WATER AND WASTEWATER MANAGEMENT OF

Kathmandu Valley

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Presentation Outline

- Present Status of Demand and Supply
- Development Scenario
- Wastewater Management Present and Future
- Development Challenges
Present Issues of Wastewater Management in Kathmandu Valley

- Population Growth regarding Kathmandu Valley

Kathmandu Population: Fivefold Growth during the Last 30 Years
Water Supply Situation

- Total Population of Kathmandu Valley - 25 million
- With temporary residents - 40 million
- Water Demand – 360 MLD: Production: 95 MLD (min): 154 MLD (Max)
- Water Losses (NRW): 48%
- Actual Availability to consumer: 15% of demand
- Non uniformity / inequality in Supply
- Untreated Water: Unsafe for drinking
- Tanker Supply by Public/Private vendor
- Maximum exploitation of Ground Water by people
Present Status

For Core areas

- 35 Surface Sources
- 78 Tube Wells (Only 59 in operation)
- 20 Treatment plants (117 MLD)
- 39 Pumping Stations
- Reservoir 41500 m3
- 1400 km of Pipe lines
- Other several small systems
Organization Involved

• Kathmandu Upatyaka Khanepani Limited (Operator)
• Department of Water supply and Sewerage (GoN)
• Municipalities/Village Development Committees
• District Development Committees
• INGos, NGOs, Bilateral Organisations, Embassys
Water Supply Demand and Supply

Demand: 529 MLD By 2030

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Avg Demand</th>
<th>Avg Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012/13</td>
<td>320</td>
<td>111</td>
</tr>
<tr>
<td>2011/12</td>
<td>320</td>
<td>119</td>
</tr>
<tr>
<td>2010/11</td>
<td>350</td>
<td>119</td>
</tr>
<tr>
<td>2009/10</td>
<td>350</td>
<td>114</td>
</tr>
<tr>
<td>2008/09</td>
<td>360</td>
<td>124</td>
</tr>
</tbody>
</table>
Nos of connections

166686   173709   181042   184720   190531

Fiscal Year
Melamchi Water Supply Project

Tunnel: 26 Km
1st Phase: 170 MLD
2nd Phase: 170 MLD
3rd Phase: 170 MLD
WTP: 1st Phase 85 MLD
       2nd Phase 85 MLD
10 Zones = 46 Sub-Zones
11 DNIs = 14 Sub-Zones
1 Pilot = 1 Sub-Zone
1 Demo = 1 Sub-Zone
30 Remaining Sub-Zones

Project Area, Bulk Distribution System and Service Reservoir

Location of Project Area, Bulk Distribution System and Service Reservoir

BDS-2 (Gaushal to Tinkune)

Sundarijal WTP
510 MLD
ELEV=1397m

ANAM NAGAR
BALAJU
BANSBARI
KHUMALTAR
KIRTIPUR
MAHANKAL CHAUR
MIN BHAWAN
PANI POKHARI
TIGENI

Katunje Reservoir (Bhaktapur) and its distribution area will be added in phase 2
Summary of Bulk Distribution and Service Reservoir Packages

Bulk Distribution System:
- 57 km (300-1400mm Dia DI Pipe)
- 4 Packages (Running)
- 6 service Reservoir (65000 cum Capacity)
- 2 Reservoir already constructed (5800 m³)
- 2 Under Tendering (9000 m³)

Existing – 37000 m³; Under construction 65000 m³
To be Constructed – 30000 m³

Distribution Network:
- 502 km (HDPE, DI Pipes)
- 3 Packages (Running)
- 502 Km
Basic Characteristics

