Energy Efficient Urban Waste Water Treatment using Phytorid

At Center of India: Nagpur

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Urban Waste Water Management

Sources

- Municipal/domestic waste water
- Strom water discharges
- Hotel and Offices
- Agricultural runoff
- Landfill leachates
- Industrial wastewater

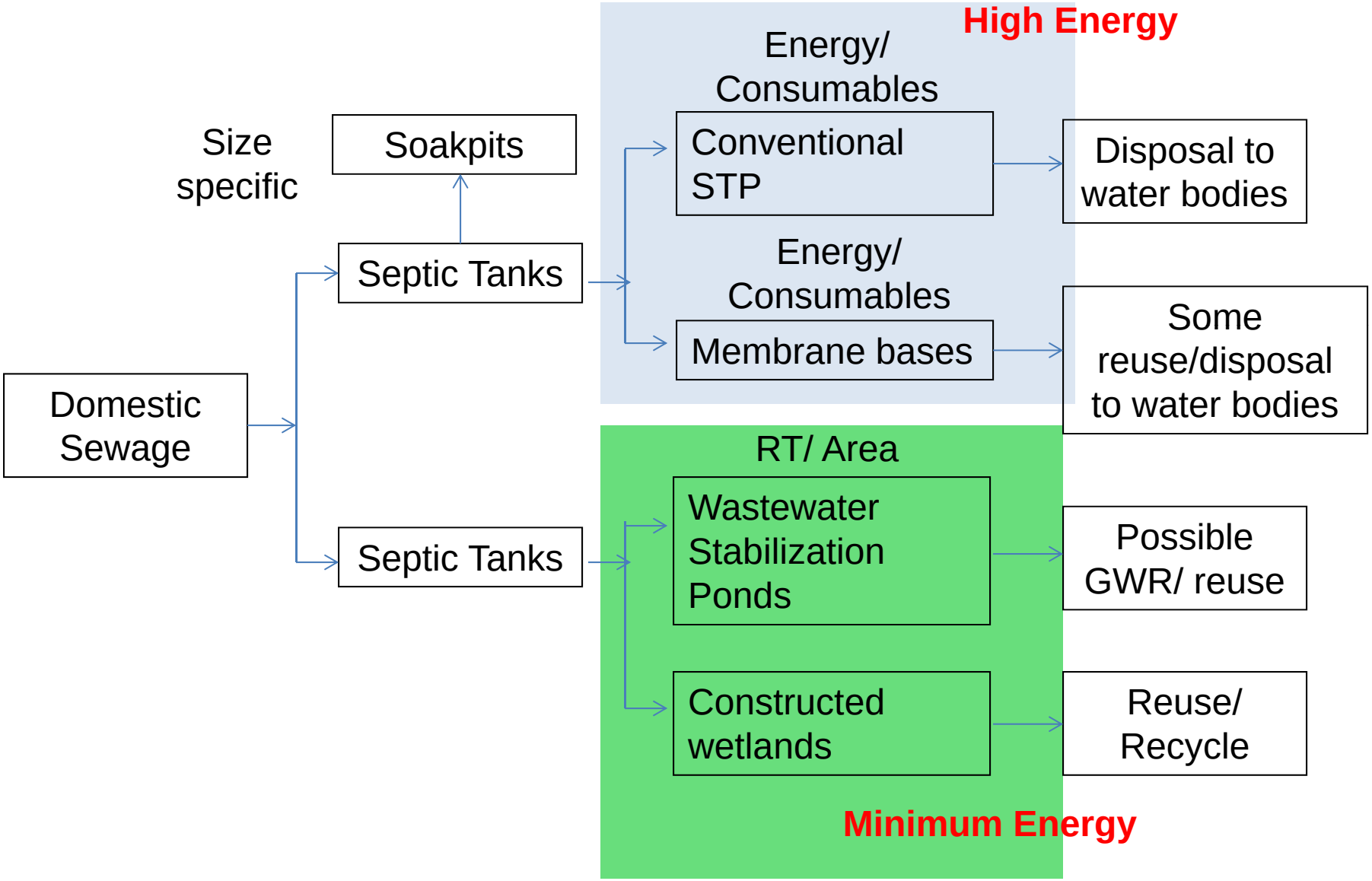
Impact

- Ground water pollution
- Eutrophication of lakes and other water bodies
- Degradation of river water quality
- Impact on public health

