Foreword

As per the appointment as Consultants for the preparation of Detailed Project Report for the Sewerage project of Waidhan area under Municipal Corporation Singrauli city we are presenting this document. The project has been prepared for the future population of 2047 which is estimated as 3,50,000. It is presumed that at the time of commissioning of project, water supply shall be available @ 135 lpcd and accordingly the rate of sewage flow has been taken as (80% of water supply) 108 lpcd. Ground water infiltration @ 250 liters per manhole has been considered. As far as possible the design has been carried out for gravity flow in the sewer. In case of non achieving the minimum velocity (self cleansing velocity 0.6 m/s) suitable remedial measures shall be adopted at the time of execution. Looking to the ground topography the entire town has been bifurcated in three zones and accordingly separate STP have been provided on Sequencing Batch Reactors (SBR) technology for achieving the effluent parameter as per MOEF guidelines. Under the proposed project laterals / Manhole for house connection have also been provided.

The designs in this project report has been prepared as per relevant clauses of CPHEEO Manual on Sewerage and Sewage treatment.

This is a draft report for the approval of Municipal Corporation, Singrauli and the State Government. However the contents should not be used for construction purpose or the items of estimate should not be used to call the tenders without the prior approval of the Consultants.

As far as possible the project has been prepared considering the existing scenario of sewerage system which is mainly through open drains. The data regarding possible sites of STPs, Rate of water supply & flow of sewage has been collected from Municipal Corporation, Singrauli. Any discrepancy may kindly be brought to our knowledge immediately.
Salient Features

**Design Flow** : 80% of water supply @ 135 LPCD + Ground water infiltration (250 lpd per manhole) has been considered as design flow.

**Design consideration of the project**

- **Project Area** : Waidhan area in Singrauli Municipal Corporation
- **Implementing Agency** : Municipal Corporation, Singrauli
- **Total Cost of the Project** : Rs. 10255 Lacs Estimate based on UADDSOR w.e.f 10/5/12 and market rates
  - **Per Capita Cost of Project (Present)** : 4883.33
  - **Per Capita Cost of Project (Ultimate)** : 2930.00
  - **Per Capita Cost for O&M (Current)** : 148.16
  - **Design Population of the project (2047)** : 350000
  - **Peak Factor for Design of sewer** : 2.25
  - **Population density** : 1.90 (Population/Length)
  - **Design length of sewer line** : 184706.00 m
  - **Rider Mains** : 92353.00 m
  - **Sewage Treatment Plant(Intermediate phase)** : Based on Sequential batch Reactor (SBR) Technology

- **Waidhan**
  - **a)** 11.00 MLD *(Ward no.48 Ganiyari Road near River)*
  - **b)** 10.00 MLD *(Ward no. 42 Devra Village)*
  - **c)** 10.00 MLD *(Ward no.33 MIG Colony near nalla)*
• Material & class of pipe used:

Sewer line - a) DWC HDPE SN 8.0 160 mm to 400 flow diameter
b) RCC- NP4 Class beyond 400 mm flow diameter

Laterals for House Connection - DWC HDPE SN 8.0 120 mm diameter 175000 m long @ 5 m per households for 35000 households.

The future population of town has been worked out as per the methods given in CPHEEO Manual on sewerage & sewerage treatment 2013 edition. The probable population obtained by incremental increased method has been considered for the design purpose.

Probable Population considered for designing the project for the various zones of the project area is as below:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Year</th>
<th>Population</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2017</td>
<td>210000</td>
<td>73000</td>
<td>68400</td>
<td>68600</td>
</tr>
<tr>
<td>2.0</td>
<td>2032</td>
<td>280000</td>
<td>97100</td>
<td>91300</td>
<td>91600</td>
</tr>
<tr>
<td>3.0</td>
<td>2047</td>
<td>350000</td>
<td>121000</td>
<td>114300</td>
<td>114700</td>
</tr>
</tbody>
</table>
Detail of the sewer pipe line comprising of DWC HDPE SN 8.0 / RCC NP4 pipe as below:-

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Diameter (mm)</th>
<th>Zone - 1 (m)</th>
<th>Zone - 2 (m)</th>
<th>Zone - 3 (m)</th>
<th>Total Length (m)</th>
<th>Pipe Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>160</td>
<td>34911</td>
<td>34112</td>
<td>38206</td>
<td>107229</td>
<td>DWC HDPE PIPE</td>
</tr>
<tr>
<td>3.0</td>
<td>200</td>
<td>2558</td>
<td>3275</td>
<td>1999</td>
<td>7831</td>
<td>DWC HDPE PIPE</td>
</tr>
<tr>
<td>3.0</td>
<td>295</td>
<td>9658</td>
<td>8217</td>
<td>7261</td>
<td>25135</td>
<td>DWC HDPE PIPE</td>
</tr>
<tr>
<td>4.0</td>
<td>480</td>
<td>2814</td>
<td>4635</td>
<td>9158</td>
<td>16606</td>
<td>RCC NP4 PIPE</td>
</tr>
<tr>
<td>5.0</td>
<td>450</td>
<td>1347</td>
<td>1132</td>
<td>292</td>
<td>2771</td>
<td>RCC NP4 PIPE</td>
</tr>
<tr>
<td>6.0</td>
<td>500</td>
<td>1587</td>
<td>3054</td>
<td>1174</td>
<td>5815</td>
<td>RCC NP4</td>
</tr>
<tr>
<td>7.0</td>
<td>600</td>
<td>3829</td>
<td>4073</td>
<td>672</td>
<td>8574</td>
<td>RCC NP4</td>
</tr>
<tr>
<td>8.0</td>
<td>700</td>
<td>-</td>
<td>1834</td>
<td>1014</td>
<td>1198</td>
<td>RCC NP4</td>
</tr>
<tr>
<td>9.0</td>
<td>900</td>
<td>7319</td>
<td>1532</td>
<td>696</td>
<td>9547</td>
<td>RCC NP4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>64022</td>
<td>60213</td>
<td>60471</td>
<td>184706</td>
<td></td>
</tr>
</tbody>
</table>

Rider mains comprising of 160 mm dia and 92353.00 m length DWC SN 8.0 pipe which shall be laid in a slope of 1 in 100 for the length of 150 m. The pipe shall be connected to the house chambers and shall carry the sewerage which will be connected to main sewer line on the either side of the road. Rider main shall only be provided for the roads having width more than 5 m.

