REGIONAL WORKSHOP – “SUSTAINABLE WATER AND SANITATION : BEST MANAGEMENT PRACTICES – “POTENTIAL & CHALLENGES

WASTEWATER RECYCLE AND REUSE !!!
Need of hour
For Sustainable Water Supply – Potential & Challenges

Presentation by :
Sanjay Kumar Guleria
NJ S ENGINEERS India Pvt Ltd.
E-47, SAKET, NEW DELHI
<sguleria@njsei.com>
Why Reuse of Wastewater is required

✧ To reduce the ever increasing gap of Potable Water Supply and Demand in Urban Cities

✧ To bring down billing charges of fresh water resulted due to long distance transportation, gradient and high energy costs.

✧ To mitigate conflicts of water resource allocation between the Domestic and Agricultural / Industry

✧ To reduce groundwater extraction and Increase conservation of water resources

✧ Make water and sanitation sector sustainable
Water Demand and Deficit

Scenario in Metropolitan Cities

<table>
<thead>
<tr>
<th>City</th>
<th>Demand (MLD)</th>
<th>Deficit (MLD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>4000</td>
<td>1000</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>3000</td>
<td>500</td>
</tr>
<tr>
<td>Mumbai</td>
<td>5000</td>
<td>2000</td>
</tr>
<tr>
<td>Chennai</td>
<td>2000</td>
<td>1500</td>
</tr>
<tr>
<td>Bangalore</td>
<td>3000</td>
<td>1000</td>
</tr>
<tr>
<td>Kolkata</td>
<td>2500</td>
<td>750</td>
</tr>
</tbody>
</table>
Trends in Water Cost - India

- Chennai
- Hyderabad
- Bangalore
- Delhi

Landed Cost of Water to Utility (Rs per kL)

- 1995
- 2000
- 2005
- 2010
- 2015

Year
Water Issues in India

- Increasing Urban Population and usage
- Competition for water between water users – domestic, industry, agriculture, others – Allocation issues
- Drought – scarcity of surface water throughout the region.
- Unsustainable water use practices - NRW/UFW
- Depleting groundwater resources/salinity intrusion.
- Insufficient infrastructure for waste management.
What we need to understand??

- The CYCLES of nature
- Why nature needs help
- Problems with “accelerating” nature
- The psychology of reuse
The Water Cycle

1. Water storage in ice and snow
2. Precipitation
3. Snowmelt runoff to streams
4. Infiltration
5. Ground-water discharge
6. Ground-water storage
7. Streamflow
8. Spring
9. Freshwater storage
10. Water storage in the atmosphere
11. Condensation
12. Sublimation
13. Evapotranspiration
14. Evaporation
15. Evaporation
16. Surface runoff
17. Water storage in oceans

http://ga.water.usgs.gov/edu/watercycle.html
# Water Cycle Residence Times

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Average Residence Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceans</td>
<td>3,200 years</td>
</tr>
<tr>
<td>Glaciers</td>
<td>20 to 100 years</td>
</tr>
<tr>
<td>Seasonal Snow Cover</td>
<td>2 to 6 months</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>1 to 2 months</td>
</tr>
<tr>
<td>Groundwater: Shallow</td>
<td>100 to 200 years</td>
</tr>
<tr>
<td>Groundwater: Deep</td>
<td>10,000 years</td>
</tr>
<tr>
<td>Lakes</td>
<td>50 to 100 years</td>
</tr>
<tr>
<td>Rivers</td>
<td>2 to 6 months</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>9 days</td>
</tr>
</tbody>
</table>
The CYCLES of Nature

- Reuse is not NEW ????
- Nature is the ultimate reuse expert – it CYCLES EVERYTHING
So what has changed?
Why not let nature continue to recycle/reuse?

