WORKSHOP ON

USED WATER MANAGEMENT: NAVIGATING CHALLENGES & OPPORTUNITIES IN MADHYA PRADESH

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APPROACH TO CIRCULAR ECONOMY IN DOMESTIC WASTEWATER

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Refs: NITI Aayog Report on CE in wastewater, SPCB reports, EU and US reports

CONTEXT

- India is urbanizing rapidly: 59 crore urban population by 2030
- Many users competing for limited water resources
- Large quantity of treated and untreated municipal wastewater (WW) is unused
- Wastewater recycling & reuse WWRR is a key to circular economy pathway for water management
- Many countries have taken 2-3 decades to develop the CE pathway in WWRR
- Need to substantially strengthen regulatory framework and policies on WWRR

WW: wastewater, WWR: Wastewater recycling, WWRR: Wastewater recycling & reuse

VALUES FOR RIVERS

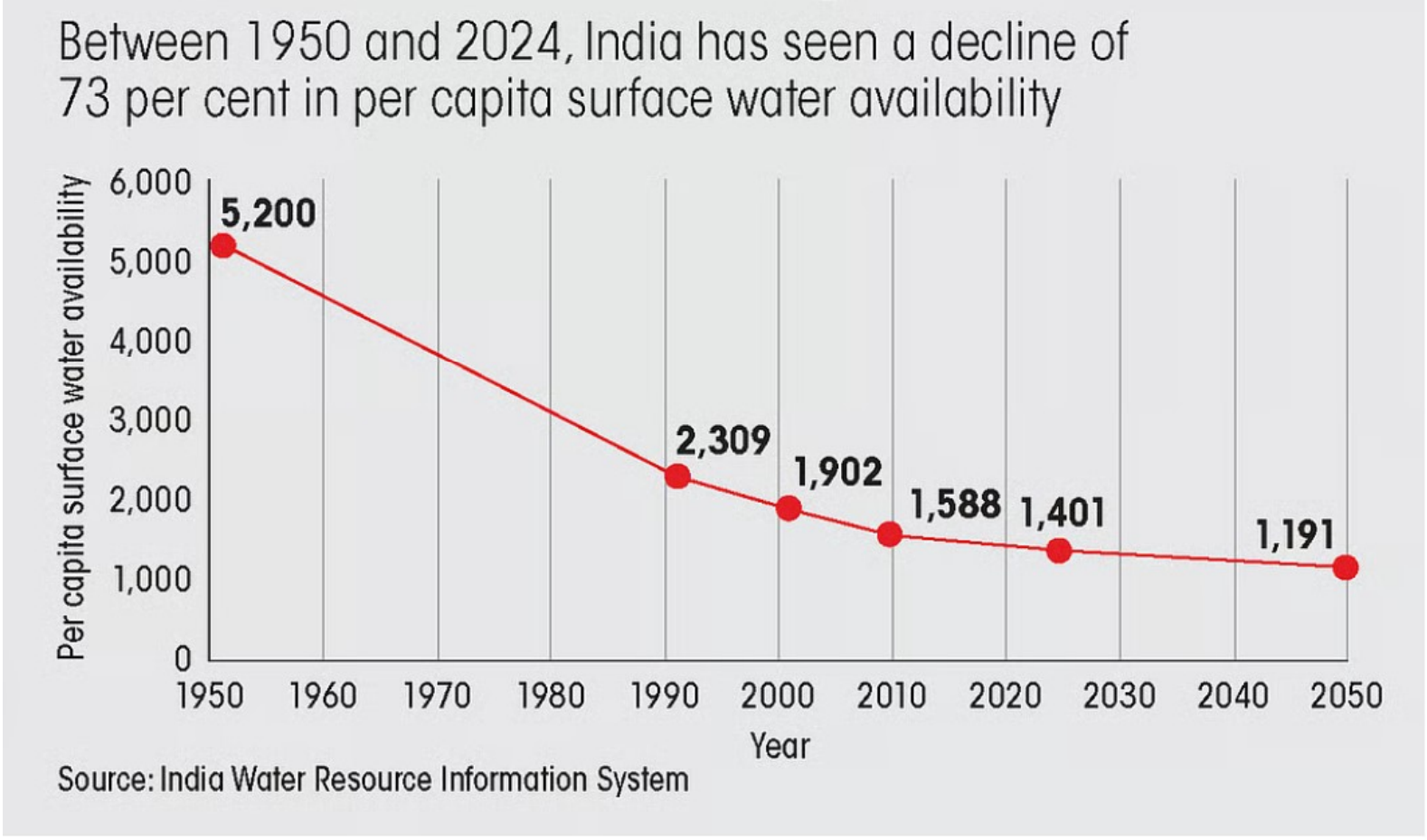
Irrigation

Fishing

Tourism

Religious and Cultural

SURFACE WATER SCARCITY



https://www.downtoearth.org.in/water/safety-in-circularity

INTRODUCTION TO USED WATER

- Used Water: Water affected in quality after domestic, industrial or commercial use.
- Domestic Wastewater: From kitchens, toilets, laundry, etc.
  - Sewage
  - Sullage
  - Sludge
- Other Terminology, Grey Water, Black Water
- Not Waste, But a Resource: Reuse, recycling, and recovery fit circular economy.

