NAGPUR MUNICIPAL CORPORATION

Reuse of Sewage Treated Water by Power Plants



Agenda



01 Introduction

02 200 MLD STP based on PPP Mode

03 130 MLD STP at Bhandewadi: EPC Mode

04 Wastewater Reuse in Thermal Power Plants

05 Project Benefits

06 Additional Revenue Potential from STP

SECTION 1 OF 6

01

Introduction



01 · INTRODUCTION

Project Area

LOCATION

Nagpur, popularly known as “Orange City” – “Green City”

STATE

Maharashtra

POPULATION

3 million

AREA

227 sq. km.



Nagpur Municipal Corporation

01 · INTRODUCTION

Catchment & Sewage Generation

Water Supply

786 MLD

water supply to city

Sewage Generation

500+ MLD

Sewerage Network

3778 Km

100–2100 mm Dia.

Pollution Loads

BOD 160–240

mg/L

Projected Year	Project Population (within NMC Limit) (Lakhs)	Total Water Supply (MLD)	Sewage Generation (MLD)
2011	24	378	302
2026	30	690	552
2030	36	736	588
2044	46	1058	648
2059	59	1357	892



NORTHERN ZONE

Pioli River

Left bank tributary of Nag river



CENTRAL ZONE

Nag River

Length: 17 Km



SOUTHERN ZONE

Pohra River

Right bank tributary of Nag river

Sewage Generation vs Treatment

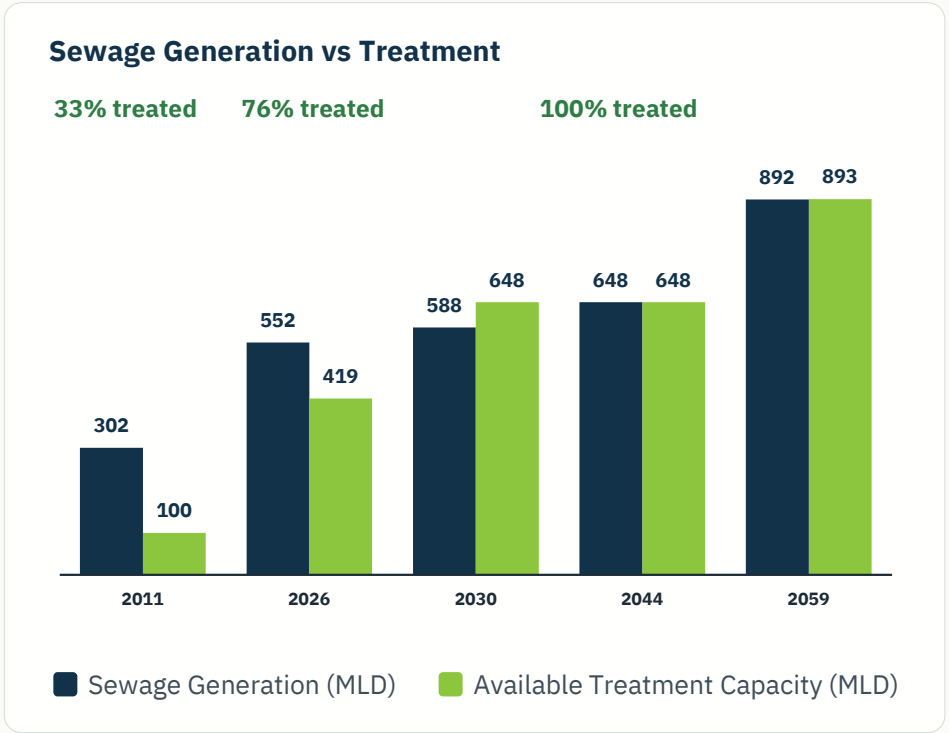
76%

Currently 76% of City's sewage generated is getting treated.

100%

By 2044, 100% of city's sewage will be treated.