- Human activity/interference
  - Some cycles broken/interrupted
    - E.g. many large rivers don’t reach the ocean
    - Glaciers not being reformed
  - Some cycles are too slow
    - E.g. cannot wait for natural replenishments of water supplies
    - Natural assimilative/purification capacity of water bodies compromised
Insufficient Infrastructure for Waste Management........
And why NOT Recycled water be used ??
See quality after treatment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Raw Sewage</th>
<th>Secondary effluent</th>
<th>TTP - Plant outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.8 – 7.8</td>
<td>6.8 – 7.8</td>
<td>6.8 – 7.8</td>
</tr>
<tr>
<td>BOD5@ 20°C</td>
<td>250 mg/L</td>
<td>Less than 20 mg/L</td>
<td>Less than 2 mg/L</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>300 mg/L</td>
<td>Less than 30 mg/L</td>
<td>Less than 2 mg/L</td>
</tr>
<tr>
<td>TKN</td>
<td>45 mg/L</td>
<td>Less than 11 mg/L</td>
<td>Less than 10 mg/L</td>
</tr>
<tr>
<td>Total phosphorus mg/L</td>
<td>8 mg/L</td>
<td>Less than 3.0 mg/L</td>
<td>Less than 0.5 mg/L</td>
</tr>
<tr>
<td>Total Coli form (MPN/100ml)</td>
<td>&gt;16,00,00</td>
<td>------</td>
<td>Less than 2 MPN / 100 mL</td>
</tr>
<tr>
<td>Water of higher quality should not be used for application that can tolerate inferior quality</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Psychology of Reuse

• “...opposition comes more from a knee-jerk response to wastewater--the "yuck" factor--than from concerns about the water's chemical composition.”

• In people's minds it's "once in contact, always in contact." Even if you convince people you did every conceivable thing to purify the water they would still be reluctant to drink it.
Public Participation Program for Water Reuse System Planning

- Specific Users Survey
- Alternatives Identification & Evaluation
  - Preliminary Investigation
  - Customer-Specific Workshops
- General Survey
- Plan of Study
- Plan Selection
- Public Notification/Involvement
- Project Implementation
- Customer-Specific Information Program(s)
Why Public Involvement?

- Identify stakeholders – citizens, government, community leaders
- Get input early on to develop community support
- Projects developed with public in mind
- More accepted projects with public understanding
### Methods of Public Involvement

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communitywide Education/Information</td>
<td>News media, editorial boards, website, exhibits, brochures, posters, documentaries, school programs, open public forums</td>
</tr>
<tr>
<td>Direct Stakeholder or Citizen Contact</td>
<td>Neighborhood meetings, speeches and presentations to citizen groups, direct mail, surveys, hotlines</td>
</tr>
<tr>
<td>Formalized Process</td>
<td>Public workshops, public meetings, presentations to elected bodies, public hearings, advisory committees, special task forces</td>
</tr>
</tbody>
</table>
Recycle and Reuse – Action Items

- Quantity
- End-use Quality
- Existing Infrastructure

- Successful Recycle and Reuse Program

- Treatment Technology
- Space Requirement
- Operability

- Public Awareness
- Sustainability
- Environmental Impact

- Capital and O&M cost
- Cost Recovery/Savings
- Legal & Institutional Issue
Recycle and Reuse - Balancing Act

- **Technology Requirements and Cost**
  - Direct Potable or High Quality Process
  - RO & Disinfection
  - Indirect Potable Reuse
  - N&P Control
  - Industrial Non-Potable Reuse
  - Tertiary Filtration
  - Restricted Urban Reuse
  - Tertiary membrane Filtration
  - Irrigation
  - Secondary Treatment
  - Tertiary Filtration

- **Decreasing Cost Recovery**
### Process Trains that are Prevalent in Indirect Reuse

<table>
<thead>
<tr>
<th>Location</th>
<th>Train Components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>California</strong></td>
<td>WWTP, MF, RO, UV-A, Buffer, WTP</td>
</tr>
<tr>
<td><strong>Surface water</strong></td>
<td>WWTP, MF, RO, IX, UV-A, Buffer Blend, WTP</td>
</tr>
<tr>
<td><strong>Namibia</strong></td>
<td>WWTP, DAF, Media Filtration, Ozonation, BAC / GAC, UF, Buffer Blend, WTP</td>
</tr>
<tr>
<td><strong>Gwinnett (Georgia)</strong></td>
<td>WWTP, MF, GAC, Ozonation, Buffer, WTP</td>
</tr>
<tr>
<td><strong>Singapore</strong></td>
<td>WWTP, RO, UV-A, Buffer Blend, WTP</td>
</tr>
</tbody>
</table>
Singapore NEWater Experience:
## Recommended Water Quality Criteria