**Sewage Treatment Plants at Waidhan**

The design of Sewer Network has been carried out for gravity flow as per the ground topography and restrict the depth of excavation. The municipal area is being divided into 3 Zones so as to have provide gravity flow and restrict the depth of excavation and each zone is provided separate STP based on SBR Technology or anyone situation. The technology is being decide primarily taking into account. The volume of sewerage water to be treated & CPCB norms for discharging waste water.

**Zone 1**

1. Construction of a sewage treatment plant at **Ward no.48 Ganiyari Road near River** having capacity of 11.00 MLD for population of 97100 estimated for the year 2032. Land required to construct STP is approximately 0.48 Ha. The STP shall have sump of 155 KL, along with 2 nos. pumps of 19.00 KW, 1 no. 37.00 KW, 1 no. 55.00 KW for
1 DWF; 2 DWF; 3 DWF of intermediate flow (9.00 MLD) shall be provided. For pumping of sewage from sump to STP, 600 mm diameter 100 m long DI K7 pipeline has been proposed.

**Zone 2**

2. Construction of a sewage treatment plant at **Ward no. 42 Devra Village** having capacity of 10.00 MLD for population of 91300 estimated for the year 2032. Land required to construct STP is approximately 0.45 Ha. The STP shall have sump of 150 KL, along with 2 nos. pumps of 17.00 KW, 1 no. 33.00 KW, 1 no. 50.00 KW for 1 DWF; 2 DWF; 3 DWF of intermediate flow (10.00 MLD) shall be provided. For pumping of sewage from sump to STP, 600 mm diameter 100 m long DI K7 pipeline has been proposed.

**Zone 3**

3. Construction of a sewage treatment plant at **Ward no.33 MIG Colony near nalla** having capacity of 10.00 MLD for population of 91600 estimated for the year 2032. Land required to construct STP is approximately 0.45 Ha. The STP shall have sump of 150 KL, along with 2 nos. pumps of 17.00 KW, 1 no. 33.00 KW, 1 no. 50.00 KW for 1 DWF; 2 DWF; 3 DWF of intermediate flow (10.00 MLD) shall be provided. For pumping of sewage from sump to STP, 600 mm diameter 100 m long DI K7 pipeline has been proposed.

**Manholes**

Construction of 3085 nos of circular manholes having size of 1500 mm bottom diameter and 525 mm top diameter including ISI marked reinforced concrete heavy duty cover complete at average 60 m spacing.

**House Chamber**

Construction of 7000 nos. Road gully chambers of Brick masonry having size of 110x50x77.5 cm one for every 5 houses as per item no. 14.9.3 Of UADD SOR w.e.f. 10 May 2012 with 500x450mm Horizontal and 450x100mm vertical gratings.

**House Connection sewer**

Providing and laying 100/120 mm diameter DWC pipe having length of 175000 m DWC Pipe as per item no. 12.2.1.2 of UADD SOR w.e.f. 10 May 2012 for connecting houses chamber to sewer lines.

**Reuse of sewerage water**

110 mm diameter 20000 m long PVC pipe shall be laid along with pump sets at STP for pumping & using treated sewerage water for the gardening & recharging of water bodies with in municipal area.
1.0 Introduction of Project area:

Singrauli is fast emerging as an energy hub of India, especially for thermal power and coal, therefore, locally it is also called 'Urjanchal' (a Hindi word which means land of energy). The area is situated in the eastern part of the Madhya Pradesh and adjoins the southern part of Sonebhadra district in the state of UP is collectively known as Singrauli. Singrauli is emerging as India’s Energy Capital, the place earlier known as Shringavali, named after the sage Shringi, which was once upon a time covered with dense and un navigable forests and inhabited by wild animals. The place was considered so treacherous that it was used by the Kings of Rewa State, who ruled the area until 1947, as an open-air prison for detaining errant civilians and officers.

Just two generations ago, small holders were tending their parcels of land here, and the original inhabitants were gathering honey and herbs in the forest. In the late fifties, a large-scale dam banked up the water of the River Rihand. Pt. Jawaharlal Nehru inaugurated the dam known as Govind Ballabh Pant Sagar in 1962. Later, rich coal deposits spread over an area of 2200 km² in the state of M.P. (eastern part of Sidhi Distt.) and U.P. (southern part of Sonebhadra Distt.) were discovered close to the artificial lake that could be used to generate electricity.

Geographical Location

The area is located in the eastern part of the Madhya Pradesh and adjoins the southern part by Sonebhadra district in Uttar Pradesh. City bounded with Rihand reservoir in eastern side and Kachan River among western side. The City is located on 24°20’ N Latitude and 82°40’ E Longitude at an altitude of 380 m above mean sea Level. The total Municipal area is approximately 284.00 Sq kms.