1. 11 Distribution network design is based on (47 DMA District Metering Units) basis.
2. DI pipes are of diameter 150mm and above upto 1000mm.
3. PE100- PN 6 pipes of diameter 75mm, 90mm and 110mm.
4. Reticulation pipe where DI pipe is in the design.
5. Both side pipe if the road width more than 7m.
6. No HH connection from DI pipes.
7. All HDPE pipes are connected with electro fusion joints.
8. Household connections from electro fusion saddle joint, brass ferrule, compression joint with HDPE pipe and small pieces of GI pipe and fittings above ground. Above ground there will be corporation stops before and after water meter.
9. Performance assessment NRW within 15% in each DMA, which is tied up with payment.
10. SCADA Friendly. 135 LPCD for permanent and 40 LPCD for temporary Residents.
1800 AD Malla Period:
For surface drainage and kitchen sullage

Between 1898 and 1950 Rana dynasty:
Further development of combined sewer, brick sewers typically 600 mm circular sections or 1050 x 1050 mm oval sections, these were constructed with a flushing system using gates to allow sudden release of flows.
History of Wastewater Management in Kathmandu Valley

World Bank / IDA projects were undertaken in three phases:

**Two wastewater treatment plants (WWTPs) were constructed**

Treatment System: Stabilisation Pond
- **Kodku (1982)**
  Capacity: 1.1 MLD
- **Dhobighat (1982)**
  Capacity: 15.4 MLD

Various interceptors were also constructed

**GTZ Projects:**
  Capacity: 0.5 MLD  2 MLD
Present Status of Wastewater Infrastructure in Kathmandu Valley

**Sewer Lines:**
- Approximately 1350 kms

**Interceptors (Excluding interceptors constructed recently by HPDBIC):**
- Approximately 35 Kms

**Functional WWTP:**
- No. - 1
- Name - Guheswori WWTP
- Capacity - 16.2 MLD
- Status - Not fully functional due to load shedding
- Dedicated Electricity Supply Line - Process undergoing for installation of dedicated line
Project Activities for overcoming Present Problems regarding Wastewater Management

1. **Sewer Asset Condition Survey**

2. **Rehabilitation and Construction of Wastewater Treatment Plants including 18 DEWATS**

3. **Construction of sewer interceptors in Bagmati river and its major tributaries: 130 km**

4. **Rehabilitation and Construction of sewerage conveyance network: 260 km**
1. Sewerage Network System

- **System Options**
  - Separate System
  - Combined System

- Wherever possible → Separate System
- Wherever not possible → Combined system
  - Overflow structure are proposed to flow storm water to river.
Project Components

- **Wastewater Treatment Plants**
  - Package 1: Guheshwor WWTP
  - Package 2: Gokarna WWTP, Dhobighat WWTP, Kodku WWTP, Sallaghari WWTP

- **Interceptor Sewers**
  - 2 Packages along tributary of Bagamati River

- **Sewer Network**
  - 2 Packages covering Kathmandu, Lalitpur, Bhaktapur and Kritipur
Kathmandu Valley
Existing Sewerage Network and Major WWTP

Dhobighat
Kodku
Guheshwori
Sallaghari
Selection of Appropriate Technology Factors

- Capital costs,
- Operation and maintenance costs
- Land requirement
- Sustainability
- Location (Urban, Semi urban, Rural)
- Social acceptability
**Design Concepts of WWTPs** Adopt New/Advanced Technologies

- **Footprint**: Abandon previously utilized systems like aerated lagoons and stabilization ponds which require large footprint

- **Deodorization**: Consider technologies which causes less nuisance regarding odour escaping to surrounding area: Covered

- **Stringent Quality Effluent**: Use of the tertiary treatment for polishing water from biological treatment in holy areas such as Gokarna and Guheswori

- **Modern Technology**: Consider technologies which require less footprint so that larger capacity WWTPs can be constructed in available land/space - ASP

- **Sludge Digestion**: Consideration of modern technology like centrifuge/filter press in place of sludge drying beds for sludge dewatering
Concepts for Design of WWTPs Adopt New/Advanced Technologies

- **Incremental Investment**: Phase wise implementation of treatment plant construction and Sewerage Network improvement is mainly focused.