Projected Year	Sewage Generation (MLD)	Available Treatment Capacity (MLD)	Plant Shortcomings: Gap (MLD)
2011	302	100	202
2026	552	419	133
2030	588	648	-
2044	648	648	-
2059	892	893	-



01 · INTRODUCTION

Types of Treatment

Overview of Primary, Secondary, and Tertiary Treatment stages in sewage treatment

Treatment Stage	Main Focus	Techniques Used	Major Output
Primary	Settleable solids, floatable	Screening, Grit Removal & Sedimentation	Removes 60% of suspended solids & 30–40% of BOD. Produces Primary Sludge
Secondary	Dissolved & suspended organic matter	Activated Sludge, Trickling Filters & Rotating Biological Contactors (RBC)	Removes 80–90% of BOD. Produces Secondary Sludge
Tertiary	Nutrients, pathogens, trace pollutants	Filtration, Nutrient Removal, Disinfection by chlorination, ultraviolet (UV) light, or ozonation, Advanced Oxidation	Reusable or discharge-ready effluent

Evolution of Treatment Capacity

2005

Bhandewadi STP	**100 MLD**

2016

1. Bhandewadi STP	**130 MLD**	2. Mokshadham	**5 MLD**
3. Mankapur	**5 MLD**		

2018

1. Bhandewadi STP	**200 MLD**	6. Kachimet	**1 MLD**
2. Somalwada-1	**20 MLD**	7. Hazari Pahad	**4 MLD**
3. Sonegaon	**0.3 MLD**	8. Dabha	**5 MLD**
4. Somalwada-2	**20 MLD**	9. Ambazari	**3.2 MLD**
5. Ita Bhatti	**10 MLD**		

2030

1. VNIT	**12 MLD**	4. Hazari Pahad	**6.5 MLD**
2. PDKV	**45 MLD**	5. Chikhali	**35 MLD**
3. Nari	**85 MLD**	6. Jaitala	**10 MLD**

2044 — EXPANSION PLAN FOR TREATMENT CAPACITY

1. Bhandewadi STP	**240 MLD**

2059 — EXPANSION PLAN FOR TREATMENT CAPACITY

1. Bhandewadi STP	**365 MLD**	6. Itabhatti STP	**13 MLD**
2. Mankapur STP	**11.6 MLD**	7. Hazari Pahad	**8 MLD**
3. VNIT STP	**17 MLD**	8. Hudkeshwar Narsala	**26 MLD**
4. PDKV STP	**55 MLD**	9. Chikhali	**80 MLD**
5. Nari STP	**110 MLD**	10. Sahakar Nagar	**17 MLD**