USED WATER AND POLLUTION

Pollution can come from a number of sources

- Industry
- Domestic
- Agriculture
- Stormwater

Pollution can be microbial, organic or inorganic in nature

Controlling the sources is important for remediating and improving river condition

SOURCE TRACKING

Understanding the source locations and contaminant is vital in the process for improving river/lakes water quality

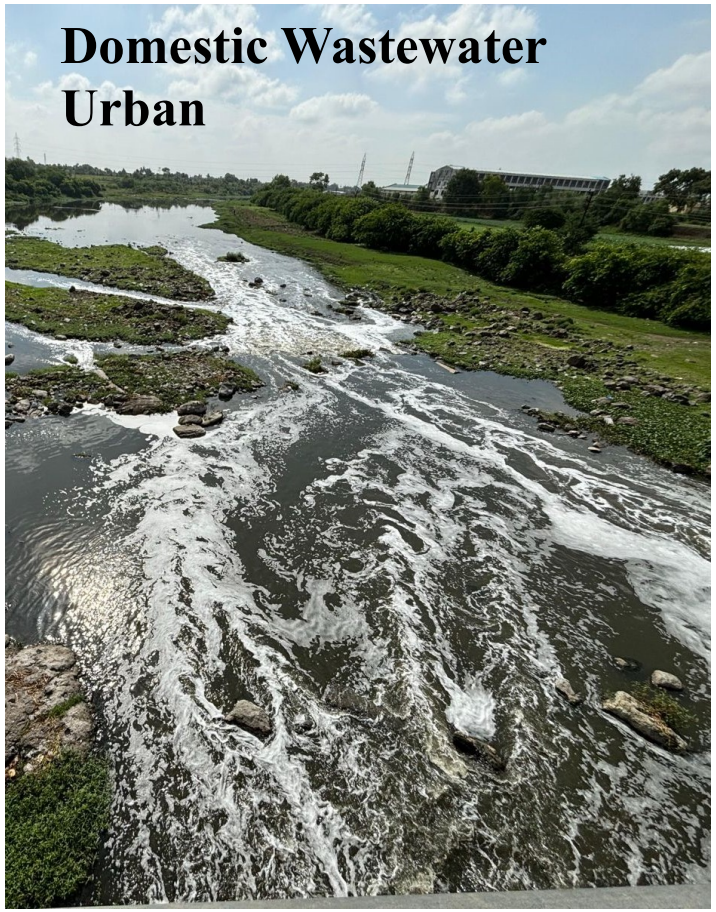
A sanitary survey can be used to identify evident pollution sources, but cannot target all sources. Difficult issue include:

- Diffuse pollution
- Detection of illegal dumping
- Agricultural vs wildlife sources
- *Determining what has the biggest input*

Source tracking involves looking for microbial and chemical markers specific for different human and animal inputs

The results can be combined with hydrodynamic modelling to identify specific contamination sources

Brick kiln activities



D/s of Nashik is seen to be foaming

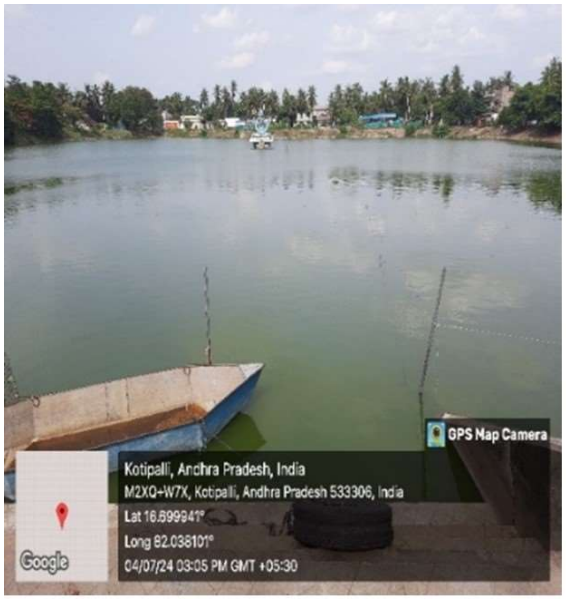
Dam

Water hyacinth eutrophication

Bank erosion is significant in upper Godavari basin, one instance is shown in Manjra area

Domestic discharge Location.

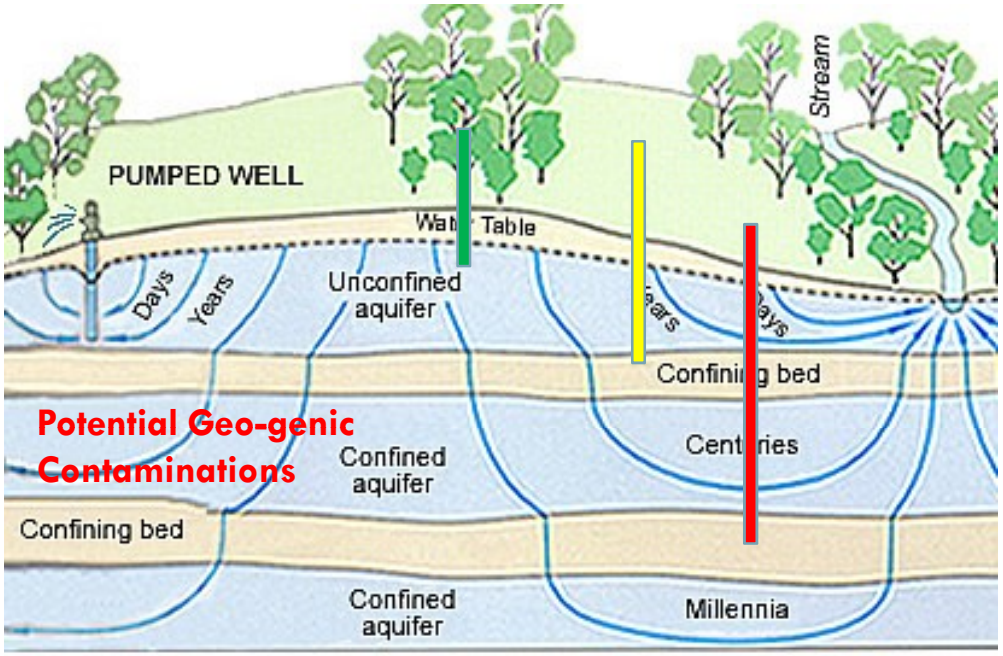
Fishing ghat and Boat point transportation