Connectivity and Linkages

While Singrauli is well connected by rail and road, but because of the poor transportation facilities accessibility of the city is poor. National Highway-75E passing through Singrauli connects it to Rewa, Singrauli and Varanasi and other cities. The city is also connected to other regional nodes like Gobindgarh by state highways and major district road. Table below shows the distance of major cities from Singrauli. Renukoot and Shakitinagar are the adjoining cities of Singrauli. Varanasi is the foremost city located from the distance of 208 K.m. Singrauli city lies on broad gauge railway line connecting Katni to Choppan. The nearest airport is at Varanasi and one at Mayurpur owned by Hindalco. However, the public transportation link is extremely poor. People either have to use their private vehicle to commute within the city or to waste a lot of time for public services mostly owned and operated by some private body.
2.0 **Existing sewerage system:**

Many things that can make for healthy cities, clean living conditions are very important. Sanitation is a basic component of development. At present, Waidhan lacks the sewerage network. The sewage from households and other commercial establishments flow with storm water on the surface. The major source of sewage is from Domestic, Commercial, Industrial and Institutional areas within the city. Presently the population of municipal corporation Singrauli is 2.16 laces (provisional census 2011). The urban area is 284 Km². Singrauli and Waidhan is drawing approximately 80.00 MLD water from from Rihind Dam and Bijur River. But there is no sewerage system exists in city as on date. However the sludge from the households and unhygienic septic tank effluent goes into open drain namely.

a) Balia nallah

The above open drains/nallahs are finally draining into Mahar River. The sewerage water is polluting the river and also creating nuisance for the common man.

The waste water coming from schools, colleges, hospitals and hotels are also draining into natural nallahs. There is no separate collection system for the waste water coming from meat market and hospital for which the sewerage collection and treatment is very important.

The total road length of Waidhan is approximately 190 kms comprising of cement concrete / WBM/ Bituminous road surface. The width of the road varies from 3.0 meters to 22.0 m. 80% of Sewage generated is been collected in the Individual Septic Tanks while rest all sewage is discharged in Natural Streams and Open Storm Water Drains in the Town. Further the effluent from Septic Tanks is also discharged in Natural Streams and can be considered a threat to health and hygiene of the citizens.

Most of the existing houses are RCC / Brick masonry structures. The people are having modern amenities and facilities in houses. Accordingly the people are willing to have an integrated sewerage system so that the sewage collection and treatment can be done in systematic manner and the town may have the clean and hygienic environment.

There are 37 slum pockets notified by Singrauli Municipal Corporation with population of 38882. The last survey for slum pockets and population was done in 2001. The main slums are,

a) Hirrawah Tola East
b) Pichaur Purani Basti
c) Naugarh Harijan Basti
d) Juwadi, Telgawan
e) Punarwas Colony
f) Harrae West
g) Dhenki  
h) Majan Khurd  
i) Chandrama Tola  
j) Kachni  
k) Saraswah Basti  
l) Tansen Ward  
m) Chatka Jhuggi Basti  
n) Basti to the East of CETI  
o) Kushwae

A total of 6,843 households come under notified slum in the city. Out of these 2,264 households come under below Poverty Line. Around 17% of SMC area 47.48 ha out of 280.67 ha comes under slum area.  
(Source: city development plan)
3.0 Need for this project:

The total installed capacity of Singrauli and Waidhan water supply system at present is 55.50 MLD. The water is being supplied mainly from Rihind Dam and Bijur River, which shall enable to fulfill the water @ 135 lpcd shall be supplied to the town.

The main components of the scheme are as below,

<table>
<thead>
<tr>
<th>Source</th>
<th>Rihind Dam and Bijur River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>20.00 m Height and 8.00 m Diameter at Rihind dam, 20.00 m Height and 6.00 m Diameter at Bijur River</td>
</tr>
<tr>
<td>Raw Water Pumps</td>
<td>6 Nos. Vertical turbine pumps</td>
</tr>
<tr>
<td>Raw Water Rising main</td>
<td>400 mm to 700 mm Dia DI-K9 pipe 5118 m long</td>
</tr>
<tr>
<td>Treatment plant</td>
<td>11.90 MLD at Bijur and 43.60 MLD at Rihind dam</td>
</tr>
<tr>
<td>Service reservoir</td>
<td>23 no. having cumulative capacity of 14.70 ML</td>
</tr>
<tr>
<td>Distribution system</td>
<td>HDPE and DI K7 129745 m</td>
</tr>
</tbody>
</table>

The City limits of Waidhan has not been extended in proportion to & the increase in population in past decade. This has resulted in increased population density. Moreover the water availability has resulted in waste water generation therefore it is necessary that there should be an integrated sewer system in the area so that,

a) The sewage flowing into the Nallahas and accumulating in various low lying areas can be checked effectively. The sewage is Municipal waste water having BOD₅ as high as 200mg/l. Thus one can easily assess the quantum of organic load flowing every day in water course due to non existence of sewerage system in Singrauli.

b) The nuisance and health hazards may be prevented due to flow of sewage on the surface.

c) The waste water may be collected and treated so as to use in various other needs like gardening etc.

Sewerage system of city should be planned to suit the present & future needs. The population of waidhan has been taken as 3,50,000 (2047) including the population of adjoining areas which have been recently included in the Municipal Limits or have fair possibility of getting merged in the municipal limits during the design period.

The sewerage system has to be planned for the 80% of the total quantity of water supplied to the population of waidhan along with ground water infiltration up to design period of 30 years i.e., for the year 2047.
4.0 Proposed Project

Proposed project is designed to collect the sewage water from the houses and carry it to a suitable place for providing desired treatment before the waste water being finally being disposed off to river or reused for the purposes like irrigation, gardening, firefighting, Industrial & institutional supply or ground water recharge etc.