SECTION 2 OF 6

02

200 MLD STP based on PPP
PPP Mode

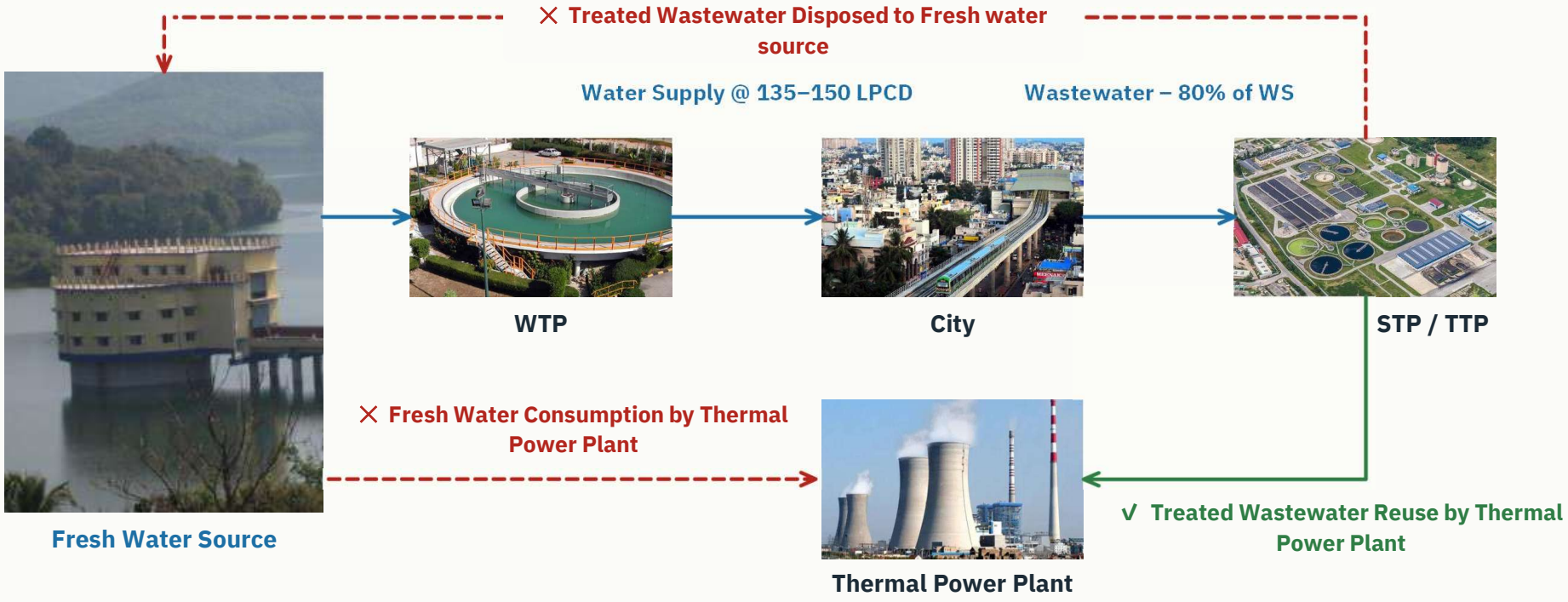
02 · 200 MLD STP BASED ON PPP MODE

Project Background ...around 2012

1. PIL was raised due to rise in pollution of city rivers due to inadequate treatment capacities.
2. High court ordered NMC to bridge the gap with immediate effect.
3. NMC initiated to increase the treatment capacity to curb the water pollution.
4. Due to fund crunch, NMC decided to go for PPP model with 100% private investment.
5. Bids were invited on PPP Model for development of 200 MLD STP at Bhandewadi through ICB.
6. Fierce competitive bidding process (RFQ - 19, RFP - 6)
7. **Vishvaraj Environment Pvt. Ltd** emerged as lowest bidder.

02 · 200 MLD STP BASED ON PPP MODE

Concept: Wastewater Reuse



02 · 200 MLD STP BASED ON PPP MODE

Key Features of 200 MLD Project

- NMC through M/s Vishvaraj Environment Pvt. Ltd. (VEPL) implemented 200 MLD STP at Bhandewadi, Nagpur.
- Project is based on Design, Build, Finance, Operate & Transfer (DBFOT) basis at Bhandewadi.
- VEPL has the rights over secondary treated water of STP.
- VEPL possess exclusive right to sell the Treated water with subject to certain royalty to NMC.

Nagpur Municipal Corporation

- Land
- Sewage
- ROW

Concession Agreement

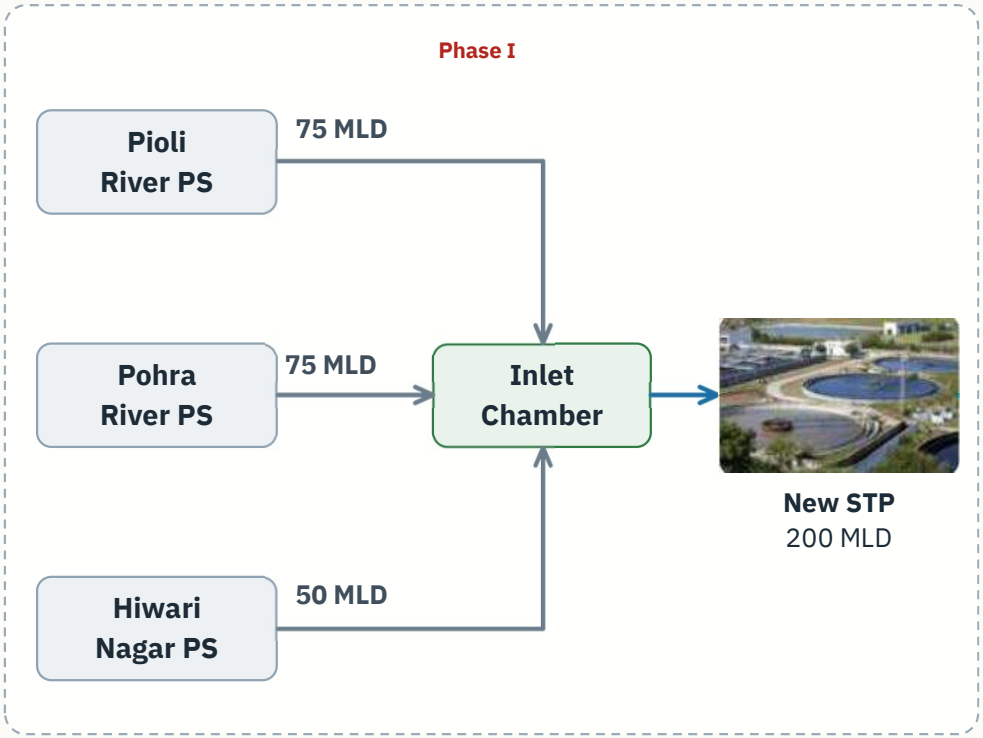
PPP Operator (Private)