Treatment

- Reuse/recycle
- Avoiding contaminations in water bodies
- Decentralized approach for reducing pressure on civic bodies

Methods, Issues, solutions



Energy Minimization though Decentralized treatment

- Improve reachability, reduce the need for sewage transportation system
- Allowing use of the treated water in-situ
- Minimizing pumping, transportation, thus energy efficient
- Smaller systems technically empowering the smaller LUBs
- Treatment where it is needed

Challenges in conventional treatment

Sewage

Conventional Treatment
Remove: TSS
Treats: Bio-oxidation
NO N, P removal mechanism

Eutrophication due to N, P

- High maintenance in terms of cost and energy
- Can not down-scale
- Failure due to aerators
- Sludge disposal
- Skilled manpower

Phytorid: Paradigm Shift in Technological Solution

Command and Control

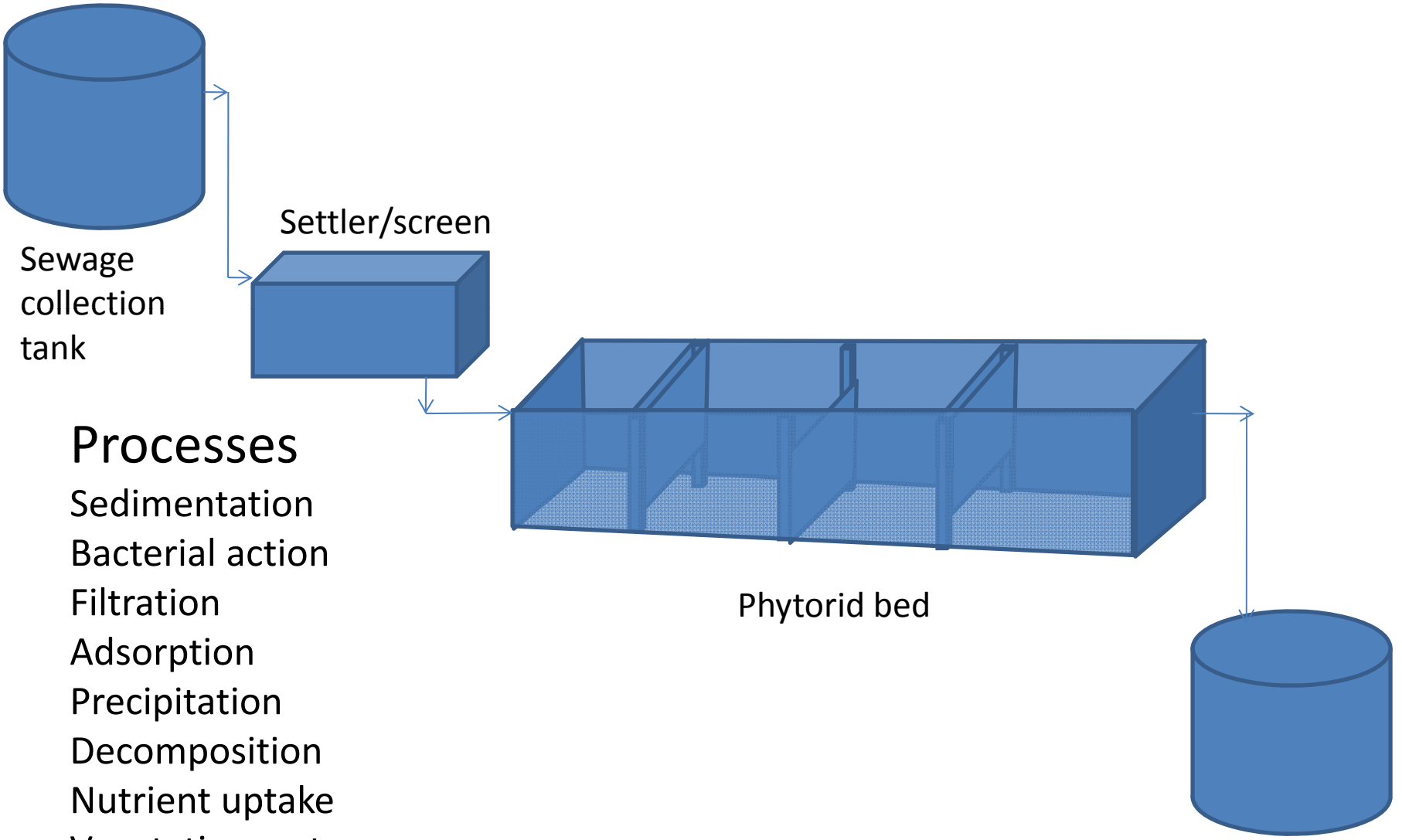
Ecosystem Based

Trade-off between space and energy

NEERI's PHYTORID
A Constructed Wetland System

- Based on 5 years of intense R&D in lab, pilot
- Now more than 7 years of field experience of plants
- Innovation based on:
  - Our climate
  - Our needs
  - Our cost issues
  - O&M practices
- International Patents:
  - Australian Patent
  - European Patent
  - Indian Patent

