FEASIBILITY REPORT

ON

SEWAGE TREATMENT PLANT

FOR

M/s. PRESTIGE ESTATES PROJECTS LTD,
BENGALURU

PROJECT : “DEVELOPMENT OF RESIDENTIAL APARTMENT”
BEARING SY. Nos. 115,116 & 117 AT UTTARAHALLI VILLAGE,
UTTARAHALLI HOBLI, BENGALURU SOUTH TALUK,
BENGALURU.

ARCHITECTS

M/s. VENKATARAMANAN ASSOCIATES
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PHE CONSULTANTS

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1.0 **PRE-AMBLE:**

M/s. Prestige Estates Projects Ltd. is coming up with Residential Development on a plot of 15 acres 37 Guntas at Uttarahalli village, Bengaluru. The total built-up area of the proposed project is 2,02,155.21 Sq.mt. comprising 1,119 Nos. of units and a Club House in 6 blocks comprising of 12 towers and a club house.

Towers 1, 2, 11 & 12 are sprawled across B+G+17 Upper Floors with a height of 55.9m. Towers 3, 5, 6, & 7 are sprawled across 2B+G+17 Upper Floors with a height of 55.9m. Towers 4, 8, 9 & 10 are sprawled across 2B+G+18 Upper Floors with a height of 58.95m and the Club House is sprawled across G+2 Upper Floors with a height of 15m.

The Basements comprises of Car parks, Ground & the Upper Floors comprises of 1,119 numbers of Apartments.

2.0 **DESIGN OF SEWAGE TREATMENT PLANT:**

2.1 Sewage Treatment Plant:

STP is envisaged for this project to conserve usage of fresh water by recycling and utilizing for Flushing in toilets & Landscaping Purpose.

Total water requirement = 790,000 Lts

Assuming Diversity Factor of 0.9 = 0.9X790,000

= 711,000 Lts/day

Adding 10% extra = 782.10 m³ / day

Sewage generated = 785 m³ / day
Based on the above discharge a state of the art sewage treatment plant of capacity **785 KLD** is proposed.

### 2.2 Quality of Raw Sewage & Treated Domestic Sewage

The general characteristic of sewage is considered as shown in the table below.

**General characteristics:**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph</td>
<td>6.5 - 8.5</td>
</tr>
<tr>
<td>BOD(_5)</td>
<td>250-300mg/lt.</td>
</tr>
<tr>
<td>COD</td>
<td>600mg/ltr</td>
</tr>
<tr>
<td>SS</td>
<td>150mg/ltr</td>
</tr>
</tbody>
</table>

The anticipated final water quality:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>6 – 8.5</td>
</tr>
<tr>
<td>BOD(_5)</td>
<td>&lt; 10 mg/lts</td>
</tr>
<tr>
<td>COD</td>
<td>&lt; 250 mg/lts</td>
</tr>
<tr>
<td>SS</td>
<td>&lt; 10 mg /lt.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt; 2 NTU</td>
</tr>
<tr>
<td>E. Coli</td>
<td>None</td>
</tr>
</tbody>
</table>

### 3.0 DESIGN DETAILS OF SEWAGE TREATMENT PLANT:

Total quantity of raw effluent = 785m\(^3\)/day = 49.0625 m\(^3\)/hr

\[
\text{BOD}_5 \text{ at } 27^\circ \text{C} = 250 \text{ mg} / \text{L}
\]

Expected BOD\(_5\) reduction:

1. Influent BOD\(_5\) = 250 mg/L
2. BOD\(_5\) reduction in SBR = 95 %

Therefore BOD\(_5\) at the outlet of secondary treatment = 12.5 mg/L

3. BOD\(_5\) reduction with tertiary treatment like Coagulation, filtration and disinfection = < 10 mg/L
3.1 **BAR SCREEN:**
* Size of the unit : 0.6 m x 1.0 m  
* Function : To separate coarse matter From the raw effluent

3.2 **RECEIVING TANK:**
* Average BOD$_5$ of effluent at the inlet of the pre-aeration tank = 250 mg/L  
* Total organic load with 20% BOD$_5$ reduction considered = 50 mg/L  
* Total organic load to be removed = 39.25 kg/day  
* Total oxygen required assuming 2 kg of O$_2$/kg of BOD$_5$ removed = 78.50 kg/day  