- Investment
- Construction
- O&M
- Quality & Quantity Assurance

Agreement

02 · 200 MLD STP BASED ON PPP MODE

Project Scheme: 200 MLD STP



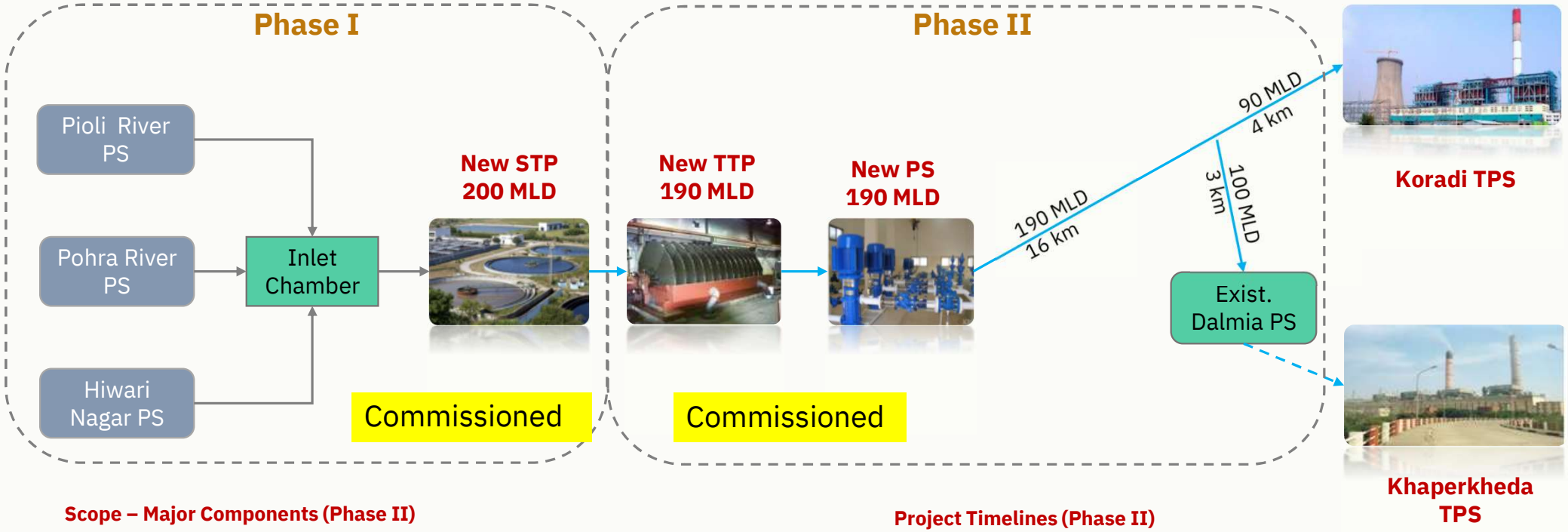
SCOPE – MAJOR PROJECT COMPONENTS (PHASE I)