PHYSICOCHEMICAL PARAMETERS OF WASTEWATER FROM VARIOUS INDUSTRIES

Parameter	Domestic Sewage	Textile Industry	Pulp & Paper Industry	Dairy Industry	Steel Industry	Refinery Industry
pH	6.5–8.5	6.0–9.0	6.5–8.5	6.5–8.5	6.5–9.0	6.0–9.0
BOD (mg/L)	150–300	80–700	200–1000	500–1500	50–200	100–500
COD (mg/L)	300–600	300–1500	600–2000	1000–2500	250–500	300–1500
TSS (mg/L)	150–400	100–1000	250–1500	200–600	100–500	100–300
TDS (mg/L)	500–1000	1000–3000	1000–5000	500–2000	1000–5000	1000–2500
Color (Pt-Co)	<100	>500	200–1000	Slight	Grey	Dark
Oil & Grease (mg/L)	10–50	5–50	10–100	50–150	10–50	50–100
Chlorides (mg/L)	50–200	200–1000	100–1000	100–300	200–800	200–1000
Sulphates (mg/L)	20–100	200–800	200–800	50–200	300–1500	500–1000
Heavy Metals	Negligible	Zn, Cr, Cu, Ni	Cr, Pb	Low	Fe, Zn, Cr, Ni	Pb, Zn, V
AOX (mg/L)	Negligible	Low	10–100	Negligible	Negligible	50–150
Turbidity (NTU)	50–150	100–500	200–600	100–400	100–300	150–400
Temperature (°C)	25–35	30–45	30–50	30–45	35–60	40–60

BUILDING OR SOCIETY LEVEL



Courtesy of U.S.Geological Survey

Fresh Water Requirement @135 LPCD 1,35,000 L/day

Population=100

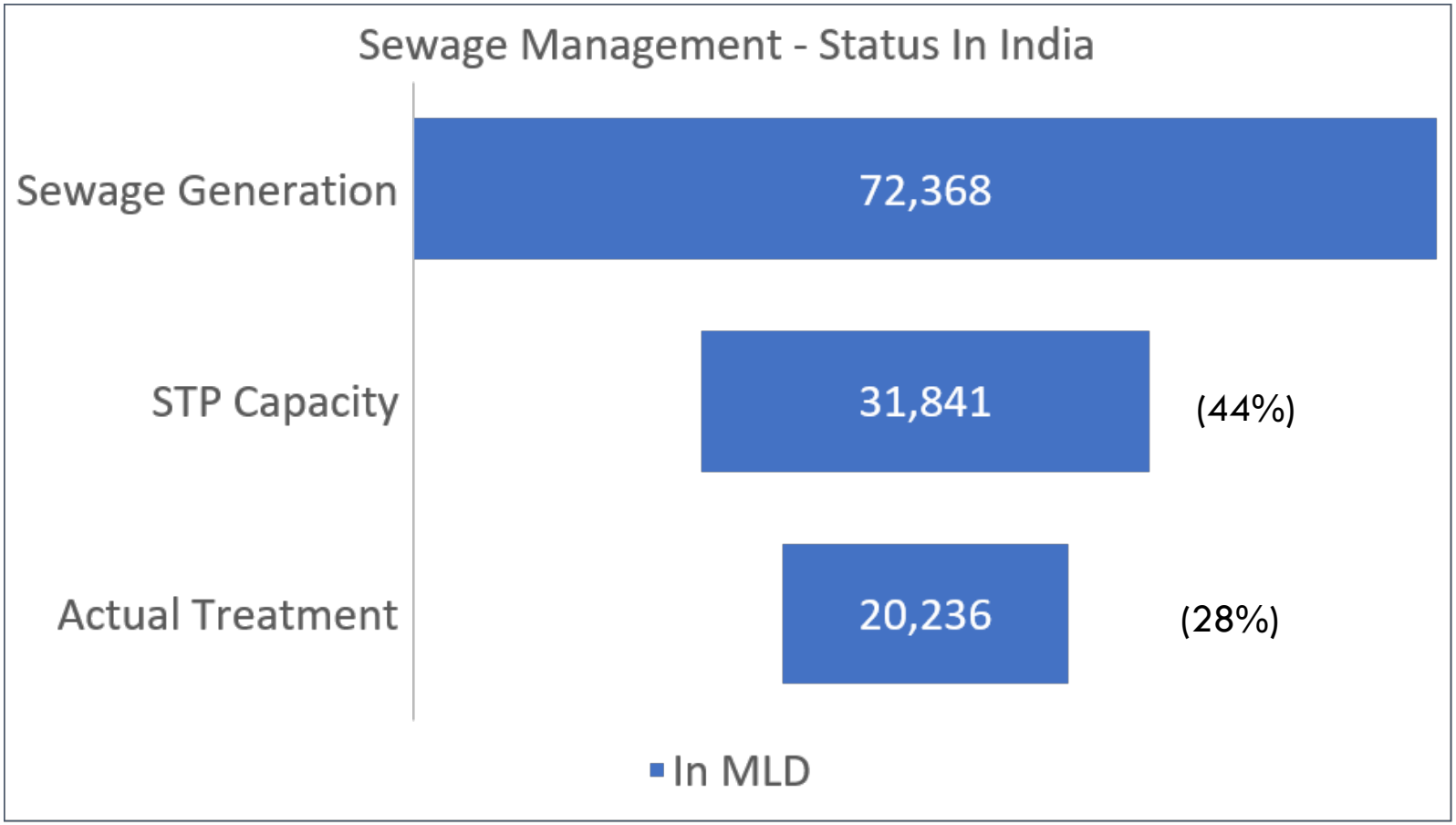
- Wastewater Generated 1,00,000 L/day
- Increased Run-off