The project has been designed as per following consideration,

a) Providing, laying and jointing of sewer network for 100 % coverage of town area. The sewer design has been done for gravity flow. The design of sewer is being done for self-cleansing velocity. Sewage treatment plant based on SBR Technology is being proposed for treatment of sewerage. Any further extension & expansion of sewer network can be done to suit the future needs of the city by Municipal Corporation Singrauli during design period.

b) This project has been prepared for the design population of the town living in the area which is under Municipal Corporation jurisdiction for public amenities. The design population for this area has been projected as 350000 (2047).

c) The project area, waidhan has been divided into three Zones to utilize available ground topography of the project area so as to have a gravity flow system having minimum velocity for self-cleansing.

STP based on SBR Technology have been provided for treatment of sewage. The STP technology is being selected primarily taking into consideration less land requirement and to have effluent characteristics as per MOEF, so that treated water can be reuse of discharged into inland water ways which are being potential drinking water sources. The total estimated cost of waidhan sewerage project is approximately 10255.00 Lacs. The details of major works of the proposed project are as below,

1.0 Providing, laying and jointing of sewer lines comprising of **DWC HDPE SN 8.0 pipes & RCC NP4 pipes** of diameters from 160 mm to 900 mm in various parts of town including all necessary civil structures like Manholes, house chambers sewer appurtenances etc. The details of the length of sewer lines for each diameter is as below,

a) 160 mm 107229.00 meters in length (DWC HDPE)

b) 200 mm 7831.00 meters in length (DWC HDPE)

c) 295 mm 25135.00 meters in length (DWC HDPE)

d) 480 mm 16606.00 meters in length (DWC HDPE)

e) 450 mm 2771.00 meters in length (NP4)
f) 500 mm 5815.00 meters in length (NP4)
g) 600 mm 8574.00 meters in length (NP4)
h) 700 mm 1198.00 meters in length (NP4)
i) 900 mm 9547.00 meters in length (NP4)

TOTAL 184706.00 m

2.0 Construction of 3 no. Sewage Treatment Plant Based on SBR Technology having cumulative capacity of 27.00 MLD sufficient enough for the treatment of sewerage likely to be generated by the population of the year 2032 which is estimated as 2,50,000.

**Zone 1**

a) Construction of a sewage treatment plant at Ward no.48 Ganiyari Road near River having capacity of 11.00 MLD for population of 97100 estimated for the year 2032. Land required to construct STP is approximately 0.48 Ha. The STP shall have sump of 155 KL, along with 2 nos. pumps of 19.00 KW, 1 no. 37.00 KW, 1 no. 55.00 KW for 1 DWF; 2 DWF; 3 DWF of intermediate flow (9.00 MLD) shall be provided. For pumping of sewage from sump to STP, 600 mm diameter 100 m long DI K7 pipeline has been proposed.

**Zone 2**

b) Construction of a sewage treatment plant at Ward no. 42 Devra Village having capacity of 10.00 MLD for population of 91300 estimated for the year 2032. Land required to construct STP is approximately 0.45 Ha. The STP shall have sump of 150 KL, along with 2 nos. pumps of 17.00 KW, 1 no. 33.00 KW, 1 no. 50.00 KW for 1 DWF; 2 DWF; 3 DWF of intermediate flow (10.00 MLD) shall be provided. For pumping of sewage from sump to STP, 600 mm diameter 100 m long DI K7 pipeline has been proposed.

**Zone 3**

c) Construction of a sewage treatment plant at Ward no.33 MIG Colony near nalla having capacity of 10.00 MLD for population of 91600 estimated for the year 2032. Land required to construct STP is approximately 0.45 Ha. The STP shall have sump of 150 KL, along with 2 nos. pumps of 17.00 KW, 1 no. 33.00 KW, 1 no. 50.00 KW for 1 DWF; 2 DWF; 3 DWF of intermediate flow (10.00 MLD) shall be provided. For pumping of sewage from sump to STP, 600 mm diameter 100 m long DI K7 pipeline has been proposed.

3.0 Laterals:

Providing, laying and jointing 100/120 mm diameter and 175000.00 m total length DWC HDPE pipe for connecting individual houses to the sewer lines. An average length of 5 m for each house has been considered for
approximately 35000 houses at present. Road Gully chamber of size 110x50x77.5 cm is being provided one for every 5 houses. Thus for 35000 houses 7000 chambers are being provided.

4.0 Railway Crossing

Total 2 nos of Railway Crossings at different locations are being proposed where in 250 mm diameter pipe of DWC HDPE shall be pushed by horizontal tunneling method below the railway track. Casing pipe of made out of Mild steel sheet 10 mm thick shall be used for the protection of pipe.

5.0 Laying of feeder line from the 33 KV line from the nearest substation up to the sewage pump houses for uninterrupted power supply to the pumps and motors.

6.0 Rider mains

Rider mains comprising of 160 mm DWC SN 8.0 pipes having length of 92353.00 m. The pipe shall be laid in a slope of 1 in 100 for the average length of 150 m. The pipe shall be connected to the house chambers and shall carry the sewage which will be connected to main sewer line on the either side of the road. Rider main shall only be provided for the roads having width more than 5 m.
### 4.1 Salient Features of Designs:

1. Sewer network for the Waidhan town is designed on Bentley Sewer Cad Software.

2. The diameters of the sewer line is being calculated as per the accepted design mythology. Minimum diameter is being taken as 150 mm. The details of design diameter and diameter of relevant commercial available pipe is given below for ready reference,