Pioli River Pumping station	**75 MLD**
Pohra River pumping station	**75 MLD**
Hiwari Nagar Pumping station	**50 MLD**
Raw Sewage Pipeline	**765 mm Dia, 17 km length**
Sewage Treatment Plant	**200 MLD (SBR Technology)**
C-Tech Operation	**PLC and SCADA based**
Secondary Treated Parameters	**As per NGT Norms.**

PROJECT TIMELINES (PHASE I)

Concession period	**32 Years**
Construction	**2 Years**
O&M	**30 Years**
Commissioned on	**30th June 2018**

Project Scheme: 200 MLD STP



Scope – Major Components (Phase II)

- Tertiary Treatment Plant : Fibre Disc Filtration
- Treated Water Pumping Station : VT pumps, VFD
- Total Pipeline : 23 Km, MS pipeline.

Project Timelines (Phase II)

- Commissioned on : June 2020
- Selling Rate/KL : Rs. 20/KL
- Royalty Rate/KL : Rs. 7.09/KL

02 · 200 MLD STP BASED ON PPP MODE

Key Features of 200 MLD Project

Nagpur Municipal Corporation

- Land
- Sewage
- ROW

Concession Agreement →

PPP Operator (Private)

- Investment
- Construction
- O&M
- Quality & Quantity Assurance

Treated Water Supply →

MAHAGENCO Power Plants

- Water Purchase
- Min. take or pay guarantee

Tri-partite Water Purchase Agreement

Sr. No.	Description	Unit	Values
1.	200 MLD STP CAPEX 100% investment by (Operator) Vishvaraj Environment Pvt. Ltd.	Rs. Cr.	573 Cr.
2.	Approx. Power Consumption per day	Kwh/day	26,000

PPP Contract Structure for 200 MLD STP

Particulars	Obligation
Investment	100% by the Operator
Revenue to the Operator	• Annuity Payment by NMC through Escrow Arrangement • CAPEX Grant – Quarterly (Fixed) • OPEX Grant – Monthly (Indexed to WPI/CPI)
Rights of treated water	• With the Operator • Royalty to NMC in case of Reuse
Status	• Commissioned in 2018 • Under O&M by operator • NMC Annuity payment to Operator started

Gallery: 200 MLD STP



200 MLD STP at Bhandewadi, Nagpur (Aerial View)



Administrative Office Building

Gallery: 200 MLD STP



Fiber Disk Filters – Tertiary Treatment Module



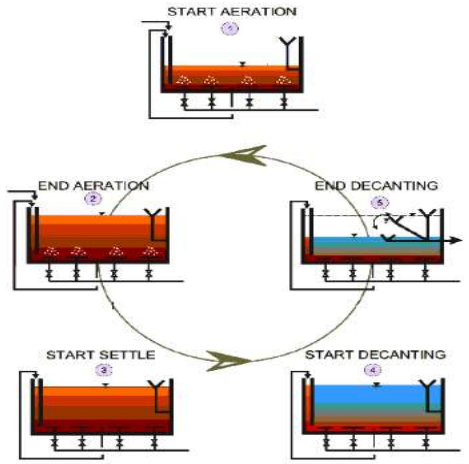
Pipeline carrying 190 MLD treated water from STP to power plant

Treatment Technology: C-Tech SBR

Sequencing Batch Reactor (SBR) Technology

- **Excellent Performance:** Treated effluent quality as per NGT Norms
- **Savings in Power Consumption:** 50% saving in power cost as compared to conventional treatment.
- **Savings in Area Requirement:** 50% lower area compared to conventional treatment.
- **Full Automation:** Controlled automatically through a PLC System

Parameters	Unit	Raw Sewage at STP Inlet	Secondary Treated Water at SBR Outlet
pH	-	6.8 – 7.8	6.8 – 7.8
BOD	mg/l	350	< 10
COD	mg/l	750	< 50
TSS	mg/l	400	< 20
Turbidity	NTU	-	< 20
TN	mg/l	35	< 10
TP	mg/l	10	< 1
Fecal Coliform	MPN/100 ml	1.6 x 10^6	< 1000
Dissolved Oxygen	mg/l	-	> 2.0
Residual Chlorine	mg/l	-	-



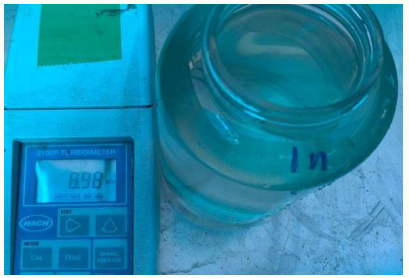
Treatment Technology: Fibre Disc Filter (FDF)

Fibre Disc Filter

- Korean Technology
- Small tank volume, compact design
- Continuous process. No downtime.
- Low backwash volume
- No air scouring required
- Ensure filtration up to 10 micron, better than sand media filtration
- Easy media replacement.