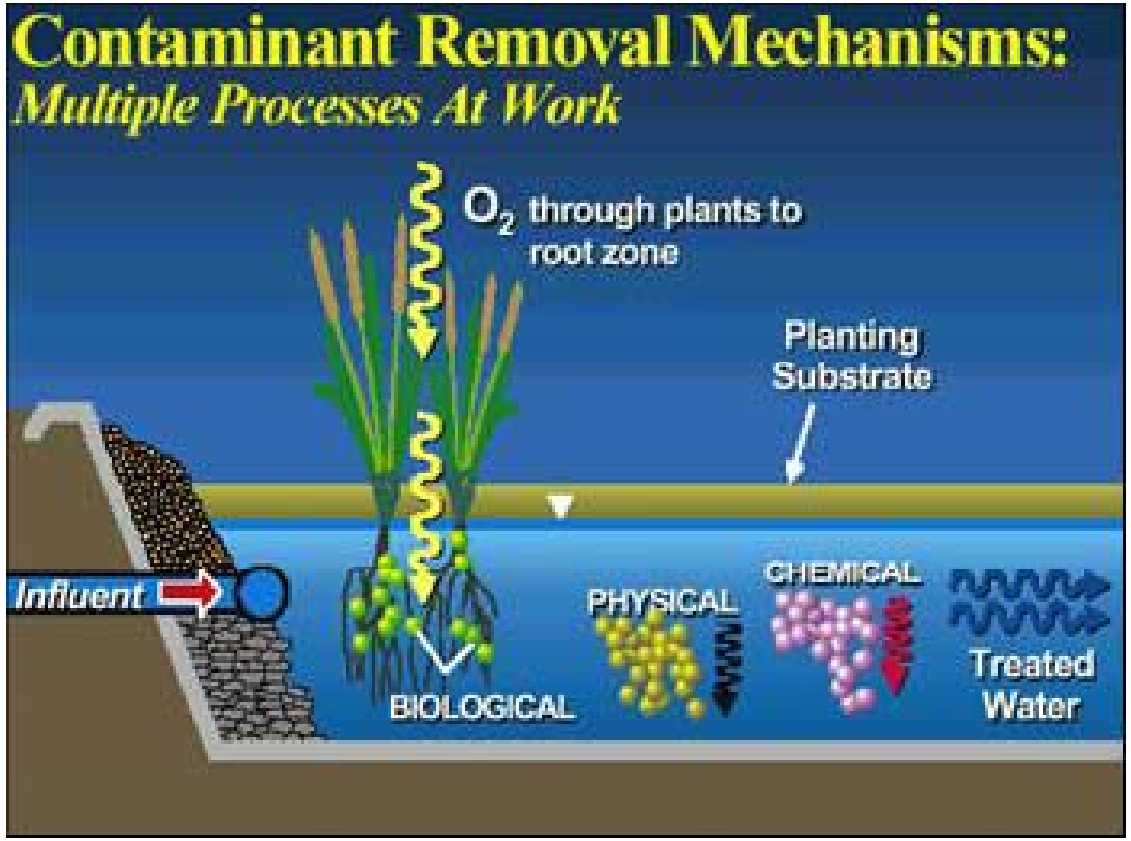
Components of PHYTORID system



Processes

Sedimentation
Bacterial action
Filtration
Adsorption
Precipitation
Decomposition
Nutrient uptake
Vegetation system

Phytorid Details



Mechanism

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

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

Design Approach

- Operating windows for sewage, parameters
- Source based selection of unit operations
- Space availability and levels
- Proximity of end use of treated water
- Quality of water required
- Soil strata
- Design of plant, conceptual, structural and asthetics

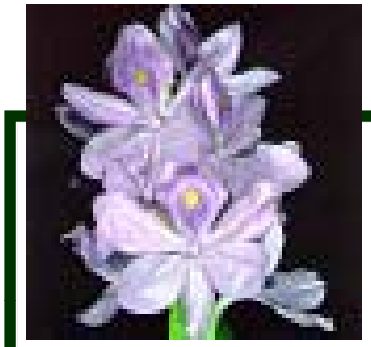
TYPICAL DESIGN FEATURES FOR WETLAND SYSTEM

Design Factor	Surface Water Flow	Sub Surface Water Flow	Phytorid Sewage
Minimum Surface Area	105-523 ac/mld	10.5 –210 ac /mld	3-4 ac/mld
Maximum Water Depth	Relatively shallow	Water level below ground surface	Water below gravel system
Bed depth	Not applicable	>1 m	>2.5 m
Minimum hydraulic residence time	7 days	7 days	1-2 days
Minimum pretreatment	Primary (secondary optional)	Primary	Primary

Typical Performance Characteristics for Various Treatment Methods

Sr.	Items	Conventional activated sludge	UASB	Extended Aeration	Facultative Aerated Lagoons	PhytoRid Technology
1	Performance BOD Removal %	85-92	75-78	95-98	75-85	80-95
2.	Sludge	First digest then dry on beds or use mech devices	Directly dry on beds or use mech devices	No digestion dry on sand beds or use mech devices	Mech. Desludging once in 5-10 years	Negligible
