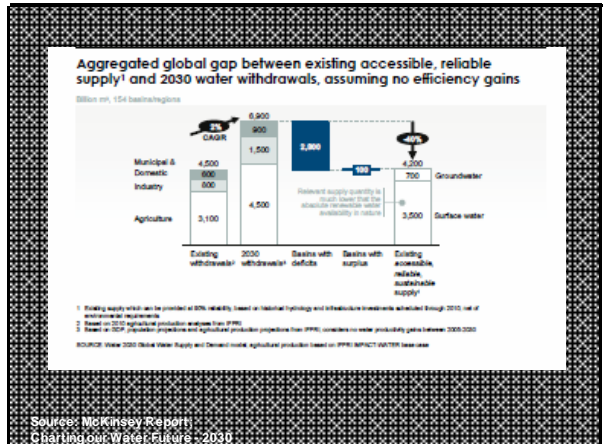


Recycle & reuse - Guiding principle

Water of higher quality should not be used for application that can tolerate inferior quality.

United Nations - 1956

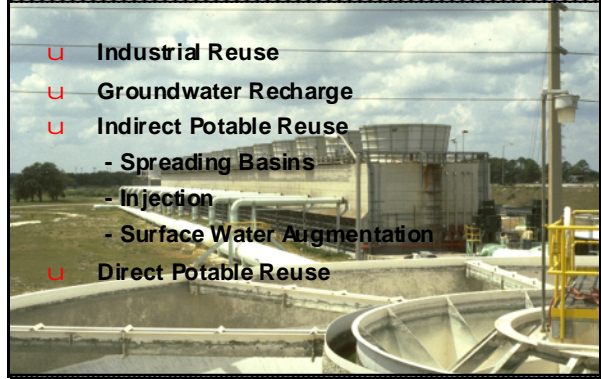


Important Issues to be Address

- ❑ The Problem
- ❑ Source Water Quality
- ❑ Regulatory and performance compliance
- ❑ Contingency planning
- ❑ Distance of bringing raw water
- ❑ Pumping head required and cost of producing the treated water
- ❑ Subsidy issue - Industrial v/s domestic costs
- ❑ Conflict
- ❑ Policies
- ❑ Perception, Risk and Branding

Reuse Categories (continued)

- U Industrial Reuse
- U Groundwater Recharge
- U Indirect Potable Reuse
 - Spreading Basins
 - Injection
 - Surface Water Augmentation
- U Direct Potable Reuse



Reuse Categories

- U Unrestricted Urban Reuse
- U Restricted Urban Reuse
- U Agricultural Reuse for Food and Non-Food Crops
- U Recreational Impoundments
- U Intrusion Barrier
- U Environmental Wetlands