Pollution Load

Contaminated Sources

Treatment

CURRENT SCENARIO – ISSUES AND CHALLENGES



SCENARIO OF TREATMENT CAPACITIES AND EXTENT IN TWO STATES

Sr. No.	State	No. of STPs	Sewage Gen (MLD)	Treatment Capacity (MLD)	Treated (MLD)	Treatment (%)
1	Maharashtra	155	9190 (U&R)	7013	4927	53%
2	Madhya Pradesh	71	2183 (U)	1477	904	41%

CHALLENGES FOR SEWERAGE SYSTEMS AND SEWAGE

URBAN

Uncontrolled growth in Peri-Urban Areas

Complete connectivity is challenge in many areas

Solids waste through storm water drains)

High use of detergents/soap

RURAL

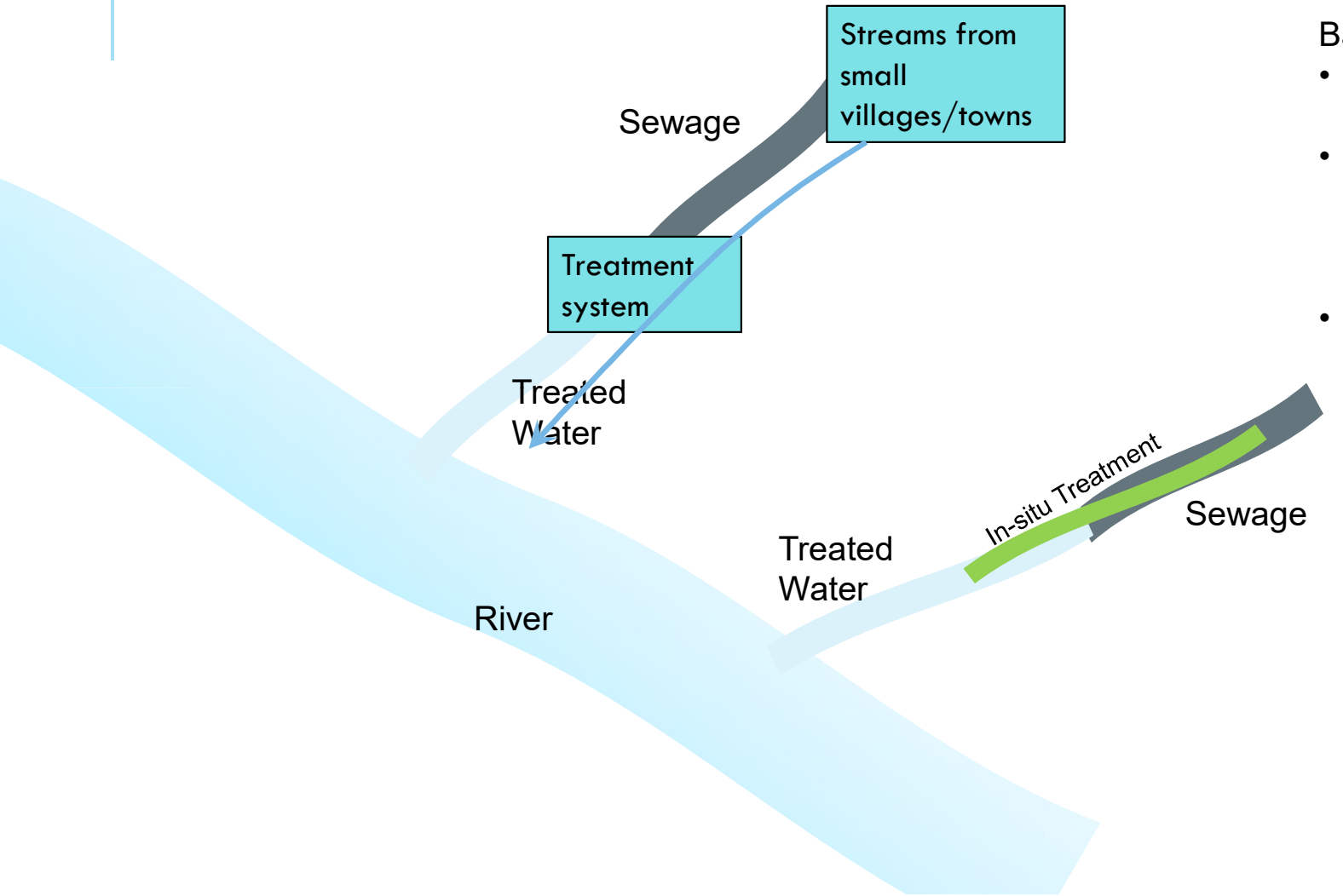
Sewage generation is challenged by low water supply

Distributed houses and random orientations of the sewage outlets

Use of Toilets, Post collection

Other solids coming in open drain (cow dung, msw and plastics)