3.	Equipment Requirement (excluding screening and grit removal common to all processes)	Aerators, recycle pumps, scrappers, thickeners, digesters, dryers gas equipment	Nil except gas collection and flaring gas conversion to elect is optional	Aerations, recycle pumps sludge, scrappers for large settlers	Aerators only	None, all flows by gravity
4.	Operational Characteristics	Skilled operation reqd.	Simpler than ASP	Simpler than ASP	Simple	Unskilled operator
5.	Special features	Considerable equipment and skilled operation reqd specially when gas collection and usage considered	Minimal to negligible power reqd. makes it economical at even if gas revenue is neglected	BOD removal highest effluent nitrified high power reqd. Favoured for small and medium plants	Power reqd. similar to ASP operation simpler	Plant species and odour less operations

Various Plant Types



Forage Kochia	*Kochia spp*
Poplar Trees	*Populus spp*
Willow Trees	*Salix spp*
Alfalfa	*Medicago sativa*
Cattail	Typha latifolia
Coontail	*Ceratophyllum demersum L*
Bullrush	Scirpus spp
Reed	*Phragmites spp.*
American pondweed	*Potamogeton nodosus*
Common Arrowhead	*Sagittaria latifolia*

ADVANTAGES

- Cost-effective
- Operation and maintenance expenses are negligible.
- Minimum electricity requirement, nearly fossil energy free
- Smaller footprint (Retention time: Typically less than 24 hrs.)
- Facilitates recycle and reuse of water
- No foul odor and No Mosquito Nuisance.
- Tolerates fluctuations in operating conditions such as flow, temperature and pH