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Design Dia</th>
<th>Outer Dia</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150</td>
<td>135/160</td>
<td>HDPE - DWC</td>
</tr>
<tr>
<td>2</td>
<td>170</td>
<td>170/200</td>
<td>HDPE - DWC</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
<td>250/295</td>
<td>HDPE - DWC</td>
</tr>
<tr>
<td>4</td>
<td>400</td>
<td>400/480</td>
<td>HDPE - DWC</td>
</tr>
<tr>
<td>5</td>
<td>450</td>
<td>450</td>
<td>RCC - NP4</td>
</tr>
<tr>
<td>6</td>
<td>500</td>
<td>500</td>
<td>RCC - NP4</td>
</tr>
<tr>
<td>7</td>
<td>600</td>
<td>600</td>
<td>RCC - NP4</td>
</tr>
<tr>
<td>8</td>
<td>700</td>
<td>700</td>
<td>RCC - NP4</td>
</tr>
<tr>
<td>9</td>
<td>900</td>
<td>900</td>
<td>RCC - NP4</td>
</tr>
</tbody>
</table>

### Design Parameters

The sewer network has been designed for gravity flow having minimum self-cleansing velocity in initial reaches where self-cleansing velocity is not achieved due to less flow flushing shall be provided at the interval of 2-3 times in a week. The design has been carried out with the help of Bentley Sewer-CAD. The input parameters are as follows,

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dia. Of Pipe (mm)</td>
<td>150</td>
<td>900</td>
</tr>
<tr>
<td>Velocity (m/s)</td>
<td>0.60</td>
<td>3.00</td>
</tr>
<tr>
<td>Slope (m/m)</td>
<td>1/2000</td>
<td>1/100</td>
</tr>
<tr>
<td>Cover</td>
<td>1.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

The design has been carried out to achieve minimum velocity of 0.60 m/s for the present design flow. However due to less velocity in initial lengths it is suggested to have flushing in the pipes, by sewer flushing machine at a desired frequency. The slope of the sewer lines has been selected so as to have...
optimum trench depth for reducing excavation cost and for ease in operation in maintenance after the commissioning of the project.

Following are the assumptions considered for design purpose,

a) Sewerage flow of 108 LPCD (80% of water supply which is 135 LPCD) has been adopted.

b) In order to accommodate the variation in hydraulic loading during the day cycle. The peak factor of 2.25 has been considered for all appurtenances, conduits, channels etc.

c) Sedimentation tanks have been designed on the basis of average flow, while consideration of both maximum and minimum flow has been given importance for designing of screens and grit chambers.

d) The velocity shall range within 0.6mps to 3.0 mps.

e) Sewers shall be at no point of time run more than 80% full. Based on this values of v/V, q/Q and d/D has been adopted as illustrated for Manning’s Formula in CPHEEO Manual.

f) Sewer network has been designed for self – cleaning velocity & optimum slope. However looking to the fall that initial years. The number of connection will not be 100 % & more to percent. In the initial stretches shall have less velocity it is proposed to clean in small sewers by pneumatic cleaning machine or manually by providing planks to hold the flow for 24 - 48 hrs. & there after removing the planks when water is head up so that the velocity is achieved.

g) The design are carried out for v/V, q/Q and d/D for average flow of sewerage. However the self-cleansing velocity shall be achieved during peak hours as every day rendering the required achieving of sewers

**Reuse of sewerage water**

110 mm diameter 20000 m long PVC pipe shall be laid along with pump sets at STP for pumping & using treated sewerage water for the gardening & recharging of water bodies with in municipal area.
5.0 Population Forecasting

The design population for the next 30 years have been forecasted for the Singrauli Town. The probable population of next 30 years has been worked out taking into account the grown of population of past decades. Four methods namely Arithmeti, Geometric, Incremental and Graphical methods of Population Projection (have been adopted) as detailed out in CPHEEO Manual. Looking to factors governing the future growth and development of the Ratlam city likewise industrial, commercial, educational, social and administrative aspects it is felt that the most suitable method for population projection will be Incremental Increase method.

Population Forecasting & Estimation

The population of the Singrauli city for the past three decades are as follows,

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>119086</td>
</tr>
<tr>
<td>2001</td>
<td>185190</td>
</tr>
<tr>
<td>2011</td>
<td>220000</td>
</tr>
</tbody>
</table>

Future population of the city has been forecasted by the following four methods,

a) Arithmetic Progression Method
b) Geometric Progression Method
c) Incremental Increase Method
d) Graphical Method
(a) Arithmetic Progression Method:

The method generally applicable to large & old cities. This method usually gives lower population & should be adopted only when the future growth of the city is expected to be very slow. Increase in population of each decade is calculated & then the average increase in population per decade is calculated by dividing total increase in population with the number of decades considered.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Increment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>119086</td>
<td>-</td>
</tr>
<tr>
<td>2001</td>
<td>185190</td>
<td>66104</td>
</tr>
<tr>
<td>2011</td>
<td>220000</td>
<td>34810</td>
</tr>
<tr>
<td>Total</td>
<td>100914</td>
<td></td>
</tr>
</tbody>
</table>

Increase of 100914 in 2 decade’s means 50457 per decade is the growth rate. Taking this into consideration the future population is,

2017 220000 + 0.6 x 50457 = 250274
2032 220000 + 2.1 x 50457 = 325960
2047 220000 + 3.6 x 50457 = 401645
(b) Geometrical Progression Method

Geometric mean is calculated for finding the rate of growth. This method is applicable in the cities where city is growing very speedily.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Increment</th>
<th>Rate of growth (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>119086</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>185190</td>
<td>66104</td>
<td>0.555</td>
</tr>
<tr>
<td>2011</td>
<td>220000</td>
<td>34810</td>
<td>0.188</td>
</tr>
</tbody>
</table>

Geometric mean = \( (0.555 \times 0.188)^{1/2} \)

= 0.323

Population of 2017 = population of 2011 \( \times (1 + 0.323)^{0.6} \)

= 220000 \( \times (1 + 0.323)^{0.6} \)