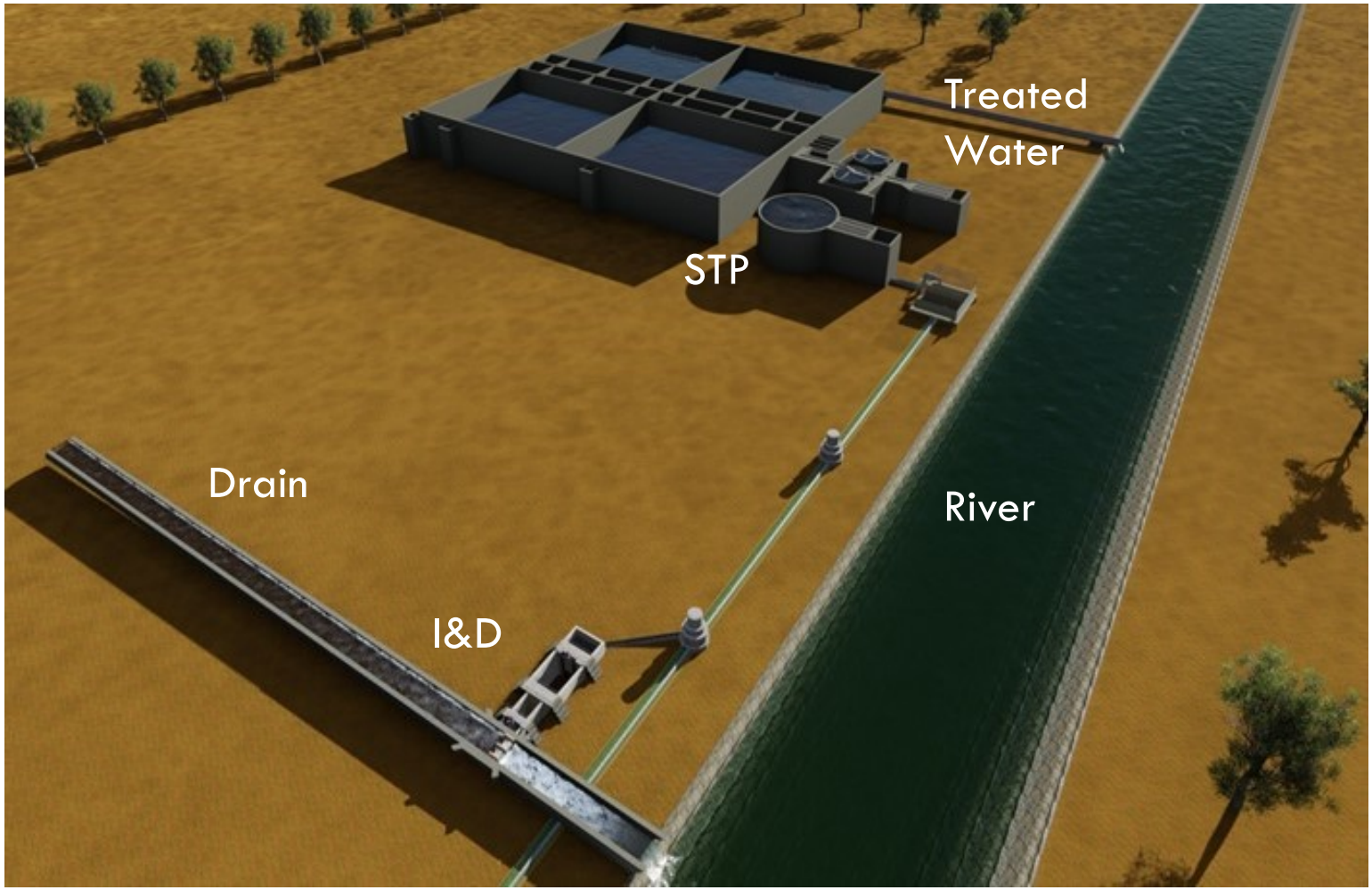
APPROACH FOR THE SEWAGE TREATMENT



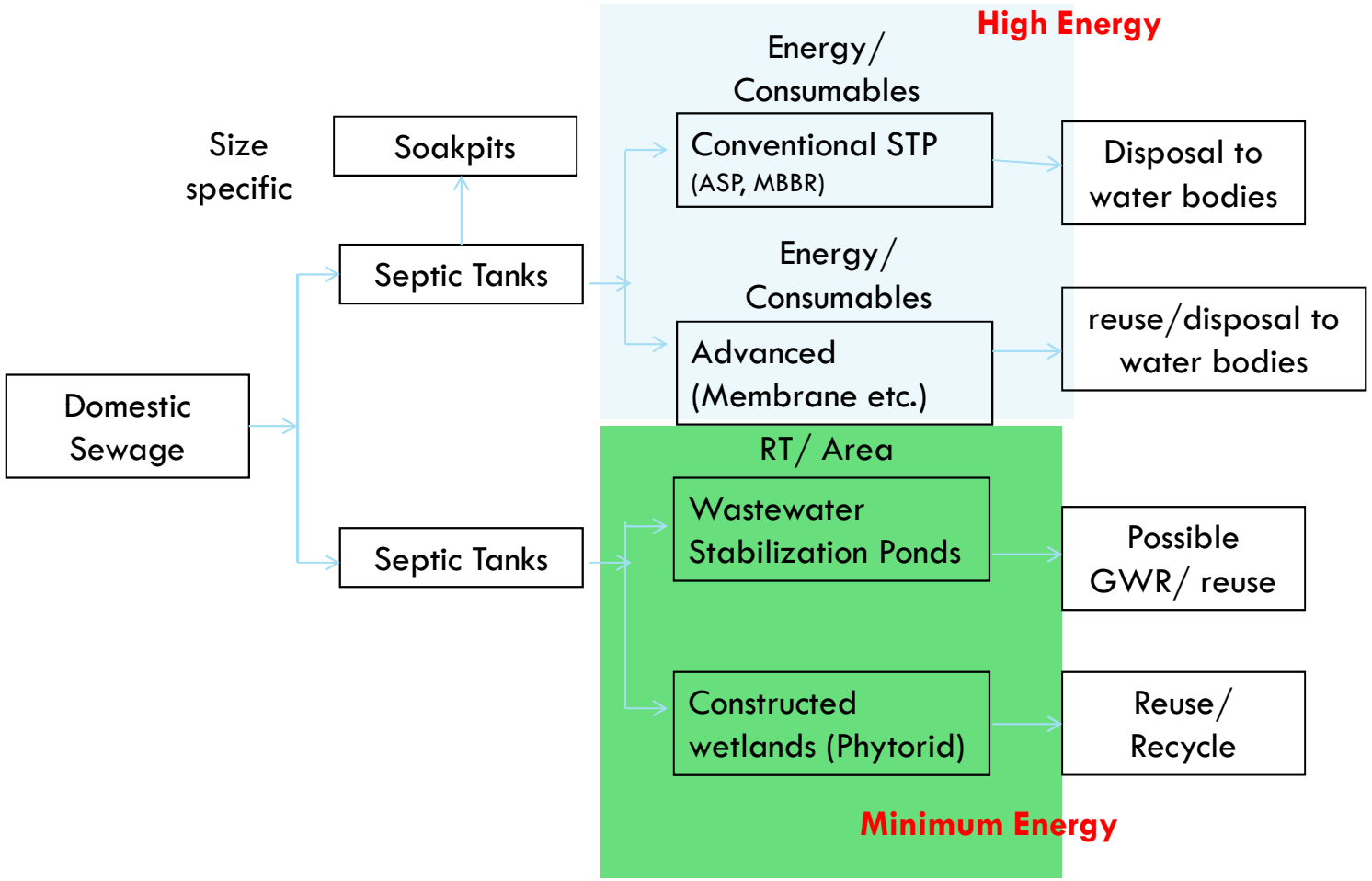
Basin Approach

- Reducing pollution load from sewage
- Decentralised treatment system at villages and town levels
- Nallah-in-situ treatment

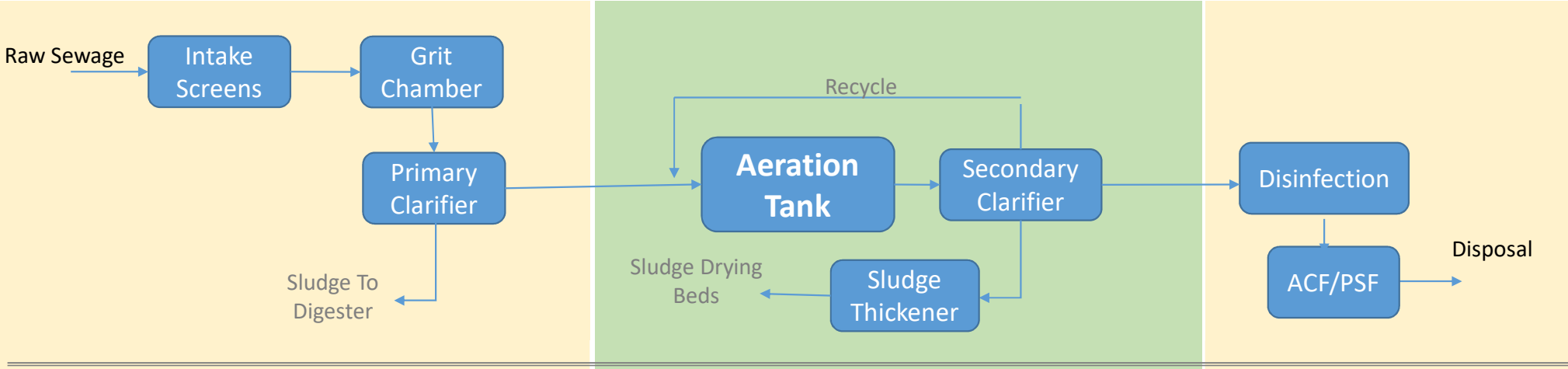
I&D AND STP