APPLICATION

PHYTORID **system is useful for treatment of waste water in following applications**

- **Domestic wastewater (including decentralized Municipal waste water treatment)**
  - **Colonies, Airports, Commercial complexes, Hotels**
  - **Open drainage**
  - **Cleaning of nallah water**
- **Agricultural wastewater**
- **Dairy waste**
- **Slaughter House Waste**
- **Fish pond discharges**
- **Pre treated industrial wastewater, Sugar Industries**
- **Municipal Landfill leachates**
- **Several other applications**

Phytorid Treating Nag River Water

Raw sewage
in nallah

Plant at Agricultural college, PKV Nagpur
Plant Capacity 100 m^3/day

Phytorid System

Treated water

Performance of PHYTORID for Sewage typical results

Parameter	Inlet sewage quality	Treated water quality	Standards for inland surface water	Standards Land Irrigation
pH	7.1 to 7.5	7.2	5.5-9.0	5.5-9.0
Biochemical Oxygen Demand (mg/L)	40 to 130	<5	30	100
Chemical Oxygen Demand (mg/L)	130 to 350	< 12-18	250	Not Specified
Total Suspended solids (mg/L)	80 to 90	< 15	100	200
Fecal Coli Farm (MNP/100ml)	10^6 to 10^7	<20	---	---
Nitrogen (mg/L)	10 to 50	4-5	5	Not Specified
Phosphate (mg/L)	10 to 50	1-4	5	Not Specified

GREEN POINTS

- Best Adoptable technology for in-situ treatment and reuse of waste water
- Phytorid Technology carryout on-site treatment and reuse of grey water up to 95%, which would attract total of 5 credits on Indian Green Building Certification (IGBC).