= 260230

Population of 2032 = 396002

Population of 2047 = 602612
(c) Incremental Increase Method

In this method the increment in arithmetical increase is determined from the past decades and the average of that increment is added to the average increase. This method improves the figures obtained by the arithmetical increase method.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Increment X</th>
<th>Incremental Increase Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>119086</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>185190</td>
<td>66104</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>220000</td>
<td>34810</td>
<td>-31294</td>
</tr>
<tr>
<td>Total</td>
<td>100914</td>
<td></td>
<td>-31294</td>
</tr>
</tbody>
</table>

Average = 1/2 x 100914 = 0
= 50457 = 0

\[ P_n = P_1 + nX + n(n+1)Y/2 \]

\[ P_{2017} = P_{2011} + 0.6 \times 50457 + 0.6(0.6+1) \times 0 \]
= 220000 +0.6 x 50457 + 0
= 250274

\[ P_{2032} = 325960 \]
\[ P_{2047} = 401645 \]
d) Graphical Method

In this method the graph is plotted based on the population of previous decades & it is smoothly extended to obtain future population. To obtain smooth line of graph the method of least squares is being adopted. The equation of curve is being derived which satisfy the pair of variables i.e, the population against the time. Here the population is taken on y-axis & time (year) on x-axis.

Starting from 1991 to 2011 the observations are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>119086</td>
</tr>
<tr>
<td>2001</td>
<td>185190</td>
</tr>
<tr>
<td>2011</td>
<td>220000</td>
</tr>
</tbody>
</table>

Thus, the set of observations are:
(0-119086), (10-185190), (20-220000)

Here the growth of population is exponentially. Therefore the equation of curve is taken as,

\[ y = ae^{bx} \] — eq. (1)

The above equation can be taken in the linear form as below,

\[ \log_{10} y = \log_{10} a + bx \log_{10} e \]
\[ Y = A + BX \] — eq. (2)
\[ \text{Sum} (Y) = n A + \text{Sum} (x) B \] — eq. (3)
\[ \text{Sum} (xy) = \text{Sum} (x) A + \text{Sum} (x^2) B \] — eq. (4)

Where, \( Y = \log_{10} y \), \( A = \log_{10} a \), \( B = b \log_{10} e \)

Graph is plotted taking Years on X-Axis where the scale is taken as 10 units equal to 10 years. Tabulating as below the data of population as per the calculation requirement.
### Sewerage Project For Waidhan

**For**

**Waidhan Municipal Corporation**,

**Singrauli**

Vastushilpi Projects and Consultants (P) Ltd.

**April, 2016**

<table>
<thead>
<tr>
<th>Year</th>
<th>X</th>
<th>Population</th>
<th>log_{10}y = Y</th>
<th>Xy</th>
<th>x^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>0</td>
<td>119086</td>
<td>5.07</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2001</td>
<td>10</td>
<td>185190</td>
<td>5.27</td>
<td>52.7</td>
<td>100</td>
</tr>
<tr>
<td>2011</td>
<td>20</td>
<td>220000</td>
<td>5.34</td>
<td>106.8</td>
<td>400</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>30</strong></td>
<td><strong>15.69</strong></td>
<td><strong>159.5</strong></td>
<td><strong>500</strong></td>
<td></td>
</tr>
</tbody>
</table>

Eq (3) & (4) will be changed to,

\[ 15.69 = 3A + 30B \quad \text{-------- (5)} \]

\[ 159.5 = 30A + 500B \quad \text{-------- (6)} \]

A = 5.1

Substituting value of (A) from eq (6)

B = 0.013

Solving it we get,

B = 0.013

A = 5.1

Y = A + B.x

Y = 5.1 + 0.013 x

B = 0.013 = b \log_{10} e

b = 0.0299

A = 5.1 = \log_{10} a

a = 125893

y = 125893 e^{0.0299x}

The graph has been plotted as per above equation. Based on the curve plotted as per the above equation the population of Singrauli for respective years is as follows,

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>369382</td>
</tr>
<tr>
<td>2032</td>
<td>578438</td>
</tr>
<tr>
<td>2047</td>
<td>905812</td>
</tr>
</tbody>
</table>
5.1 Conclusion:

From the population projection we are having for the Singrauli city it is concluded that

1. **Arithmetic Progression** method has given the population projection on the lower side. This method is not suitable for the city like Singrauli. The probable population worked out in this method growth of 82% in 36 years (2011-2047) which is almost 2.2% per annum or 22% for decade. This projection is less than the average growth rate of Madhya Pradesh. Hence the population projection seems to be on lower side.

2. The probable population worked out in the **Geometric Progression** method shows a growth of 173% in 36 years (2011-2047) which almost 4.8 percentage per annum and 48% per decade. Hence looking to the future development aspects of Singrauli the population projection given by this method seems to be very much higher side.

3. **Incremental Increase** method improves the figures obtained by Arithmetic method and shows a growth of 83% in 36 years, which almost 2.29% per annum or 23% per decade. This projection is line with the average growth rate of Madhya Pradesh. Henceforth, gives a projection which is realistic and can be adopted for design purpose.

4. In case **Graphical Method** the population projection figures are close to Geometric progression method and seems to be far realistic and practical. This method shows a growth of 311% in 36 years (2011-2047) which is almost 8.65% per annum or 87% per decade. This projection is far more than the average growth rate of Madhya Pradesh. Hence the population projection figures obtained in this method and are on higher side and can’t be acceptable for design purposes.