- **Augmentation** of River System
  ([Presentation Slide for River Flow augmentation.pptx](#))

- **Design Build and Operate** Contract procedure Opportunities/Risk and Uncerta

- **Reuse** of Effluent water and sludge cake.

- **Septage Management**
Concepts for Design of WWTPs: Recover Energy

Generate Electricity by Methane Gas from Anaerobic Digester Sludge treatment of Dhobighat, Kodku and Sallaghari WWTP

Anaerobic Digester

Gas Storage
Concepts for Design of WWTPs

Be Harmony with Surrounding Area: Good Neighbour

- Provide Recreational area and public park for population on reserved area in WWTP or water front
- WWTPs not only treat wastewater but also provide site for relaxation and recreation
**Gauging Stations**

**Proposed WWTP Locations**

**Base Flow m³/s**

<table>
<thead>
<tr>
<th>Location</th>
<th>Guheshwori</th>
<th>Sallaghari</th>
<th>Kodku</th>
<th>Dhobighat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaurigha</td>
<td>0.38/0.50m³/s</td>
<td>0.12m³/s</td>
<td>0.10m³/s</td>
<td>0.43/1.27m³/s</td>
</tr>
<tr>
<td>Khokana</td>
<td>0.32m³/s</td>
<td>0.32m³/s</td>
<td>0.32m³/s</td>
<td>3.41m³/s</td>
</tr>
<tr>
<td>Bagmati River</td>
<td>0.16m³/s</td>
<td>0.16m³/s</td>
<td>0.16m³/s</td>
<td></td>
</tr>
</tbody>
</table>

**Effluent Discharge of WWTP (Phase I/Phase II)**

<table>
<thead>
<tr>
<th>WWTP</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Future</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guheshwori</td>
<td>32.4</td>
<td>10.6</td>
<td></td>
<td>43.0</td>
</tr>
<tr>
<td>Sallaghari</td>
<td>14.2</td>
<td></td>
<td></td>
<td>14.2</td>
</tr>
<tr>
<td>Kodku</td>
<td>17.5</td>
<td>17.5</td>
<td></td>
<td>35.0</td>
</tr>
<tr>
<td>Dobighat</td>
<td>37.0</td>
<td>73.0</td>
<td></td>
<td>110.0</td>
</tr>
<tr>
<td>Sub Total</td>
<td>101.1</td>
<td>101.1</td>
<td></td>
<td>202.2</td>
</tr>
<tr>
<td>Khokana</td>
<td></td>
<td></td>
<td></td>
<td>294.7</td>
</tr>
<tr>
<td>Total</td>
<td>101.1</td>
<td>101.1</td>
<td></td>
<td>496.9</td>
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</table>
Flow Augmentation Scenario after WWTP and Nagmati Dam

Gauging Stations
- Basist Flow m³/s
- Effluent Discharge of WWTP (Phase I/Phase II)

Proposed WWTP Locations

Bagmati River

Gaurigha
- 1.07/1.40 m³/s
- 0.61/0.73 m³/s
- 0.38/0.50 m³/s
- 0.23 m³/s
- 1.07/1.40 m³/s

Dhobighat
- 0.43/1.27 m³/s
- 1.50/2.80 m³/s

Khokana
- 4.91/7.21 m³/s
- 3.41 m³/s

Sallaghari
- 0.19 m³/s

Kodku
- 0.20/0.41 m³/s
- 0.26 m³/s

Gokarna
- 0/0.07 m³/s

Sundarijal
- 0.16 m³/s

Proposed WWTP

Base Flow m³/s

Effluent Discharge of WWTP (Phase I/Phase II)

Khokana WWTP C.A.

Gaurigha WWTP C.A.