SEWAGE TREATMENT: METHODS, ISSUES, SOLUTIONS



Sewage Treatment Plant Process



Primary Treatment

- Typically remove floating material, grit etc.
- Minor portion of treatment cost

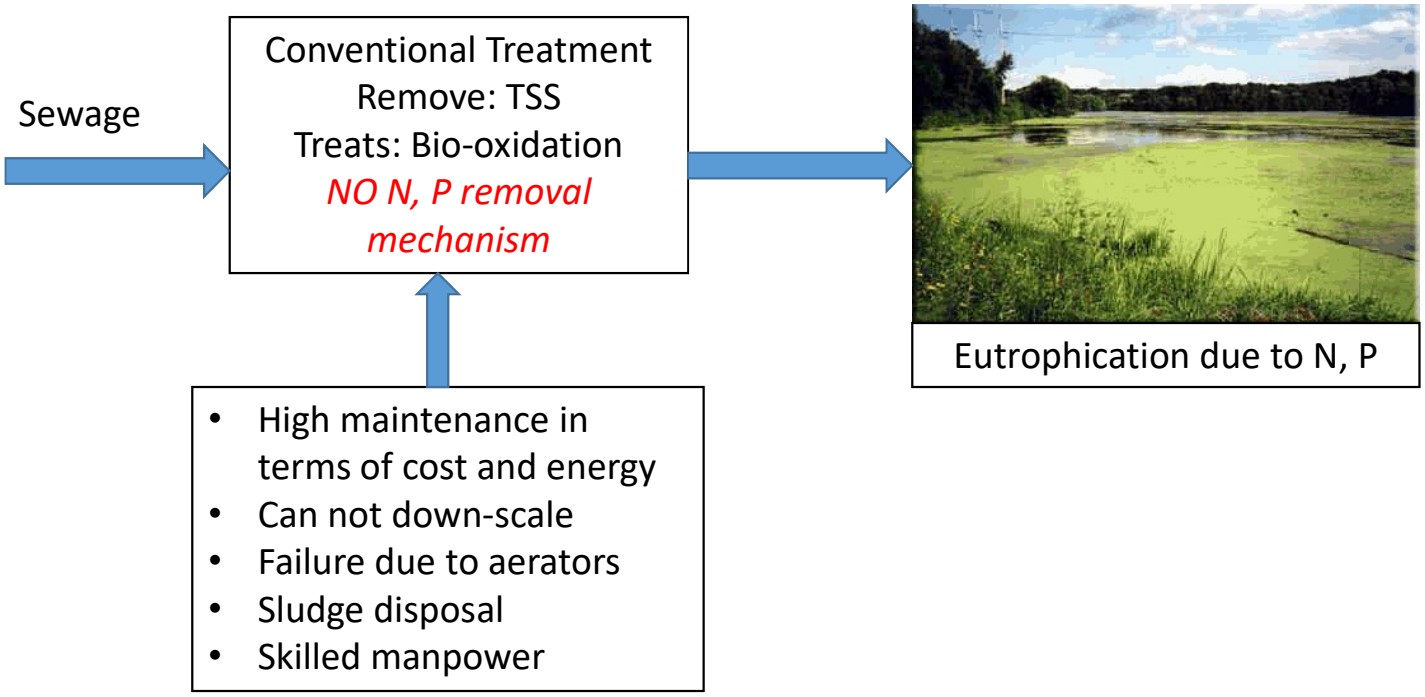
Secondary Treatment

- Biological Process removing organic pollution
- Heart of the STP
- Major portion of treatment cost

