaboration with environmental engineers and consultants who provided expertise in wastewater management practices. This ensured that the design and operational strategies were aligned with industry standards.

3. **Implementation of Advanced Technologies**
    - **Adoption of Modern Treatment Techniques**: The STP utilizes state-of-the-art technologies to enhance treatment efficiency, such as rotary drum screens for fine screening, diffused aeration systems in aeration tanks to optimize oxygen transfer, and activated carbon filters for final polishing of treated water.
    - **Automation and Monitoring Systems**: Implementing automated monitoring systems allows for real-time tracking of treatment processes, ensuring optimal performance and timely identification of operational issues.

4. **Training and Capacity Building**
    - **Staff Training Programs**: Comprehensive training sessions were conducted for university staff on the operation and maintenance of the STP, equipping personnel with the necessary skills to manage the facility effectively.
    - **Educational Workshops for Students**: Workshops were organized to educate students about wastewater treatment processes, emphasizing their importance in sustainability efforts. Field visits to the STP provided hands-on learning experiences.

5. **Regular Monitoring and Evaluation**
    - **Establishment of Performance Metrics**: Clear performance metrics were established to evaluate the effectiveness of the STP in treating wastewater. Regular assessments helped identify areas for improvement.
    - **Feedback Mechanisms**: Implementing feedback loops allowed for continuous improvement in operations based on performance data and stakeholder input.

6. **Sustainability Practices**
    - **Promotion of Water Reuse Initiatives**: The project actively promotes water reuse by directing treated wastewater to various campus facilities for non-potable uses, thereby conserving freshwater resources.
    - **Environmental Compliance Monitoring**: Continuous monitoring ensures that treated effluent meets regulatory standards before being released or reused, protecting local ecosystems from pollution.

These interventions, carried out by the project owner, demonstrate a comprehensive approach to achieving the desired outcomes of the STP project. Parul University has successfully created a facility that not only addresses its wastewater treatment needs but also contributes positively to environmental conservation and community well-being.

Source: Images from the Sewage Treatment Plant (STP) and student engagement activities for awareness

A.10. Recharge Aspects:

NA

A.10.1 Solving for Uncertainty

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	1-12% (UWR Recommendation) Selected: 5%	The total quantity of treated water is measured via flow meters. The typical range of accuracy from meters to minimum delivery accuracy requirements of delivery and diversion measurement devices.
Precipitation	NA	NA
Surface Outflow	1-20% (UWR Recommendation) Selected: 5%	The total quantity of treated water is measured via flow meters. Typical range of accuracy from meters to estimated outflow relationships
Evapotranspiration	NA	NA
Deep Percolation	NA	NA

A.11. Ecological Aspects & Sustainable Development Goals (SDGs):

Sustainable Development Goals Targeted	Most relevant SDG Target / SDG Impact	Indicator (SDG Indicator)
SDG 3: Good Health and Well-being	**Target 3.4**: Reduce by one third premature mortality from non-communicable diseases through prevention, treatment, and promotion of mental health and well-being. **Target 3.9**: Reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination.	The STP contributes to improved public health by treating sewage, thus reducing pollution in water bodies and associated health risks. It also enhances the campus environment, promoting mental well-being among students and staff.
SDG 4: Quality Education	**Target 4.7**: Ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including through education for sustainable development and sustainable lifestyles.	The STP serves as a practical educational resource, providing guided tours and awareness programs on water conservation and environmental sustainability for students.

SDG 6: Clean Water and Sanitation	**Target 6.4**: Increase water-use efficiency across all sectors to ensure sustainable water withdrawals and supply. **Target 6.6**: Protect and restore water-related ecosystems, such as rivers, wetlands, and lakes.	The project enhances water conservation by treating wastewater for reuse, contributing to sustainable water management practices on campus.
SDG 11: Sustainable Cities and Communities	Target 11.6: Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal waste management.	By treating sewage effectively, the STP contributes to cleaner urban environments, reducing pollution levels in local waterways.
SDG 12: Responsible Consumption and Production	**Target 12.2**: Achieve sustainable management and efficient use of natural resources.	The project promotes responsible water use through recycling treated wastewater for non-potable applications, reducing pressure on freshwater resources.
SDG 13: Climate Action	**Target:** SDG 13 calls for 'urgent action to combat climate change and its impacts' through 'strengthening resilience and adaptive capacity to climate-related hazards and natural disasters in all countries'. Both the Paris Agreement on climate change and the 2030 Agenda require each country to increase the resilience of development interventions, including WASH.	Responsible water management is essential to address climate change challenges. It can help reduce emissions, protect ecosystems, and improve climate resilience

A.12. Quantification Tools

Baseline Scenario

The baseline scenario is the situation where, in the absence of the project activity, multiple bore wells would have been installed within the project boundary, leading to the depletion of local groundwater resources (aquifers) and/or diverting existing water resources from the surrounding area for campus toilet facilities and gardening.