Parameters	Unit	Mahagenco's Expected Outcome	Tertiary Treated Water at TTP Outlet
pH	-	6.8 – 7.8	6.8 – 7.8
BOD	mg/l	Less than 5 mg/l	< 5
COD	mg/l		< 50
TSS	mg/l	Less than 5 mg/l	< 5
Turbidity	NTU	Less than 5 NTU	< 5
TN	mg/l	Less than 10 mg/l	< 10
TP	mg/l	Less than 0.5 mg/l	< 1.0
Fecal Coliform	MPN/100 ml	Less than 1000 MPN/100 ML	< 100
Dissolved Oxygen	mg/l	More than 2.0 mg/l	> 2.0
Residual Chlorine	mg/l	0.2 to 0.5 mg/l	0.2 – 0.5



FDF Inlet Turbidity = 8.98 NTU



FDF Outlet Turbidity = 0.98 NTU

SECTION 3 OF 6

03

130 MLD STP at Bhandewadi: EPC Mode

03 · 130 MLD STP AT BHANDEWADI: EPC MODE

130 MLD STP Bhandewadi

- The 130 MLD Sewage Treatment Plant is a Joint Project of Nagpur Municipal Corporation (NMC) & MAHAGENCO.
- MAHAGENCO signed the Memorandum of Understanding (MOU) with NMC in support of NMCs to supply treated wastewater from STP as water linkage to meet additional demand at TPS at Koradi.
- MahaGenco to pay royalty of **Rs.15 Cr./ year with escalation of 10% every 3 years** to NMC against the supply of raw sewage to STP and re-use of treated sewage in MahaGenco's Koradi Thermal Power plant.
- STP project is based on EPC Contract including 10 Years of O&M.
- This resulted in an environment friendly solution to city of Nagpur by abetting the pollution of city rivers by NMC.

Pumping Station 130 MLD on Nag River @ Hiwari PS → **130 MLD STP (SBR Tech.)** → **Rapid Gravity Sand Filter** → **Treated water Reuse** →



Koradi TPS

Treatment Technology: Rapid Sand Filter

Rapid Sand Filter

- Conventional Technology
- High Flow Rate
- Effective Suspended Solid deduction.
- Clear and more Transparent Effluent
- Effective Particle & Pathogen Removal
- Cost Effective for large scale tertiary treatment facility



Parameters	Unit	Mahagenco's Expected Outcome	Tertiary Treated Water at TTP Outlet
pH	-	6.8 – 7.8	6.8 – 7.8
BOD	mg/l	Less than 5 mg/l	< 5
COD	mg/l	-	< 50
TSS	mg/l	Less than 5 mg/l	< 5
Turbidity	NTU	Less than 5 NTU	< 5
TN	mg/l	Less than 10 mg/l	< 10
TP	mg/l	Less than 0.5 mg/l	< 1.0
Fecal Coliform	MPN/100 ml	Less than 1000 MPN/100 ML	< 100
Dissolved Oxygen	mg/l	More than 2.0 mg/l	> 2.0
Residual Chlorine	mg/l	0.2 to 0.5 mg/l	0.2 – 0.5

Details: Royalty to NMC

Financial Year	Unit	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
200 MLD Bhandewadi Phase I									
Annual Grant	Rs. Cr.	-42.3	-55.7	-53	-51.5	-53.1	-54.56	-55.02	-53.71
200 MLD STP Phase II									
Royalty Received from Phase II (Sale of Water)	Rs. Cr.	-	-	38.5	45.6	47.2	48.52	49.03	48.47
Royalty Received from 130 MLD Plant (Sale of Water)	Rs. Cr.	15	16.5	16.5	16.5	18.15	18.15	18.15	19
Net Amount to NMC	Rs. Cr.	-27.3	-39.2	-2	10.6	12.25	12.11	12.16	13.76