Let us assume  
* Alpha = 0.6  
* Beta = 0.7  
* Oxygen transfer at 0.25 m depth = 25%  
* Density of air = 1.2 kg/m$^3$  
* Percentage of oxygen in atmosphere = 21%  
* Therefore air required for aeration = 2966.74 m$^3$/day  
* Air requirement per hour = 185.42 m$^3$/hr  
* Type of aeration: coarse bubble diffused aeration system  
* Detention time = 4 Hrs  
* Volume of the unit = 353.25 m$^3$  
  **Say 355 m$^3$**  
* Size of the unit = 71.30Sq.mt X 5.0m liquid depth
3.3 SEQUENTIAL BATCH REACTOR (2 No.s)

i) Basic design assumptions

<table>
<thead>
<tr>
<th></th>
<th>Inlet</th>
<th>Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; at 27° C, mg/L</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>TSS, mg/L</td>
<td>200</td>
<td>30</td>
</tr>
<tr>
<td>(NH&lt;sub&gt;3&lt;/sub&gt; – Ammonia), mg/L</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Total Phosphorous, mg/L</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>TKN, mg/L</td>
<td>40</td>
<td>5</td>
</tr>
</tbody>
</table>

ii) SBR design calculations

b) Reactor volume

Assumptions for SBR kinetics

* F/M ratio = 0.15
* MLSS = 4000 mg/l
* Net sludge yield = 0.76 kg MLSS/kg BOD5
* Min. solids retention time = 8 days
* Reactor volume decanted each day = 60%
* Dissolved O2 liquor concentration = 2 mg/l
* Oxygen co-efficient
  * kg of O<sub>2</sub>/kg of BOD<sub>5</sub> = 1.28
  * kg of O<sub>2</sub>/kg of NH<sub>3</sub>N = 4.6
* Oxygen transfer factors
  * A (typical for coarse bubble diffusers) = 0.85
  * ß (typical for domestic wastewater) = 0.95
* Typical O<sub>2</sub> transfer rate for coarse bubble diffusers = 1.25 kg O<sub>2</sub>/KWH
* No. of cycles/day = 4
* BOD<sub>5</sub> removed (kg/day) = [(BOD influent – BOD effluent) (mg/L)] x flow (L/day)]
  * BOD<sub>5</sub> = 141.30 kg/day
* Required aerobic mass = \( \frac{BOD_5 \text{ removed}}{F/M \text{ Ratio}} \)
  
  = 942 kg MLS

* Reactor volume (low water volume) = \( \frac{\text{MLSS mass (kg)}}{\text{MLSS concentration}} \)
  
  = 235.50 m³

* Since the decant volume represents 60% of the total volume

* Total reactor volume = 588.75 m³
  
  Say 590 m³

* Size of the unit (1)-320 cum=64.20 Sq.mt x 5.0 m liquid depth

* Size of the unit (2)-270 cum=54.0 Sq.mt x 5.0 m liquid depth

b) Decant volume

* Total decant volume = total reactor volume – reactor Volume
  
  (Low water level)

  Total decant volume = 261.66 m³
  
  Say 265 m³

* Maximum detention time= 6 hrs

* Max. Retention time = 2 hrs

* Size of the unit = 89.0 Sq.mt x 3.0 m liquid depth

Aeration:

* Nitrogenous O₂ demand (kg of O₂/day) = NH₃ - N oxidized (kg/day) x kg O₂/kg of NH₃N

* Carbonaceous O₂ demand (kg of O₂/day) = BOD₅ mass (kg/day) x kg O₂/BOD₅

* NH₃ - N oxidized (kg/day) = TKN removed (kg/day) - synthesis N (kg/day)

* TKN removed = 27.475 kg/day

* Synthesis N = 5% waste activated sludge of total daily sludge production
* Sludge production (kg/day) = net sludge yield (kg MLSS/kg BOD₅) x BOD₅ removed (kg/day)
Therefore sludge production  = 0.76 x 141.30 kg/day
= **107 kg/day**

* Synthesis N           = 5.3694 kg/day
* NH₃ - N oxidized      = 22.10/day
* Nitrogenous O₂ demand = 101.68 kg of O₂/day
* Carbonaceous O₂ demand = 6.86kg/day
* AOR (kg/day) = nitrogenous O₂ demand + carbonaceous O₂ demand (kg/day)
Where AOR = Actual Oxygen Requirements (kg O₂/day)
* AOR                    = 108.54kg/day

SAOR (kg O₂/hr) = [AOR x Cₛ x teta (T-20)] / [aₑ x (beta x Cₛ - C₀) x blower usage (hr/day)]
where SAOR = standard actual O₂ requirement (kg O₂/day)

  teta = temperature correction factor = 1.024

  Cₛ = O₂ saturation concentration at standard temperature and pressure
      = 9.02 mg/L

  Cₛₚ = concentration correction for elevation 1000 ft.
      = 9.02 - 0.0003 x elevation        = 8.72 mg/L

(Note: 0.0003 may be used as a rule of thumb describing a 0.0003 mg/L rise/drop in DO saturation concentration per every foot of elevation increase/decrease.)