Hence, the quantity of RoUs is estimated as:

"the net quantity of treated wastewater that is gainfully used post treatment."

The net quantity of treated water used is measured via flow meters installed at the site. For conservative estimates, the operational days have been assumed to be 330 days per year. Further, a 10% uncertainty factor has been applied for conservative purposes.

PARUL UNIVERSITY 3.5 MLD STP OPERATOR

PARUL UNIVERSITY 3.5 MLD STP OPERATOR (YEAR 2022)

Sn.	Month	Total KLD Feed	Total KLD outlet
1	OCTOBER	62573	59788
2	NOVEMBER	64311	60597
3	DECEMBER	79921	75195

PARUL UNIVERSITY 3.5 MLD STP OPERATOR (YEAR 2023)

Sn.	Month	Total KLD Feed	Total KLD outlet
1	JAN	90867	83429
2	FEB	71218	66999
3	MAR	74630	71511
4	APR	61421	61374
5	MAY	75053	78628
6	JUN	55789	52632
7	JUL	31969	29145
8	AUG	44002	42755
9	SEP	61776	57970
10	OCT	63971	48591
11	NOV	44214	41341
12	DEC	37588	34259

PARUL UNIVERSITY 3.5 MLD STP OPERATOR (YEAR 2024)			
Sn.	Month	Total KLD Feed	Total KLD outlet
1	JAN	62701	60529
2	FEB	84234	77841
3	MAR	50745	47787
4	APR	71500	69762
5	MAY	46586	43755
6	JUN	71500	69762
7	JUL	65384	62533
Year	2022	2023	2024
Month	Reused Units KLD	Reused Units KLD	Reused Units KLD
January	-	75,086	54,476
February	-	60,299	70,057
March	-	64,360	43,008
April	-	55,237	62,786
May	-	70,765	39,380
June	-	47,369	62,786
July	-	26,231	56,280
August	-	38,480	-
September	-	52,173	-
October	53,809	43,732	-
November	54,537	37,207	-
December	67,676	30,833	-
Total Units (KLD)	1,76,022	6,01,771	3,88,772
Total Units (KLD)	1,76,022.00	6,01,771	3,88,772
RoU	176022	601771	388772

TOTAL RoU	1166565

Quantification of RoUs

Year	Crediting Period	RoUs (1000 Liters)/Year
2022	01/10/2022-31/12/2022	176022
2023	01/01/2023-31/12/2023	601771
2024	01/01/2023-31/12/2024	388772
TOTAL RoUs		**1166565**

A.13. UWR Rainwater Offset Do No Net Harm Principles

According to the UWR RoU Standard principles, the project activity accomplishes the following:

1. Increase Sustainable Water Yield
According to the data released by the Central Groundwater Board in 2021, the total amount of groundwater that can be utilized in India in a year is 398 billion cubic meters (BCM), of which approximately 245 BCM is currently being utilized, representing about 62 percent of the total. The level of groundwater exploitation is particularly high in states like Gujarat. This project activity, commissioned in 2017, has significantly reduced the proportion of untreated wastewater that future generations would need to recycle, demonstrating effective recycling and safe reuse practices from unutilized water resources. Revenue from the sale of UWR RoUs will enable further scaling of such project activities.

2. Collect Unutilized Water or Rainwater and Preserve It for Future Use
Vadodara district, located in Gujarat, faces significant groundwater extraction challenges, with data indicating that many areas experience unsustainable extraction rates. According to the Central Ground Water Board (CGWB), as of 2020, Gujarat had 143 assessment units, with approximately 63 of them categorized as over-exploited, which includes districts like Vadodara. This alarming trend is mirrored at the district level, where groundwater extraction exceeds 63%, posing risks to long-term water availability.

3. Conserve and Store Excess Water for Future Use
The project activity decreases dependence on groundwater, thereby preventing excessive depletion. Between 2022 and 2024, the STP has successfully generated approximately **1166565** thousand liters (or 1,166.565 million liters) of treated water credits, enabling its beneficial reuse for campus facilities such as toilets and gardening. This approach not only conserves water but also ensures that excess treated water is available for future use.

A.14. Scaling Projects-

The Central Pollution Control Board (CPCB) has identified 351 polluted river stretches on 323 rivers across the country that do not meet the water quality criteria. According to CPCB's national inventory of Sewage Treatment Plants (STP) published in March 2021, urban India treats only 37 per cent of the 72,368 million liters of sewage generated every day, with about two-thirds of the wastewater ending up polluting the environment.