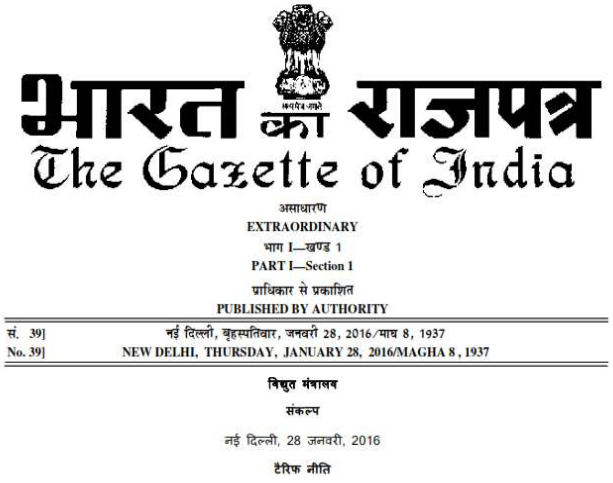
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04

Wastewater Reuse in Thermal Power Plants

Mandate for Reuse

The **thermal power plant(s) including the existing plants** located **within 50 km radius of sewage treatment plant** of Municipality/local bodies/similar organization shall in the order of their closeness to the sewage treatment plant, **mandatorily use treated sewage water produced by these bodies and the associated cost on this account be allowed as a pass through in the tariff.** Such thermal plants may also ensure back-up source of water to meet their requirement in the event of shortage of supply by the sewage treatment plant. The associated cost on this account shall be factored into the fixed cost so as not to disturb the merit order of such thermal plant. The shutdown of the sewage treatment plant will be taken in consultation with the developer of the power plant.



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संकल्प

नई दिल्ली, 28 जनवरी, 2016

टैरिफ नीति

Reuse Details: Treated Water

STP REUSE RATE

20 Rs.

/ KL of Treated Water supplied

Water rate for reuse of treated water depends on:

1. Quality of treated water required by Power Plants.
2. Quality of sewage available at STP inlet.
3. Power charges in the city
4. Scalability (volume of water supplied)
5. Distance between STP & Power Plants

Thermal Power Plants: Details

THERMAL POWER PLANT IN NAGPUR CITY

Location	Capacity of Power Plant
Koradi	3 x 660 MW
	2 x 660 MW (Upcoming)
Khaperkheda	2 x 210 MW
	1 x 500 MW
Total Existing Capacity	2900 MW
Upcoming Capacity	1320 MW

WATER CONSUMPTION LIMIT FOR THERMAL POWER PLANTS

Description	Water Consumption
Existing Cooling Tower (CT) based Plants	Up to maximum of 3.5 m^3/MWh
New Plants installed after 1st Jan 2017	Up to maximum of 2.5 m^3/MWh along with ZLD system



Khaperkheda Thermal Power Station



Koradi Thermal Power Station

Thermal Power Plants: Details

WATER REQUIREMENT BREAK UP FOR POWER PLANTS

Process	Water Required (%)
Makeup water for Cooling Tower	75 – 80%
Water for Ash Handling	10%
Cycle Makeup water, Wash water, Service & Potable water, etc.	10%

REQUIRED & AVAILABLE WATER FOR COOLING TOWER AT NAGPUR

Description	Unit	Existing Capacity (Values)
Available Capacity of Power Plant (Nagpur City)	MW	2900
Water Requirement	MLD	300
Currently Water provided through Bhandewadi STPs	MLD	190 + 110 = 300 MLD

SECTION 5 OF 6

05

Project Benefits

05 · PROJECT BENEFITS

Benefits, Replicability and Scalability ...1

Nagpur City

- Additional 30 Crs. litres per day of fresh water
- Helps in increasing the water reservation for drinking purpose.
- Future demand for next 15 years is fulfilled.
- No new dam needed – saving investment, land, project affected people (PAP)

Nagpur Municipal Corporation (NMC)