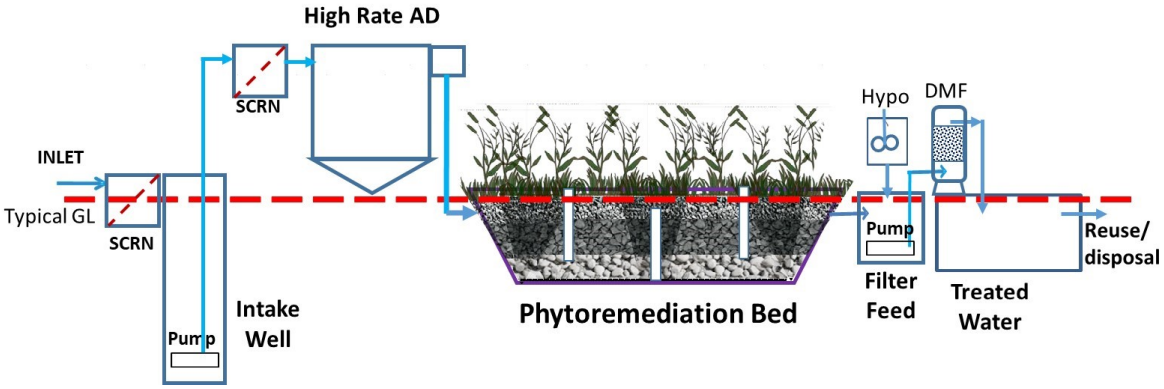
Tertiary Treatment

- Used for disinfection and final polishing filtration
- Average cost component

Challenges in conventional treatment

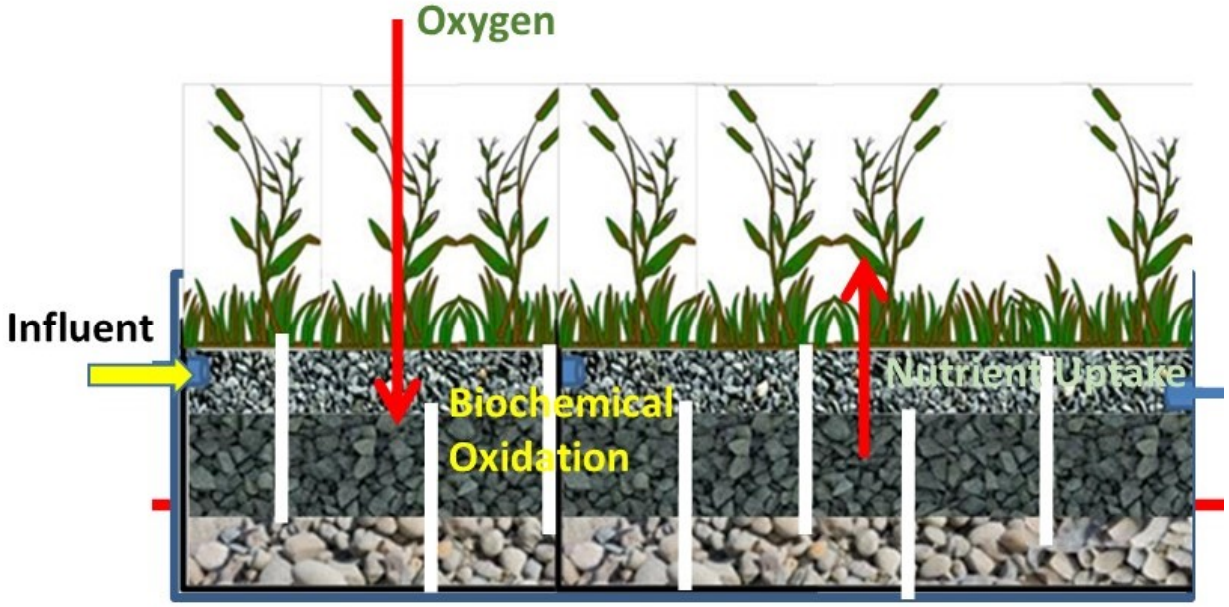


Constructed Wetland (Ecological)



For 1 MLD:
Space Required: 650 m^2
Electricity Required: 280-300 kwh/d

Contaminant Removal in Wetland (secondary treatment)