<table>
<thead>
<tr>
<th>Water Quality Parameter</th>
<th>Irrigation</th>
<th>Water exchange</th>
<th>Reservoir recharge</th>
<th>Ground-water recharge</th>
<th>Domestic non-potable or indirect potable</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD$_5$ mg/L</td>
<td>30</td>
<td>30</td>
<td>≤ 3</td>
<td>≤ 3</td>
<td>≤ 3</td>
</tr>
<tr>
<td>TSS, mg/L</td>
<td>50</td>
<td>50</td>
<td>≤ 5</td>
<td>≤ 5</td>
<td>≤ 5</td>
</tr>
<tr>
<td>Turbidity, NTU</td>
<td>–</td>
<td>–</td>
<td>5</td>
<td>5</td>
<td>≤ 5</td>
</tr>
<tr>
<td>Fecal coliform, #/100 ml</td>
<td>1,000</td>
<td>10,000</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>≤ 500</td>
</tr>
<tr>
<td>Total nitrogen, mg/L</td>
<td>15</td>
<td>–</td>
<td>≤ 10</td>
<td>&lt; 5</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Total phosphorus, mg/L</td>
<td>2</td>
<td>–</td>
<td>≤ 0.6</td>
<td>&lt; 1</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>pH</td>
<td>6 – 9</td>
<td>6 – 9</td>
<td>6 – 9</td>
<td>6 - 9</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Chlorine residual, mg/L</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>≤ 3</td>
<td>≥ 1</td>
</tr>
<tr>
<td>Drinking water standards</td>
<td>–</td>
<td>–</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Case Study - 1

130 MLD Sewage Reuse project for supply of water to 3x 660 MW KORADI TPS Expansion Nagpur, (Maharashtra State)
Objectives of this Project

- NMC and MAHAGENCO had signed the agreement on 4th Oct 2008 for Construction of 130 MLD Sewage Water Reuse Project for supplying treated sewage water to meet water requirement of the 3x660 MW Koradi TPS Expansion Project.

- The treated water mainly used for Condenser Cooling Water Requirement & Ash Sluicing Scheme
NMC - MAHAGENCO WATER REUSE PROJECT
(PLANT CAPACITY 130 MLD)

PROJECT COMPONENTS

<table>
<thead>
<tr>
<th>MODULE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>INTAKE WORKS</td>
</tr>
<tr>
<td>B</td>
<td>STP</td>
</tr>
<tr>
<td>C</td>
<td>TERTIARY T.A.</td>
</tr>
<tr>
<td>D</td>
<td>TRANSMISSION SYSTEM</td>
</tr>
<tr>
<td>E</td>
<td>TREATED SEWAGE WATER PUMP HOUSE AND B.T.P.</td>
</tr>
</tbody>
</table>

Flow Diagram as per NMC agreement
The agreement is executed with NMC on 04.10. 2008.

M/s NJS Consultants Co. Ltd. is the technical consultant for the project.

The total water requirement for proposed 3x660MW Expansion project at Koradi TPS is about 52.50 MM³/year.

Estimated cost of the project - Rs. 279 crores

The Projects consists of 130 MLD Capacity Intake Works, STP, TTP, Pumping stations and Transmission Pipelines.

Period required for completion of the work will be 2 Years followed by 1 Year defects liability period and 10 years of Comprehensive O&M.

NMC has handed over the site for construction of STP on Dt. 27-07-10
Boiler Lightup Schedule

<table>
<thead>
<tr>
<th>Boiler Lightup Schedule of 3x660 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit - 1</td>
</tr>
<tr>
<td>22/06/2013</td>
</tr>
</tbody>
</table>

Water Saving is ensured by implementing AWR & ETP Schemes

Standby Arrangement:

- It is proposed from pond No.3 by making suitable arrangement
Capacity of the Plant

Change in Design Flow

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>As per DPR</th>
<th>Present</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity Water Required</td>
<td>Capacity Water Required</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2 x 800 MW</td>
<td>40 MM³ Per Year (110 MLD)</td>
<td>3 x 660 MW</td>
</tr>
</tbody>
</table>

First unit of 1x660 MW will be replacement unit against existing 4x120 MW,
The available 8.0 MM³ from the existing 4x120 MW units will be utilized for the new TPS.

Capacity of the plant - 130 MLD (45 MM³)

Water Availability – (8.0 MM³ + 45 MM³) = 53 MM³
Water Required – 3 X 17.5 MM³ = 52.5 MM³
**Location of the Components of this Project**

**As per agreement (2008)** - The location of Intake Works, STP, TTP and Pump House was proposed in Pioli Nadi and the land was to be handed over to MAHANGENCO within six months from the date of agreement.

**As per tender (2010)** - However the said land Pioli Nadi could not be handed over to MAHAGENCO because of unauthorized encroachment and now alternative vacant land near existing Bhandewadi STP is handed over by NMC as an alternative.