Recycle and Reuse - Balancing Act

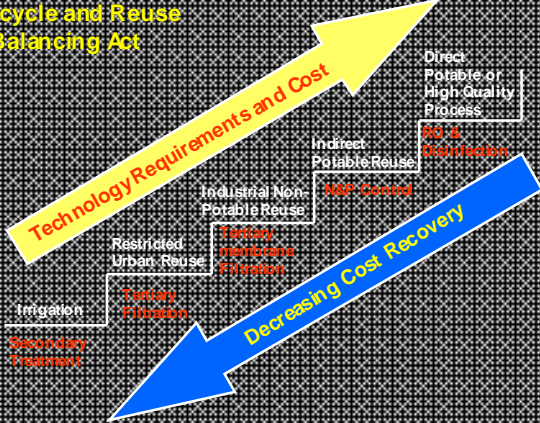
Technology Requirements and Cost

100% Cost

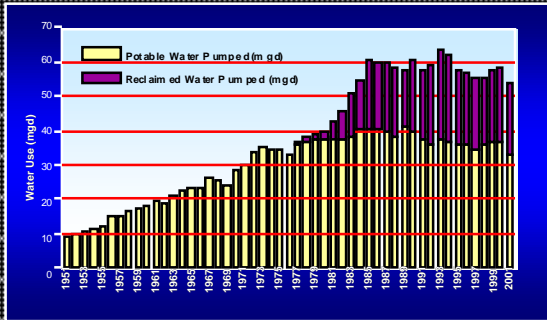
75% Cost

50% Cost

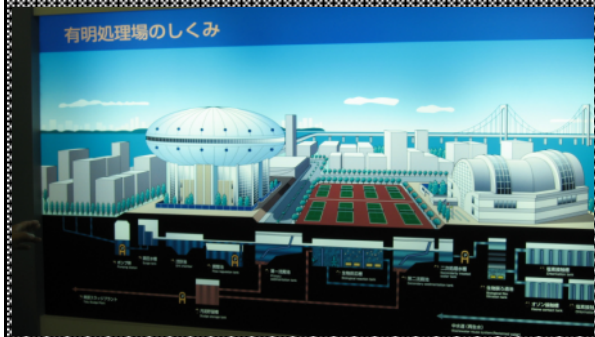
25% Cost



**Potable and Reclaimed Water Usage
City of St. Petersburg, FL (20 mgd - 75 MLD)**



**Ariake Wastewater Treatment Facility
Tokyo Metropolitan Water Authority**



NEWater Factories in Singapore

Total Capacity: 92,000m³/day

Supply to industrial/commercial sectors

10% potable water supply is reclaimed water



Water Issues Facing India

- ❖ Drought - scarcity of surface water throughout the region
- ❖ Unsustainable water use practices - NRW/OEW
- ❖ Depleting groundwater resources/salinity intrusion
- ❖ Insufficient infrastructure for waste management



Worldwide Daily rates of Water Reuse

Country	Daily Rate of Water Reuse (%)	Reference
Australia	20%	McDonald, Bales, et al. (2001)
Belgium	2%	Wolff, Khandajanian (2001)
China	1.5%	Wang, et al. (2001)
Spain	0.5%	Alcalá, (2000)
Italy	0.8%	Battaglia Rossi, et al. (2001)
Japan	0.4%	Shimizu, et al. (2000)
Korea	2.2%	Choi and Shin (2001)
Mexico	1%	Shelton (2001)
China	0.3%	Chen, et al. (2001)
USA	0.1%	Chen, et al. (2001)
Spain (waste)	0.4%	Chen, et al. (2001)
China (waste)	0.1%	Chen, et al. (2001)
USA (waste)	0.1%	Chen, et al. (2001)
Japan	0.1%	Shelton (2001)

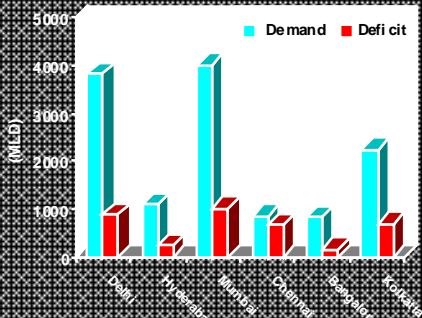
Source: WERF Wastewater Reuse Document - 2004

Water Issues Facing India

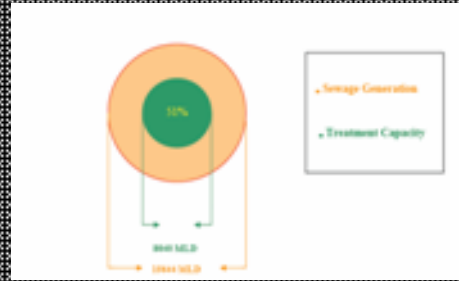
- ❖ Fire Fighting - projects under execution to bring water from distances in excess of 200 Km and above
- ❖ Unsustainable practices to cope with the demand (conveyance through rail and road)
- ❖ Scarcity of resources
 - ❖ hamper urban development
 - ❖ as well as public health



Water Demand and Deficit Scenario in Metropolitan Cities

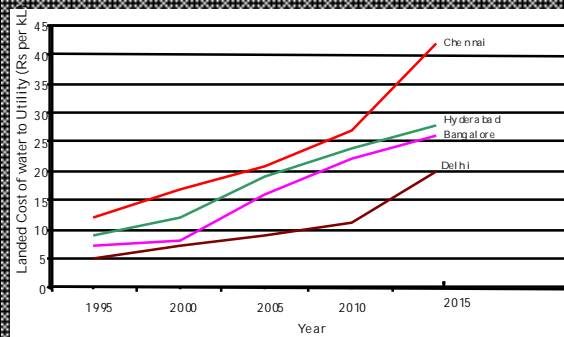


Sewage Generation and Treatment Capacity in Metropolitan Cities in India



Source: CPJ Research Services (2008) in State of Water Supply, Wastewater Generation and Treatment in Major Cities of India