4.91/7.21 m³/s

1.07/1.40 m³/s

3.41 m³/s

0.38/0.50 m³/s

0.61/0.73 m³/s

0.23 m³/s

0.19 m³/s

Bagmati River

Dhobighat

Khokana

Sallaghari

Kodku

Gokarna

Sundarijal

Gaurigha

Proposed WWTP Locations

Flow Augmentation Scenario after WWTP and Nagmati Dam
Total Catchment Area
A = 195.2 km²
2.2 Guheshwori WWTP PLAN

**Summary**

<table>
<thead>
<tr>
<th>PLAN</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>32.4 MLD</td>
</tr>
<tr>
<td>Site Area</td>
<td>50,000 ㎡</td>
</tr>
<tr>
<td>WWTP Area</td>
<td>28,583 ㎡ (53.12%)</td>
</tr>
</tbody>
</table>

**Summary**

- Equalization tank
- PTF: 2 Tanks
- PST: 4 Tanks
- A/T: 2 Tanks
- SST: 2 Tanks
- Sludge Treatment (thickening-digestion-dewatering process)
- Biogas & Power Generation (300KWH)
2.2 Guheshwori WWTP PLAN

Process Flow Diagram

Influent

PTF (Pre-Treatment Facility)

Inlet Chamber

Screen

Grit Chamber

ET (Primary Sedimentation Tank)

PST

A/T (Aeration Tank)

SST (Secondary Sedimentation Tank)

DF (Disinfection Facility)

Discharge to River

LEGEND

- Wastewater Flow
- Sludge Flow
- By-Pass Flow
- GAS Line
- Return flow
- Septic Sludge Flow

NOTE
PTF: Pre-Treatment Facility
PST: Primary Sedimentation Tank
A/T: Aeration Tank
SST: Secondary Sedimentation Tank
DF: Disinfection Facility

Gravity Thickener

Mechanical Thickener

Degritting & Decilting Facility

Anaerobic Digester

Gas Holder

Bio-Gas Generation

Lime Mixing

Centrifuge Dewatering

Sludge Cake

(Agricultural Use or Landfill)
Conceptual Design of Guheswori WWTP

A. Pre-Treatment Facilities
B. Primary Sedimentation Tank
C. Oxidation Ditch
D. Tertiary Treatment
E. Tunnel Discharge
F. Deodorization
G. Bio Gas Generation
H. Photovoltaic (Future)
Proposed Works Under KVWWMP

- **Wastewater Treatment Plant**: 2 Packages
  - Package 1: Guheswori
  - Package 2: Sallagahi, Kodku, Dhobighat

- **Interceptors**: 2 Packages
  - Manohara and Hanumante Interceptors

- **Sewer Network**: 2 Packages
  - Package 1: KMC
  - Package 2: All other Municipalities inside
### Service Area & Design Criteria

#### Service Area

**Coverage**
- 5 Municipalities
- 17 VDCs

#### Estimation Criteria for Discharge rate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population connected to off-site system</td>
<td>%</td>
<td>70</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>Domestic sewage</td>
<td>lpcd</td>
<td>80</td>
<td>80</td>
<td>96</td>
</tr>
<tr>
<td>Nondomestic sewage</td>
<td>%</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Infiltration rate</td>
<td>%</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Peak factor of Domestic Sewage</td>
<td>-</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

#### Service Area

<table>
<thead>
<tr>
<th>Service Area</th>
<th>Total Area (ha)</th>
<th>Coverage Area (ha)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathmandu M.</td>
<td>5,194.15</td>
<td>5,194.15</td>
<td>100.0</td>
</tr>
<tr>
<td>Lalitpur Sub-M.</td>
<td>1,518.65</td>
<td>1,518.65</td>
<td>100.0</td>
</tr>
<tr>
<td>Bhaktapur M.</td>
<td>670.61</td>
<td>670.61</td>
<td>100.0</td>
</tr>
<tr>
<td>Kirtipur M.</td>
<td>1,539.35</td>
<td>1,539.35</td>
<td>100.0</td>
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<tr>
<td>Madhyapur Thimi M.</td>
<td>1,125.98</td>
<td>1,125.98</td>
<td>100.0</td>
</tr>
<tr>
<td>32 VDCs in Kathma (previous) partly</td>
<td>14,058.35</td>
<td>6,275.62</td>
<td>44.6</td>
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<tr>
<td>10 VDCs in Lalitpur partly</td>
<td>3,975.52</td>
<td>2,273.96</td>
<td>57.2</td>
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<tr>
<td>7 VDCs in Bhaktapur Partly</td>
<td>3,959.76</td>
<td>924.91</td>
<td>23.4</td>
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<tr>
<td>Total</td>
<td>32,042.37</td>
<td>19,523.23</td>
<td>60.9</td>
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### WWPTs Expansion Plan