The Change in Location of the Components is Highlighted Below

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Intake Works</td>
<td>Pioli Nadi</td>
<td>Nag Nallah</td>
</tr>
<tr>
<td>B</td>
<td>STP (Primary &amp; Secondary)</td>
<td>Pioli Nadi</td>
<td>Bhandewadi</td>
</tr>
<tr>
<td>C</td>
<td>TTP</td>
<td>Pioli Nadi</td>
<td>Bhandewadi / Koradi</td>
</tr>
<tr>
<td>D</td>
<td>Pump House &amp; Pipeline</td>
<td>Pump House (Pioli Nadi) Pipeline (pioli nadi to Koradi)</td>
<td>Pump House (Bhandewadi) Pipeline (Bhandewadi to Koradi)</td>
</tr>
<tr>
<td>E</td>
<td>Inter-Connectivity Pump House &amp; Pipeline</td>
<td>Pump House (Bhandewadi) Pipeline (Bhandewadi to Koradi)</td>
<td>Pump House (Bhandewadi) Pipeline (Bhandewadi to Koradi)</td>
</tr>
</tbody>
</table>
Process adopted in the tender for STP

Sewage Treatment Plant

The Contractors are permitted to quote for one of four options which are specified for the Aerobic Biological treatment in the STP. They are as follows:


4. Improved Bio-Tower Process including Biological Nutrient & Phosphorous Removal

Conventional or SBR or MBR or Improved Bio-Tower, these process is subject to the same fundamental laws of microbiology and physics.
**STP - Conventional Activated Sludge (CASP) Layout**

1. Preliminary Treatment
2. Primary Settlement
3. Aeration
4. Sludge Return
5. Settling
6. Secondary Clarifier
7. Waste Sludge
8. To TTP

**Sequencing Batch Reactor (SBR) Layout**

1. Preliminary Treatment
2. Primary Settlement
3. Sequencing Batch Reactor
4. SBR Reactor (Aeration + Settling)
5. Sludge Return
6. Waste Sludge
7. To TTP

**Membrane Bio Reactor (MBR) Layout**

1. Preliminary Treatment
2. Primary Settlement
3. MBR Reactor (Aeration with Membrane filtration)
4. Sludge Return
5. Waste Sludge
6. To Reuse
Improved Bio-Tower Process

Preliminary Treatment → Primary Settlement → Bio-Tower → Aeration → Aeration Tank → Settling → Secondary Clarifier → Settling → Waste Sludge

Raw and Treated Sewage Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Raw Sewage Quality</th>
<th>Secondary treated effluent</th>
<th>TTP - Plant outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.8 – 7.8</td>
<td>6.8 – 7.8</td>
<td>6.8 – 7.8</td>
</tr>
<tr>
<td>BOD5@ 20°C</td>
<td>250 mg/L</td>
<td>Less than 15 mg/L</td>
<td>Less than 5 mg/L</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>300 mg/L</td>
<td>Less than 20 mg/L</td>
<td>Less than 5 mg/L</td>
</tr>
<tr>
<td>TKN</td>
<td>45 mg/L</td>
<td>Less than 11 mg/L</td>
<td>Less than 10 mg/L</td>
</tr>
<tr>
<td>Total phosphorus mg/L</td>
<td>8 mg/L</td>
<td>Less than 3.0 mg/L</td>
<td>Less than 0.5 mg/L</td>
</tr>
<tr>
<td>Total Coli form (MPN/100ml)</td>
<td>&gt;16,000,000</td>
<td>----</td>
<td>Less than 2 MPN / 100 mL</td>
</tr>
</tbody>
</table>
### STP: Performance of CASP, SBR, MBR and Improved Bio-Tower Process

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>CASP</th>
<th>SBR</th>
<th>MBR</th>
<th>Improved Bio-Tower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proven Technology</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reliable and Sustainable</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Technically Feasible</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Plant Footprint</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>O &amp; M Cost</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CASP</th>
<th>SBR</th>
<th>MBR</th>
<th>Improved Bio-Tower</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD$_5$</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 2 mg/l</td>
<td>&lt; 10 mg/l</td>
</tr>
<tr>
<td>TSS</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 1 mg/l</td>
<td>&lt; 10 mg/l</td>
</tr>
<tr>
<td>Total Nitrogen (as N)</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 1 mg/l</td>
<td>&lt; 10 mg/l</td>
</tr>
<tr>
<td>Total Phosphorous <em>(with Coagulant)</em></td>
<td>&lt; 1 mg/l</td>
<td>&lt; 1 mg/l</td>
<td>&lt; 0.1 mg/l</td>
<td>&lt; 1 mg/l</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 10 mg/l</td>
<td>&lt; 1 mg/l</td>
<td>&lt; 10 mg/l</td>
</tr>
</tbody>
</table>
Process proposed for Tertiary Treatment