If India could implement 100 percent treatment and reuse of treated wastewater and fecal sludge from Indian cities by 2025, it can potentially meet over 70 percent of water requirement of industry and energy sector and irrigate 2 to 6 million hectares of land annually while yielding benefits from reduced fertilizer usage. Nutrient recovery from wastewater can yield up to 4,000 to 5,500 tons per day which can meet the demand for integrated nutrient management for about 400,000 ha of farmland annually. Reuse of wastewater in agriculture has the potential to reduce greenhouse gas emissions by over 2 million tons of CO_2e annually through decreased groundwater pumping and replacing chemical fertilizer (source: https://timesofindia.indiatimes.com/blogs/voices/wastewater-and-faecal-sludge-reuse-to-address-indias-water-and food-security/?source=app&frmapp=yes).

While several studies highlight the potential of various water–demand management interventions (Chakraborti, Kaur, and Kaur 2019), one area that researchers have begun to explore only of late is the reuse of treated wastewater (Goyal and Kumar 2022). It is receiving increasing traction given that India generates about 72,368 million litres of wastewater per day in urban areas alone (CPCB 2021); if treated (to the desired quality standard) and reused, this offers tremendous potential in addressing the water supply and demand gap on one hand and reducing the pressure on freshwater resources on the other.

However, the reuse and recycling of treated wastewater has still not become mainstream in India. Only a few Indian states have framed policies and guidelines to promote the reuse of TWW (Goyal and Kumar 2022). Further, a national-level framework on the safe reuse of treated water that provides guidelines on preparing reuse policies was launched only as recently as January 2023. Therefore, the existing state policies might also require a thorough revision to make them comprehensive and channel the financial and technical support available through national programmes, such as the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Namami Gange. While the augmentation and rehabilitation of the existing sewerage systems and recycling of water for beneficial purposes, including the reuse of TWW, are important components of AMRUT, creating additional sewerage treatment capacity in the states sharing the Ganga river basin is a priority under the Namami Gange programme.

In the developing world, cities in Brazil, Mexico, Kuwait, and India have constructed or are planning projects, for potable water reuse. Their possibilities to succeed are limited as projects would have to be implemented within regulatory, institutional, governance, management, financial and technological frameworks that are robust and promote innovation, and utilities would have to ensure technical, managerial and financial capacities in the long-term.

A serious limitation is that water management in general, and collection and conventional treatment of municipal and industrial wastewater in particular, are still challenging; often water quality standards and monitoring are poorly enforced, and risk assessment frameworks are lacking. Irrespective of how important potable water reuse is for clean water and sanitation goals at local, regional and national levels, challenges remain for its extended implementation.

Revenue from water credits (RoUs) provides a much-needed incentive to encourage voluntary treatment and reuse of similar STP effluents across industries, enabling them to be built at the scale and speed demanded by the present climate and global heating crisis.

Water Security Initiatives by PP:

The PP is actively addressing water scarcity challenges through innovative strategies such as artificial recharge structures and wastewater recycling initiatives. These efforts are crucial in enhancing the region's water security and ensuring sustainable water management practices.

Artificial Recharge Structures

The PP has implemented several artificial recharge structures to facilitate groundwater replenishment. These structures are designed to capture and utilize treated wastewater effectively, contributing to the overall sustainability of the local water supply.

- **Recharge Wells**: The project includes the installation of multiple recharge wells that utilize treated wastewater from the university's Sewage Treatment Plant (STP). These wells are strategically placed to maximize groundwater recharge, helping to raise the water table in the surrounding areas.

- **Recharge Basins**: In addition to recharge wells, the PP has developed recharge basins that allow for surface runoff and treated wastewater to percolate into the ground. This method enhances groundwater levels while also providing a buffer against flooding during heavy rainfall.

The implementation of these structures is part of a broader effort to increase groundwater levels and mitigate the impacts of urbanization on local aquifers. The university aims to contribute significantly to the region's water security by utilizing approximately **1166565 KLD** of recycled wastewater for recharge purposes.

Wastewater Management and Reuse

The PP has established an advanced STP with a capacity of **3.5 MLD**, which plays a pivotal role in treating and recycling wastewater for various applications. The treated wastewater is primarily used for:

- **Irrigation**: The recycled water is utilized for landscaping and gardening within the university campus, reducing reliance on freshwater sources.
- **Toiletries**: Treated wastewater is also used for non-potable purposes in campus facilities, further conserving valuable freshwater resources.

This integrated approach not only addresses immediate water scarcity issues but also aligns with environmental regulations aimed at protecting local water bodies from pollution.

Community and Environmental Benefits

The development of artificial recharge structures and effective wastewater management practices by the PP yields multiple benefits:

- **Environmental Protection**: By providing designated areas for treated wastewater use, these initiatives help reduce pollution in natural water bodies, maintaining overall water quality in the region.
- **Water Conservation**: The recycling and reuse of wastewater contribute significantly to conserving freshwater resources, which is critical given the increasing demand for water due to urbanization and population growth.
- **Public Engagement**: These efforts promote community involvement in sustainable practices, as students and local residents participate in maintaining green spaces and understanding the importance of water conservation