Trends in Water Cost - India

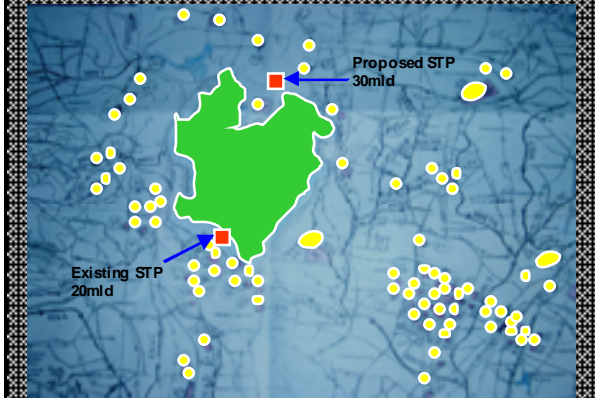


Case Study - Hyderabad Project

- Feasibility study on wastewater recycling for Hyderabad
- Development of Number of Recycle and reuse options with Technical, Economical, Environmental Analysis
- SWAP (Freshwater in exchange for recycled water for agricultural under consideration by Govt. of A.P.)



Locations of Potential Consumers



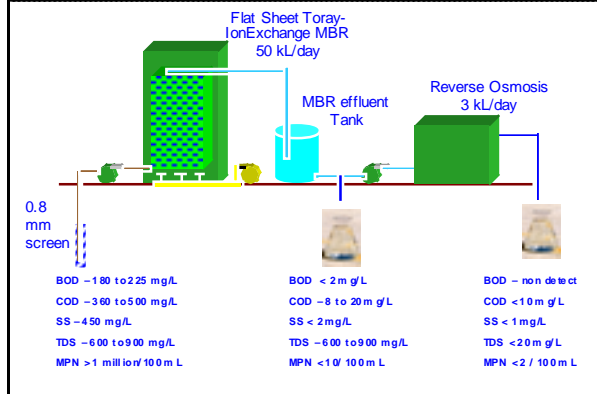
Recycling prospects for Okhla

- Improved quality to existing end users
(26 MGD plant)
- New prospective end users
 - plant capacity 2.1MGD based on demand assessment
 - Okhla industrial area
 - Nearby hospitals (Apollo, Escorts)
 - Construction, non-potable use eg. Vehicle washing
 - Upcoming townships
 - Landscape irrigation in nearby areas
 - Industrial cooling water at NTPC's power plant in Badarpur (special case, discussed separately)

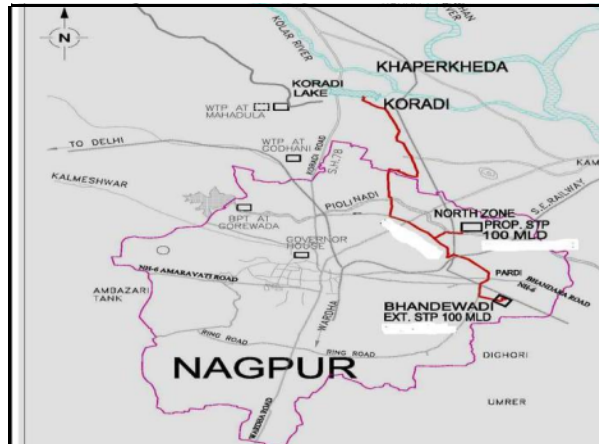
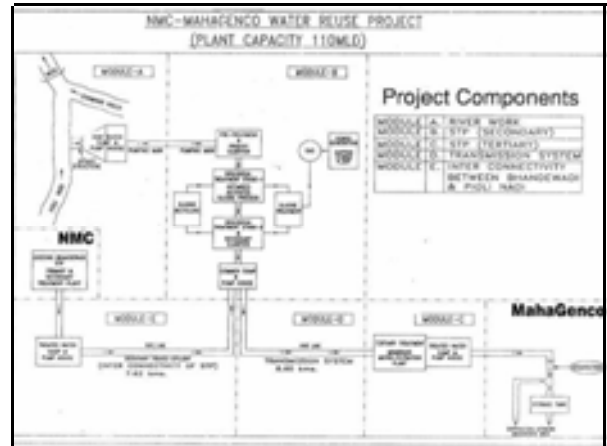
Case Study - Delhi Jal Board