As per the figures obtained from various methods the population projection obtained as per Incremental Increase method is in line with the state decadal growth rate and seems to be realistic. Thus for design purpose it is suggested to follow the population given by Incremental Increase Method

Note:-

The total population of Singrauli Municipal Corporation area worked out by population projection method is 250274 (2017), 325960 (2032), 401645 (2047). Due to the presence of various industries like Singrauli Super Thermal Power Station, Vindhyachal Thermal Power Station, Rihand Thermal Power Station, Northern Coalfields Limited, Sasan Ultra Mega Power Project and many others in the town. The population adopted in the project is at higher side i.e.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>3,00000</td>
</tr>
<tr>
<td>1st Phase</td>
<td>4,00000</td>
</tr>
<tr>
<td>2nd Phase</td>
<td>5,00000</td>
</tr>
</tbody>
</table>
The above probable population has been forecasted for the entire Singrauli Municipal area including Waidhan. However the probable population for Waidhan has been taken as 70 % of the total population,

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>2, 10000</td>
</tr>
<tr>
<td>1st Phase</td>
<td>2032</td>
</tr>
<tr>
<td>IIInd Phase</td>
<td>2047</td>
</tr>
</tbody>
</table>
6.0 SEWAGE CHARACTERISTICS AND TREATMENT

Characteristics of wastes are essential for an effective and economical waste management programme. It helps in deciding treatment mechanism along with usage in irrigation community, industrial, institutional needs & recharging methods the extent of the treatment for optimum reuse of natural bodies of water in a planned and controlled manner.

Domestic sewage comprises of spent water from kitchen, bathroom, lavatory etc. The factors which contribute to variations in characteristics of the domestic sewage are,

a) Daily per capita water use, quality of water supply and the type.

b) Condition and extent of sewerage system and habits of the people.

In our case Singrauli does not have any Industrial establishment discharging its waste water in Municipal Waste water collection system. Commercial establishments like Hotels, Restaurants, Meeting places etc. have been considered. The important characteristics have been discussed here after considering that the waste is only municipal waste and Hospital waste and industrial waste will not come in the proposed sewerage system.

Temperature

Observation of temperature of sewage is useful in indicating the solubility of oxygen which affects oxygen transfer capacity of aeration equipment's and rate of biological activity. Extremely low temperature affects adversely the efficiency of sedimentation. In our case where the waste comprises of domestic and municipal sewage, temperature is slightly higher than that of the water supply.

Hydrogen Ion Concentration

The hydrogen ion concentration, more conveniently expressed as pH, is a valuable parameter in the operation of biological units. The pH of fresh domestic sewage is slightly more than that of the water supply to the community. However, the onset of septic conditions may lower the pH while the presence of industrial wastes may produce extreme fluctuations. In our case it has been considered slightly more than that of the water supply to the community.

Color and Odor

The fresh domestic sewage has a slightly soapy and earthy odor and cloudy appearance depending upon its concentration. With passage of time, the sewage becomes stale, darkening in color with a pronounced smell due to microbial activity.
Solids

Though sewage contains only 0.1 percent solids, the rest being water, still the nuisance caused by the solids cannot be overlooked, as they are highly putrescible and therefore need proper disposal. The sewage solids may be classified into suspended and dissolved fraction which may be further subdivided into volatile and non-volatile solids. The concentration of the volatile or organic fraction of solid which is putrescible is important in deciding the load on biological treatment units or oxygen resources of a stream when sewage is to be disposed of by dilution. The estimation of suspended solids, both organic and inorganic, also gives a general picture of the load on sedimentation and grit removal processes in sewage treatment. Dissolved inorganic fraction is considered when sewage is to be used for land irrigation or reuse of sewage, is planned.

Nitrogen

The principal nitrogenous compounds in domestic sewage are proteins, amines, amino-acids and urea. Ammonia nitrogen in sewage results from the bacterial decomposition of these organic constituents. Nitrogen being an essential component of biological protoplasm, its determination in wastes is necessary for proper biological treatment or land irrigation. Where nitrogen content is inadequate, it becomes necessary to supplement with addition of salts containing nitrogen. Generally domestic sewage contains sufficient nitrogen, to take care of the needs of the biological treatment.

Phosphorus

Phosphorus is contributed to domestic sewage from food residues containing phosphorus and their breakdown products. The use of increased quantities of synthetic detergents adds substantially to the phosphorus content of sewage. Phosphorus just as nitrogen is an essential nutrient for biological processes. In normal conditions domestic sewage contains adequate quantities of phosphorus.

Chlorides

Concentration of chlorides in sewage above the normal is due to chloride content in water supply and is used as an index of the strength of the sewage. The daily contribution of chlorides averages to about 8 gm per person. Based on an average sewage flow of 150 lpcd, the chloride content of sewage is being 50mg/l, higher than that of the water supplied. The abnormal increase indicate discharge of chloride bearing wastes or saline ground water infiltration, the latter adding to the sulphates which may lead to excessive generation of hydrogen sulphide.
Biochemical Oxygen Demand

The Biochemical Oxygen Demand (BOD) of sewage or of polluted water is the amount of oxygen required for the biological decomposition of biodegradable organic matter under aerobic conditions. The oxygen consumed in the process is related to the amount of decomposable organic matter. Greater reliance is placed on BOD test as compared to determination of volatile solids when putrescibility of the sewage is to be determined. The standard BOD test is carried out for a period of 5 days at 20°C and is expressed as BOD₅.

Chemical Oxygen Demand

The Chemical Oxygen Demand (COD) test gives a measure of the oxygen required for chemical oxidation. This test does not differentiate between biologically oxidisable and non-oxidisable material. However, the ratio of the COD to BOD does not change significantly for a particular waste and hence this test could be used conveniently for interpreting performance efficiencies of the treatment units. In situations like ours where the toxic materials are not present this test is not useful.

Toxic Metals and Compounds

Some heavy metals and compounds such as chromium, copper, cyanide, which are toxic may find their way into municipal sewage through industrial discharges. Determinations of these assume importance if such waste is to be treated by biological process or disposed of in stream or on land. However, the same is not relevant in our case.