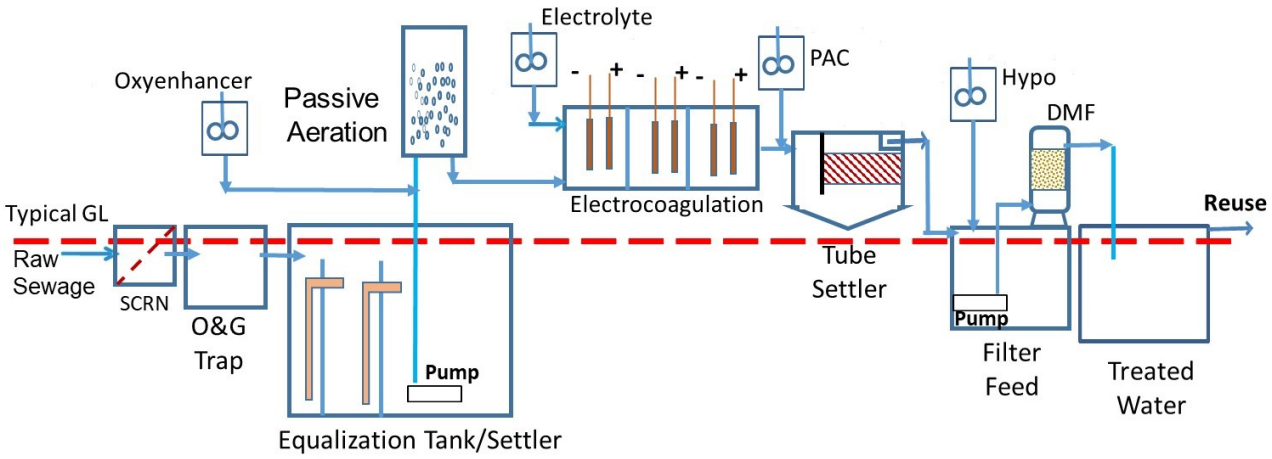


Mechanism

1) Biochemical Oxidation of organics
2) Nitrification/de-nitrification
3) Phosphate uptake
4) Anaerobic treatment zones at bottom

- **BOD reduction : $\underline{O_2}$ diffusion in liquid is limiting factor in any STP, No matter how it is supplied**
- **Improved surface area helps Mass Transfer**

Electro-coagulation: Non-biological



For 1 MLD:

Space Required: 300 m^2

Electricity Required: 350-400 kwh/d

CONSTRUCTED WETLAND TREATING NAG RIVER WATER

Raw sewage
in nallah

CW System

Treated water

ENERGY SCENARIO: CLIMATE CHANGE TO BE CONSIDERED

Sr. No.	Technology	Energy Performance Index (kWh/m^3)
1	Sequential Batch Reactor (SBR)	0.27-0.30
2	Extended Aeration (EA)	0.57-0.60
3	Intermittent Decanted Extended Aeration (IDEA)	0.85-0.92
4	Moving Bed Bio Reactor (MBBR)	0.65-0.75
5	Constructed Wetland (without tertiary)	0.12-0.18
6	Constructed Wetland (with tertiary)	0.24-0.27

With current sewage treatment capacities and treatment estimates

Sr. No.	Time line	Treatment (MLD)	CO_2 emissions (T/Yr)
1	Current (2022-24)	20500	1800000
2	Current @100% capacity	35000	3050000
3	Future 2050 @100% treatment	120000	10500000

STRATEGY - FOCUS ON 4 SECTORS FOR NON-POTABLE USE

Industries	• Power sector: 88% water demand • Pulp and paper and Textile industries • Zero Liquid Discharge – net water demand reduced	**Nagpur:** 110 MLD reuse → Power Plant
Municipal (non-potable)	• Construction : Ready mix plants i.e., RMC • Toilet flushing, gardens, parks, golf course, lakes, airports, etc.	**Nanded City Pvt. Township Pune** 22.75 MLD reuse → non-potable
Agriculture	• > 85% of water demand • 688 bcm in 2010 and 1,072 bcm in 2050	**KC valley Bangalore** 440 MLD → fill 137 tanks in draught prone districts
Environmental	• Water body rejuvenation, ground water recharge etc.	**Bangalore** Mahadevapura lake

POTENTIAL USERS - INDUSTRIAL … 1

Industrial User

- Power sector – a major consumer of water, 88% demand within industries
- Regulations restrict water usage by power plants
- Focus on Pulp and paper and Textile industries

- Zero Liquid Discharge – net water demand reduced

Industrial Sector	*Annual wastewater discharge (million cubic metres)*	*Annual consumption (million cubic metres)*	*Proportion of total water consumed in industry (per cent)*
Thermal power plants	27,000.9	35,157.4	87.87
Engineering	1551.3	2019.9	5.05
Pulp and paper	695.7	905.8	2.26
Textiles	637.3	829.8	2.07
Steel	396.8	516.6	1.29
Sugar	149.7	194.9	0.49
Fertilizer	56.4	73.5	0.18
Others	241.3	314.2	0.78
Total	30,729.2	40,012.0	100.0

Nagpur:

110 MLD of recycled water → Power Plant

Chennai :

Two TTRO plants of 45 MLD → recycled water to industries

POTENTIAL USERS – MUNICIPAL (NON-POTABLE)

- Real estate **construction sector**: Water demand 37.2 million m^3 in 2019
- **Ready mix plants i.e., RMC** : 22,46,262 cum/month in India
- **Indian Railways & Metro**: About 12,000 litres to 14,000 litres for cleaning one rake (22-24 coaches)
- Toilet flushing, gardens, parks, golf course, lakes, airports, etc.

Bangalore -Cubbon park

4 MLD → Irrigation → 177 acres of park

Revenue: INR 6.75 lakhs/month

Nanded City Township Pune

700-acre private township (30,000 residents)

22.75 MLD → toilet flushing, gardening, HAVAC and dust control

ENERGY EFFICIENCIES ACTIONS REQUIRED

- Section of technologies with lower energy footprint
- Consider constructed wetland having 50% footprint as energy for partial treatment, space may be given
- Moving away from biological methods (activated sludge) to physico-chemical, consider options as Electro-coagulation, Electro-dialysis
- Integration of renewable energy source for sewage treatment

SUMMARY: ACTIONS REQUIRED

To formulate a comprehensive action plan for implementation of **circular economy in Recycle and Ruse of Treated Municipal Sewage** built on previous studies undertaken and previous reports published

To list out the proposed actions, **identify obligations** for all stakeholders and **timelines** for transitioning to achieve circular economy

To bring out the **global and domestic best practices** and experiences, and learning from them

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