- To evaluate technologies to retrofit existing 30.1MGD portion of Okhla STP for recycle and reuse of wastewater for non-potable applications
- Performance assessment of the 30.1MGD facility
- Define recycled water quality goals
- Identify suitable technologies
- Technology evaluation
- Recommendations

MBR & RO/NOI Performance



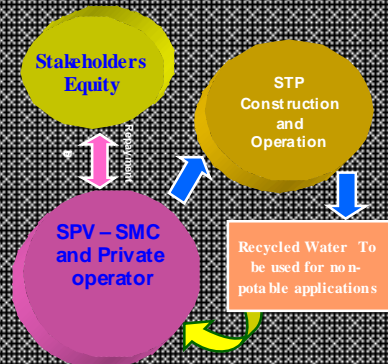
Case Study Nagpur Project – Reuse of Wastewater for Non-potable applications



US Filter – Triveni Engineer's Pilot – Nagpur Case Study



Suggested Financial Model for PPP - Project Implementation

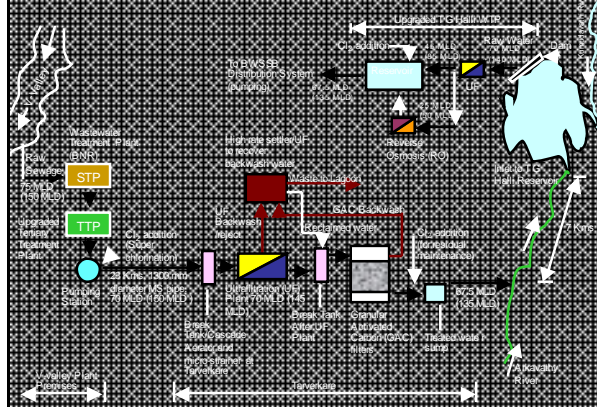


Case Study Bangalore Project - Reuse of Wastewater for Non-potable as well as Indirect Potable applications

Initial assessment of Financial viability

- Base case assumptions
 - Capex - Rs. 80 crore
 - O&M - 15% of capex + Rs. 3.5 crore for STP O&M
 - Concession period - 30 years
 - Debt Equity structure - 70:30
 - Escalation of base tariff - 5% annually
- A project IRR of 15% seems achievable at Rs. 15-17 per KL at the consumer level

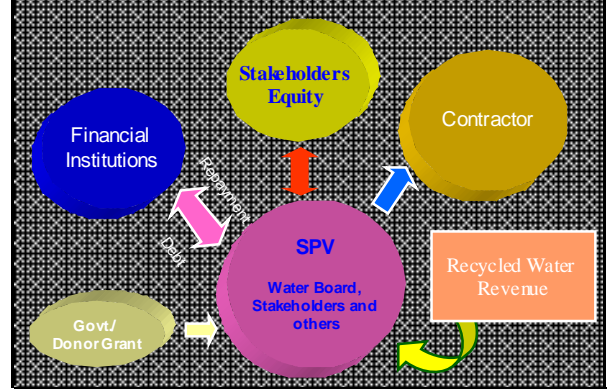
135 MLD Reuse Process Scheme - Indirect Potable use