  C₀     = 2 mg/L
  aₑ     = 0.85
  Beta   = 0.95
  T      = 30 °C (67 °F)

Blower usage = 16 hrs/day
(Based on 4 cycles per day (6 hr/cycle), 1.0 hr fill time, 3.5 hr react time, 0.75 hr settle time, 0.5 hr decant time, and 0.25 hr idle time

SAOR = 14.52 kg of O₂/hr

* Sludge flow rate (L/day) = sludge mass flow (kg/day) / sludge density (kg/L)
* Typical sludge density = 1.02 kg/L
* Therefore sludge flow rate = 105.28 kg/day

### 3.4. FILTER FEED PUMPS:

* Pumping rate = 49.0625 m³/hr
* Pumping head = 30.0m

### 3.5. PRESSURE SAND FILTER:

* Total Flow = 785 m³/day
* Duration of Pumping assumed = 10 hrs
* Pumping rate = 78.5 m³/hr
* Surface loading considered = 10 m³/ m²/hr
* Area of filter required = 7.85 m²
* Diameter of filter required = 3.2 m
* Number of sand filters = 1
* Height of shell = 2.5 m
* Media for sand filter: Pebbles, grit, silt, gravel, and coarse & fine sand.

### 3.6. SLUDGE PUMP:

* Duration of pumping = 8 hrs/day
* Pumping rate = 2.0 m³/hr
* Pumping head = 15.0m

### 3.7. SLUDGE HOLDING TANK:

* Quantity of sludge generated = 785 m³/day
* Designing sludge holding tank with 1 day holding capacity
* Provided Volume of the tank = 157.0 m³

**Say 160 m³**
* Size of the tank = 31.50Sq.mtx3.0 m liquid depth

### 3.8. SCREW PUMP:
* Pumping rate = 2.0 m³/hr
* Pumping head = 10 m

### 3.9. MECHANICAL FILTER PRESS:
* Design liquid sludge flow = 23550 L/day
* Daily solid sludge generation rate = 282.60 kg/day
* No. of days = 3 days
* Quantity of sludge solids load on the filter press = 847.80 kg/3 days

* Assume sludge holding capacity = 40 kg/m²
* Size of the filter press required = 21.195 m²
* Let the size of each plate = 0.61 m × 0.61 m = 0.37 m²
* Number of plates required = 57.28 no’s.
* Provide 1 filter press with 58 chambers each.

### 3.10. ALUM DOSING TANK WITH FLASH MIXER:
Provide metering pump of dosing capacity 4–6 LPH with 100 liters capacity dosing tank

### 3.11. COMMON TREATED WATER SUMP:
* Detention time = 12 hrs
* Volume of the unit = 588.75m³

Say 590 m³
* Air required = 295.0 m³/hr
* Size of the unit = 90.0 sq.mtx 6.80 liquid depth
3.12. **BLOWER CAPACITY:**

* Blower capacity required = Receiving tank + SBR + Treated Water collection sump + 10% extra

\[
= 560.40 \text{m}^3/\text{hr}
\]

**Say 565 m}^3/\text{hr}**

3.13. **UV DISINFECTION:**

The filtered water is passed through an U.V. Sterilizer for disinfection. One number of U.V. Sterilizer is provided for this purpose

3.14. **INTER PLANT PIPING:**

Provide PVC pipes of 4 ksc pressure rating including necessary specials like tee’s, bends, elbows, flanges etc

3.15. **ELECTRICALS:**

Provide and install motor control center with necessary cabling, earthing etc. complete.

Design details summary for STP of **785 KLD capacity**

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Particulars</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bar screen</td>
<td>0.6 x 1.0m long</td>
</tr>
<tr>
<td>2</td>
<td>Receiving tank</td>
<td>71.30 Sq.m x 5.0 m liquid depth</td>
</tr>
<tr>
<td>3</td>
<td>SBR (2 no.s)</td>
<td>64.20 Sq.m x 5.0 m liquid depth &amp; 54.0sqmx5.0m liquid depth</td>
</tr>
<tr>
<td>4</td>
<td>Pressure sand &amp; carbon filter</td>
<td>3.2m dia</td>
</tr>
<tr>
<td>5</td>
<td>Sludge holding tank</td>
<td>31.50 Sq.m x 3.0 m liquid depth</td>
</tr>
<tr>
<td>6</td>
<td>Decant Tank</td>
<td>89.0 Sq.m x 3.0 liquid depth</td>
</tr>
<tr>
<td>7</td>
<td>Mechanical filter press (Plates of 58 nos.)</td>
<td>0.61 m x 0.61</td>
</tr>
<tr>
<td>8</td>
<td>Common treated water collection</td>
<td>90.0sq.m x 6.80 m liquid depth</td>
</tr>
<tr>
<td>9</td>
<td>Blower capacity</td>
<td>565m}^3/hr</td>
</tr>
</tbody>
</table>
4.0 SCHEMATIC FLOW CHART:

Flow in 785m³/day

Bar screen chamber

Air Blowers

Receiving Tank

Sludge pump

SBR cum settling tank -1

SBR cum settling tank -2

Decant Tank

Filter feed pump

Activated Carbon filter
Pressure Sand filter

UV Steriliser

Common Treated water Sump

Reused for landscape development/toilet flushing/surplus discharge BWSSB sewer line

Sludge holding tank

Mechanical filter press

Sludge used as manure

PHE& Firefighting Consultants:
M/s. Sampath Kumar Associates Pvt. Ltd
Bengaluru