AESTHETICS

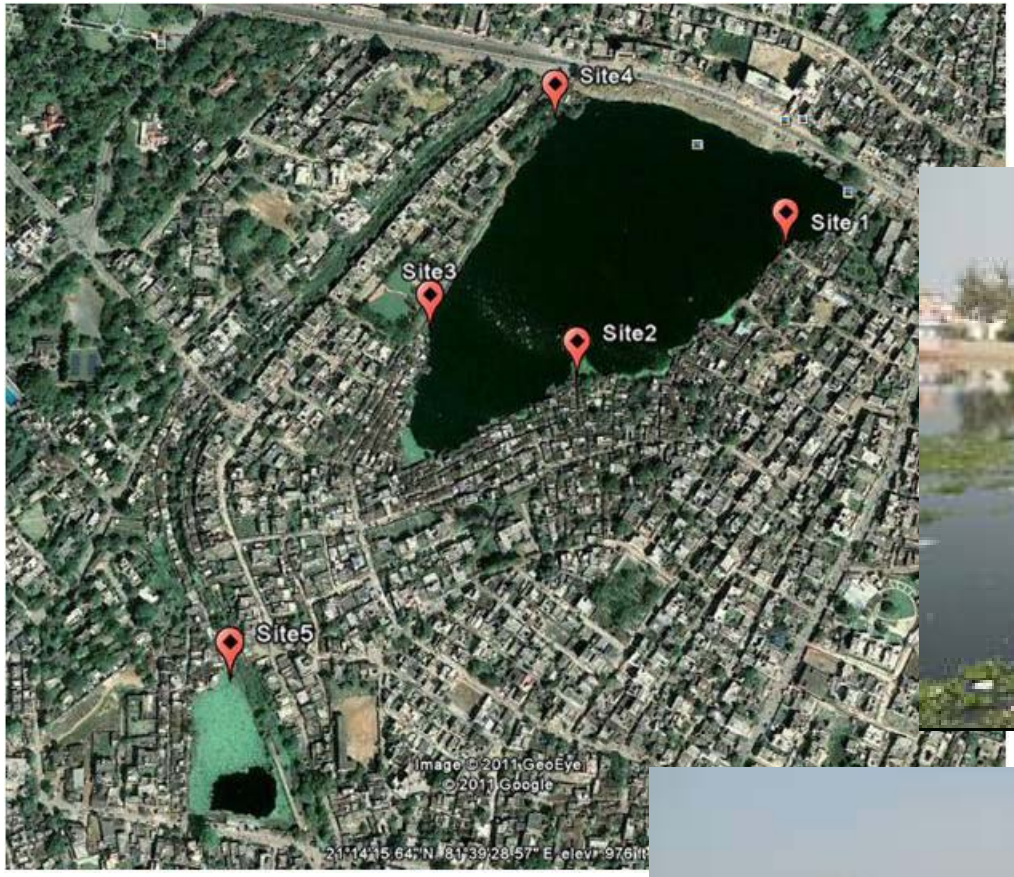
5 lakh liter/day

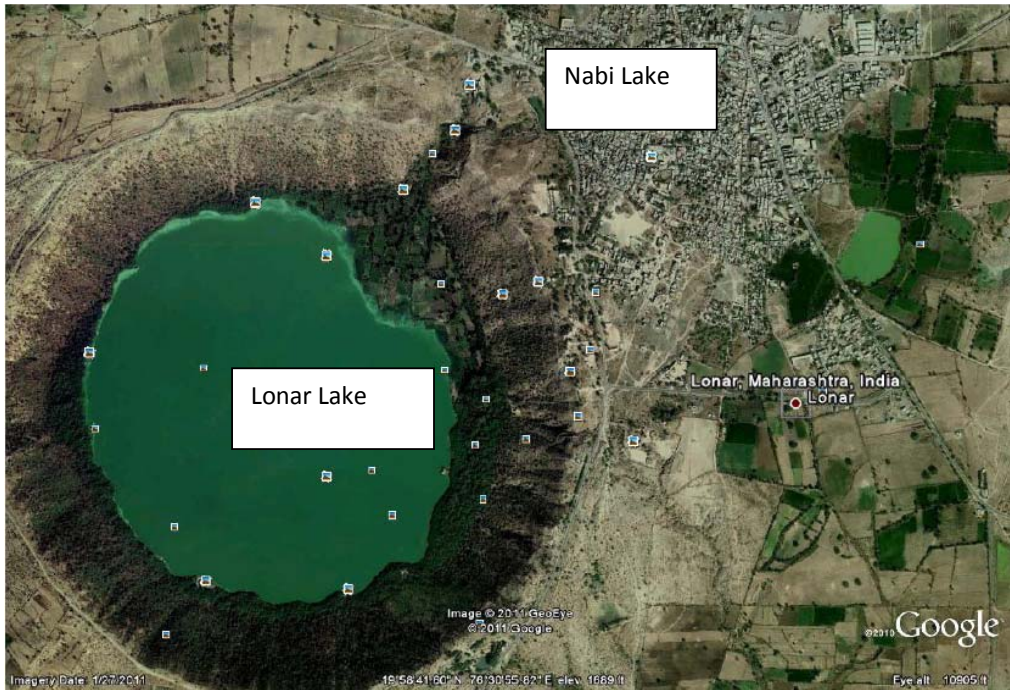
Payback in 2 years


Clear Water !!!