Proposed Indirect Potable use - Bangalore



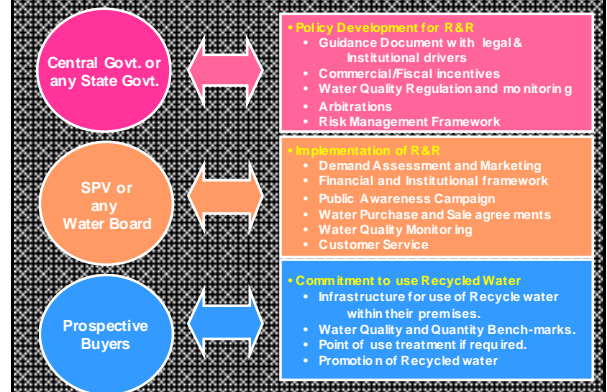
Suggested Financial Model for Project Implementation



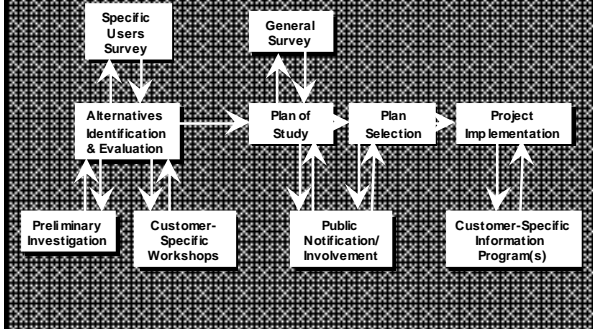
Bangalore Pilot Experience



Promoters of Recycled Water

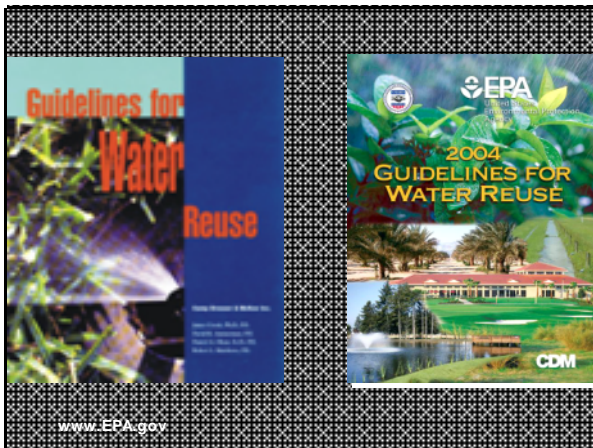


Public Participation Program for Water Reuse System Planning



Existing Standards for Reuse in India (CPCB, MOEF)

Class	Designated Best Use	Criteria
A	Drinking water source without conventional treatment but after disinfection	Dissolved Oxygen: 6 mg/l or more Biochemical Oxygen Demand: 2 mg/l or less Total Coliform: 50 MPN/100 ml
B	Outdoor Bathing (Organised)	Dissolved Oxygen: 5 mg/l or more Biochemical Oxygen Demand: 3 mg/l or less Total Coliform: 500 MPN/100 ml
C	Drinking water source with conventional treatment followed by disinfection	Dissolved Oxygen: 4 mg/l or more Biochemical Oxygen Demand: 3 mg/l or less Total Coliform: 5000 MPN/100 ml
E	Industrial, Institutional cooling and control fluid waste disposal	Electrical Conductivity: 2250 μ hos/cm Sulfate: 100 mg/l Boron: 2 mg/l



Proposed Water Quality for Reuse

User	Required Water Quality	Indian Standard
Agricultural	Irrigation	E
Domestic	Public access	C
Industrial	Per industry requirements	Negotiate w/ industries
Groundwater Recharge	Indirect potable	E
Reservoir Recharge	Indirect potable	C

If we Do not Recycle & Reuse.....

- u Poor Water Availability– Poor Public Health
- u Increasing Cost for Water Supply– long distance transportation with elevations.
- u Poor Economic Performance of ULBs
- u Interstate Disputes on Resource Allocation
- u Unsustainable Growth

Thirsty

New Approach to Sustainability is to Convert Sewage Treatment Plants (STPs) into Water Factories to Achieve the Millennium Goal



Way Forward

- u Provide incentives to Industries and Agencies using reclaimed water.
- u Address legal and Institutional issues.
- u Develop State Specific - reuse Guidance Document.
- u Promote Recycle and Reuse Educational & Public Awareness Programs – for non-potable and indirect potable applications.
- u Develop Funding Alternatives for Reuse Projects