Following two process were proposed for the Tertiary Treatment:

1) Deep bed Multimedia Filtration Process
2) Membrane Filtration (Ultra filtration / Microfiltration)
TTP - Tertiary filtration systems

**Raw Wastewater** → **Activated Sludge** → **Secondary Effluent** → **Filters (Sand / Membrane)** → **To Reuse**

<table>
<thead>
<tr>
<th></th>
<th>Multi Media Filters– (Sand &amp; Anthracite)</th>
<th>Membrane filters (MF / UF membranes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtration size</td>
<td>0.4 to 1.0 mm</td>
<td>0.04 microns</td>
</tr>
<tr>
<td>Outlet solids</td>
<td>5 – 10 mg/L</td>
<td>&lt; 1 mg/L</td>
</tr>
<tr>
<td>Status in India</td>
<td>Established</td>
<td>Established</td>
</tr>
<tr>
<td>Alum/Polymer dosage</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Flow Schematic – Deep Bed Multi Media Filtration

- Raw Wastewater
- Primary Clarifier
- Aeration Tank
- Secondary Clarifier
- Primary Sludge Thickening
- WAS Thickening
- Digester
- Sludge Dewatering
- Sludge
- For Disposal
- Return Stream
- Supernatant
- Dewatering
- Treated Effluent
- Deep Bed Multi Media Filters
- Backwash
Process - STP & TTP adopted by the Successful contractor M/s GSJ Envo Ltd in consortium with SMS infrastructure.

STP - Sequencing Batch Reactor (SBR) Layout
TTP – Deep Bed Multi Media Filters
Case Study 2– Delhi Jal Board

- To evaluate technologies to retrofit existing 30 IMGD portion of Okhla STP for recycle and reuse of wastewater for non-potable applications
- Performance assessment of the 30 IMGD facility
- Define recycled water quality goals
- Identify suitable technologies
- Technology evaluation
MBR & RO Pilot Schematic

- Flat Sheet Toray IonExchange MBR
  50 kL/day

- MBR effluent Tank

- Reverse Osmosis
  3 kL/day

- 0.8 mm screen
MBR & RO Pilot Performance

Flat Sheet Toray-IonExchange MBR 50 kL/day

MBR effluent Tank

Reverse Osmosis 3 kL/day

• 0.8 mm screen

BOD – 180 to 225 mg/L
COD – 360 to 500 mg/L
SS – 450 mg/L
TDS – 600 to 900 mg/L
MPN > 1 million/100 mL

BOD < 2 mg/L
COD – 8 to 20 mg/L
SS < 2 mg/L
TDS – 600 to 900 mg/L
MPN < 10/100 mL

BOD – non detect
COD < 10 mg/L
SS < 1 mg/L
TDS < 20 mg/L
MPN < 2/100 mL
CM Sheila Dikshit takes a sip of treated water during a visit to a treatment plant on Thursday.
Need of Water Sector......

- Development of Reliable and acceptable Reuse plans and suggestive methods.
- Development of reuse effluent guidelines based on end-use applications.
- Development of regulatory criteria and framework for Reuse: performance, redundancy, specifications, and safety & Health issues.
- Development of appropriate Public awareness campaign procedures to gain public confidence
- Guidelines for reuse projects under PPP and other funding scenarios
Draft National Water Policy 2012

• Legislation

National water framework law of general principles on water, to lead the way for essential legislation on water governance in each state

• Water Usage

• The centre, states and local bodies have been advised to provide minimum quantity of potable water needed for essential health & hygiene., Ecological needs of rivers

• Basic livelihood support to the poor and national food security

• Efficiency of water usage

• Over and above pre-emptive needs, priced to promote efficient use, hence should be treated as an economic good. **Recycle and reuse should be encouraged**, especially through planned tariff system, Need for saving water in irrigation - micro, auto irrigation etc. Development of system for measuring water footprints and water auditing
New Approach to Sustainability is to Convert Sewage Treatment Plants (STPs) into Water Factories to Achieve the Millennium Goal.
If we Do not Recycle & Reuse......

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

Sanjay Kr Guleria
<sguleria@njsei.com>