Phytorid 750 KLD

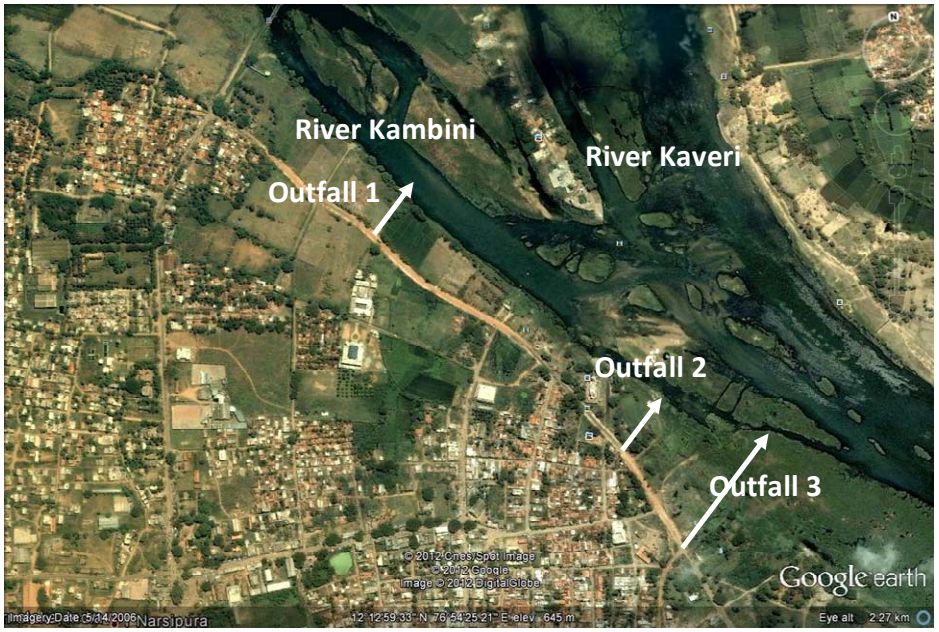
Telibandha Lake, Raipur





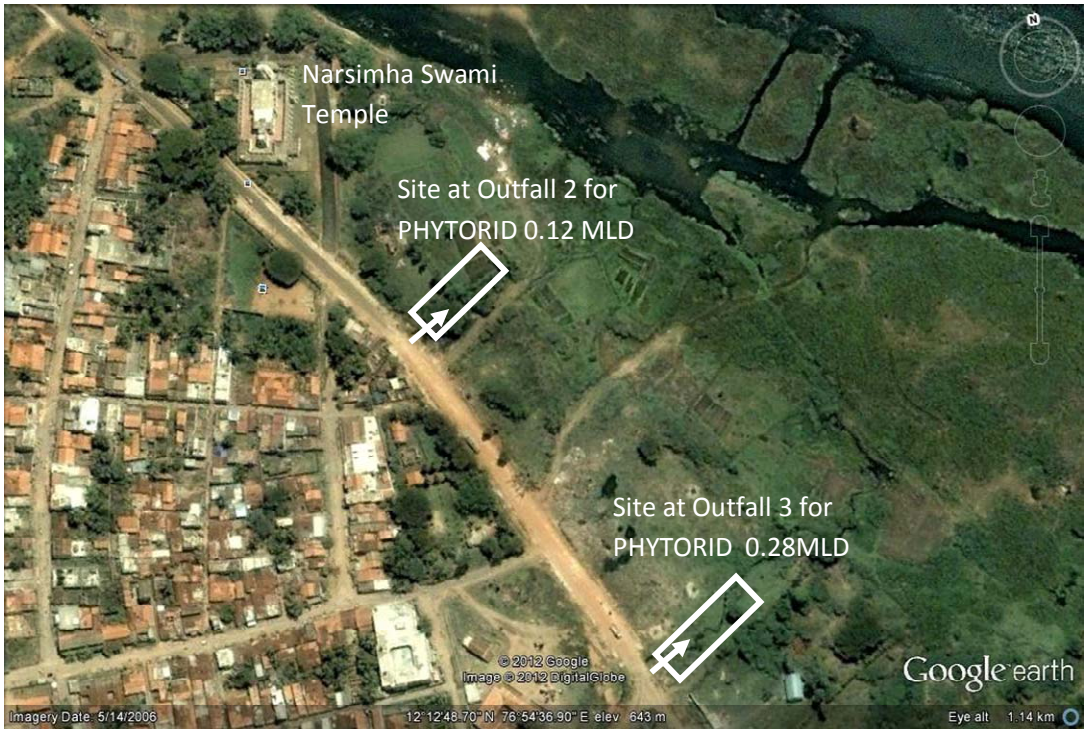
Under Consideration

Lonar Lake, Maharashtra



Under Consideration

T. Nasripura, Mysure



Conclusions

- Constructed wetland is the needed innovative technology: Ecologically benign
- Nearly free of fossil based energy therefore sustainable and doable
- Cost effective in terms of O&M is most important factor

Thank You

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