- Zero investment (Capex/Opex by operator being paid through sale of treated water)
- Ensured quality treatment
- Less pollution / Improved health

Power Plants (MAHAGENCO)

- Secured source of water
- No upfront investment – entire construction / quality risk transferred to operator
- Pass through tariff – no financial burden

Largest Reuse
project

Resulted in National Policy
mandatory use for power plants

Water for 16 Crs. citizens
This can pave way for 8,000 MLD of reuse by power plants in India

05 · PROJECT BENEFITS

Benefits, Replicability and Scalability ...2

For Irrigation (Swapping Model)

- Concept Overview**:** Swapping Mechanism Under the swapping model,
- Additional Treated wastewater from STPs is conveyed to nearby irrigation command areas.
- In return, the equivalent quantity of freshwater originally allocated for irrigation from nearby dams is reserved and supplied to the city.

- This dual-benefit approach ensures:

- 100% reuse of treated sewage water
- Conservation of high-quality reservoir water for potable use
- Compliance with CPHEEO/CPCB/NGT directives on zero discharge
- Strategic substitution during seasonal fluctuations (e.g. monsoon vs. non-monsoon)

> *Central/ State Government intervention in framing and implementation of Policy is desired*

SECTION 6 OF 6

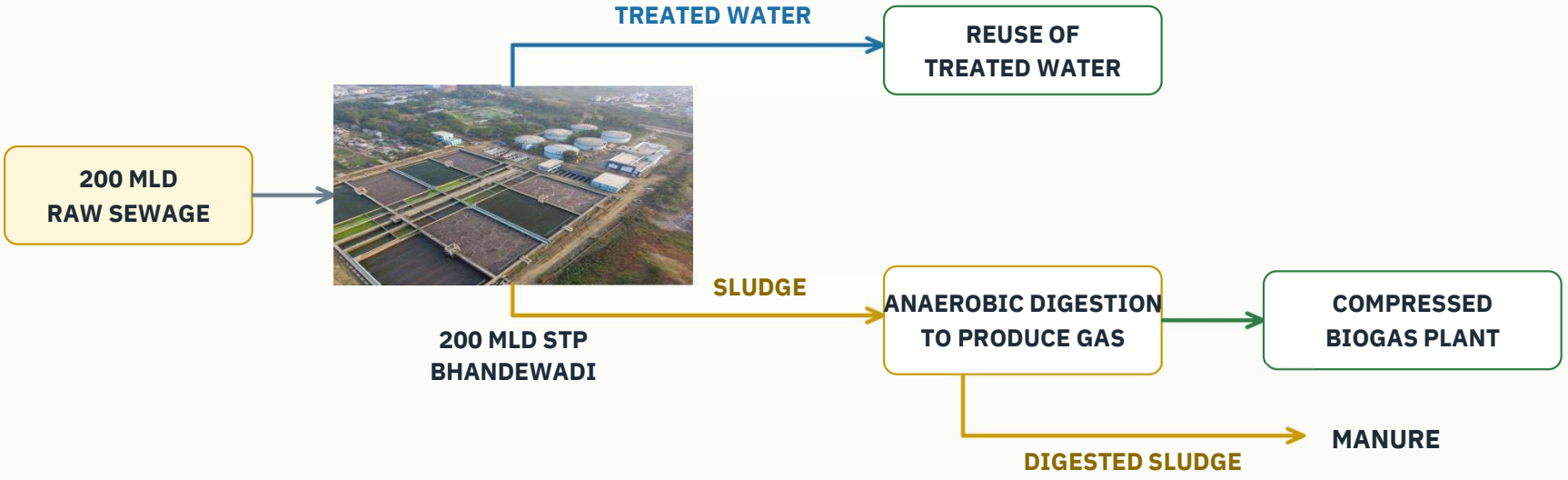
06

Additional Revenue Potential from STP

Additional Revenue Potential from STP

STP WASTEWATER & SLUDGE TREATMENT

- TREATED WATER REUSE TO POWER PLANTS
- SETTING UP CBG PLANT



A CLOSER VIEW TO THE BHANDEWADI 200 MLD STP





Thank You

NAGPUR MUNICIPAL CORPORATION