<table>
<thead>
<tr>
<th>Category</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>Remarks</th>
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<tbody>
<tr>
<td><strong>Total Discharged</strong></td>
<td>159.2</td>
<td>221.2</td>
<td>496.8</td>
<td></td>
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<tr>
<td><strong>Total Cap. Of WWTP</strong></td>
<td>16.2</td>
<td>101.1</td>
<td>502.8</td>
<td></td>
</tr>
<tr>
<td><strong>Surplus Cap.</strong></td>
<td>-143.0</td>
<td>-110.1</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>

#### Guheshwori WWTP
- **Discharged**: 12.0, 17.5, 42.9
- **Capacity**: 16.2, 32.4, 48.6
- **Surplus Cap.**: 4.2, 14.9, 5.7

#### Sallaghari WWTP
- **Discharged**: 7.3, 8.7, 14.0
- **Capacity**: - , 14.2, 14.2
- **Surplus Cap.**: -7.3, 5.5, 0.2

#### Kodku WWTP
- **Discharged**: 9.9, 14.4, 35.0
- **Capacity**: - , 17.5, 35.0
- **Surplus Cap.**: -9.9, 3.1, -

#### Dhobighat WWTP
- **Discharged**: 38.6, 52.3, 109.9
- **Capacity**: - , 37, 110.0
- **Surplus Cap.**: -38.6, -15.3, 0.1

#### Khokana WWTP
- **Discharged**: 91.4, 128.4, 294.9
- **Capacity**: - , - , 295.0
- **Surplus Cap.**: -91.4, -128.4, 0.1

#### Graph
- **Total Discharged**
- **Khokana**: 295.0
- **Gueshswori**: ext 16.2
- **Total**: 48.6

- **Sallaghari**: 14.2
- **Kodku**: 17.5
- **Dhobighat**: 37

- **Guheshwori**: ext 16.2
- **Total**: 32.4
Rehabilitation and Construction of Wastewater Treatment Plants:

Interventions: Construction of Wastewater Treatment Plants

- Gokarna (1 MLD) + 1.8 MLD
- Guheswori (32.4 MLD) + 16.2 MLD
- Kodku (17.5 MLD) + 17.5 MLD
- Sallaghari (14.2 MLD)
- Dhobighat (37 MLD) + 74 MLD
- Khokana (245 MLD) (including septage treatment facilities)
- DEWATS (18 no. at various emerging peri areas)
Present Issues of Wastewater Management in Kathmandu Valley

- Development of Wastewater Infrastructure without Masterplan
- Involvement of various organisations
- Aged system for sewer conveyance
- Inadequate capacity of Sewers
- Cross connections between domestic sewer and stormwater sewer
- Non-Priority area of Development
WWM: Issues and Challenges

Septage Management for generated from 22000 households

Contract Bidding Procedure (DBO manageable or not)

Phasewise Construction: Challenge for fund generation

Institutional Capacity Not Sufficient

Electric Power Problem for 24 hours operation

Conducive Environment for large Project ??

Opportunities

Need of Valley River Restoration
Environmental Sanitation improvement
Wastewater Generation increased
THANK YOU FOR YOUR KIND ATTENTION