Effluent disposal and utilisation

The sewage after treatment may be disposed into a water body. It may also be utilised for several purposes such as

(i) Industrial reuse or reclaimed sewage effluent in cooling systems, boiler feed, process water etc.,

(ii) Reuse in agriculture and horticulture, watering of lawns, golf courses and such purposes.

(iii) Ground water recharge for augmenting ground water resources for downstream users or for preventing saline water intrusion in coastal areas.

(iv) Use of sewage effluent may be at the treatment plant itself for purposes, such as, flushing and foam control, chlorinator injector water, lawn sprinkling, fire protection (with necessary safe-guards) and general plant operation.
6.1 Sampling of the sewage

Presently the waste water comprising of Sewage and Strom water flows into low lying areas or flows in the form of Nallahas without any proper treatment. The objective of proposed waste water system is to collect the waste water and treat it so as to stabilize decomposable organic matter present in sewage so as to produce an effluent having characteristics with in the prescribed norms and sludge which can be disposed off without causing health hazards or nuisance.

Design of treatment plant is based on the characteristics of the raw sewage and the quality of the final effluent desired. Accordingly looking to Municipal waste having low strength in terms of organic load the treatment facility and the sewerage network has been designed for Ratlam so that the effluent may be reuse for the purposes like irrigation, gardening, firefighting, Industrial & institutional supply or discharged in the river for a period of next 30 years after its completion i.e., upto 2047.

In Municipal waste water the quantity of sewage and its characteristics show a marked range of hourly variation and hence peak, average and minimum flows are important considerations. The process loadings in the sewage treatment are based on the daily average flows and the average characteristics as determined from a 24 hour weighted composite sample.
6.2 UNIT OPERATIONS AND PROCESSES

For the removal of contaminants a sequential combination of various physical unit operations and chemical and biological unit processes are to be carried out. The physical unit operations include screening, grit removal and sedimentation. The chemical processes including chemical coagulation followed by flocculation are not usually used for treatment of domestic waste waters. The biological processes can be broadly classified as,

(i) Suspended growth processes both aerobic and anaerobic, including activated sludge process, extended aeration, lagooning, nitrification, denitrification and anaerobic digestion.

(ii) Attached growth processes such as aerobic and anaerobic filter processes.

6.3 DESIGN OF PROCESS FLOW SHEETS

The design of process flow sheet involves selection of an appropriate combination of various unit operations and unit processes to achieve a desired degree of contaminant removal. The selection of unit operations and processes primarily depends on the characteristics of raw waste water and the required levels of contaminants permitted in the processed effluents. The design of process flow sheets is very important step in the overall design of waste water treatment and requires a thorough understanding of the treatment units and associated unit operations/ processes along with the mechanisms involved and performance levels attainable under variable conditions. It calls for optimization of waste water treatment system coupled with stage wise optimal design of individual operation/ process to achieve a minimal cost design.

The main contaminants in domestic waste water to be removed are biodegradable organics, as usually measured by BOD, suspended solids and pathogens with the first two having been traditionally considered as the performance indicators for various treatment units. The objective of domestic waste water treatment plant will be to produce treated effluents having BOD₅ of 30 mg/l or less and suspended solids of 50 mg/l or less so as to disposal it into inland water bodies.

The conventional process flow sheet of municipal wastewater treatment plant comprises the unit operations of screening, grit removal and primary sedimentation followed by unit process of aerobic biological treatment usually achieved by activated sludge process or trickling filter followed by secondary sedimentation. The sludges removed by primary and secondary sedimentation are digested anaerobically followed by drying of anaerobically digested sludge on sand sludge drying beds.
The activated sludge process or trickling filter process are replaced by low cost treatment devices such as oxidation pond, aerated lagoon or waste stabilization ponds. Such treatment devices obviate the necessity of some of the unit operations and processes like primary sedimentation and anaerobic digestion. Also they are low in capital as well as O&M cost.

With the better understanding of microbiology and biochemistry of anaerobic treatment, it is now feasible to treat dilute organic wastewater such as domestic wastewater also directly through anaerobic treatment using recently developed innovative devices such as Up flow Anaerobic Sludge Blanket Reactor (UASBR), Fluid-Bed Submerged Media Anaerobic Reactor (FB-SMAR) and Anaerobic Filter (AF) or Static-Bed SMAR(SB-SMAR) and Anaerobic Rotating Biological Contractor (AnRBC). Though enough field data is to be generated as yet on their performance. It is generally reported that BOD$_5$ removal efficiencies may range from 60-80%. Consequently cost treatment will generally be required to achieve the prescribed effluent standards.

According Sequential Batch Reactor (SBR) is one of the best available treatment for Municipal Sewerage so as to achieve effluent parameters as per PCB norms.
6.4 SELECTION OF SUITABLE PROCESSES

Sewage treatment processes may be generally classified as primary, secondary and tertiary. The general yardstick of evaluating the performance of sewage treatment plants is the degree of reduction of BOD, SS and Total Coliforms. The efficiency of a treatment plant depends not only on proper design and construction but also on good operation and maintenance. Expected efficiencies of various treatment units are given Table

<table>
<thead>
<tr>
<th>Process</th>
<th>Percentage Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS</td>
</tr>
<tr>
<td>1. Primary Treatment (Sedimentation)</td>
<td>45-60</td>
</tr>
<tr>
<td>2. Chemical Treatment</td>
<td>60-80</td>
</tr>
<tr>
<td>3. Secondary Treatment</td>
<td></td>
</tr>
<tr>
<td>(i) Standard trickling filters</td>
<td>75-85</td>
</tr>
<tr>
<td>(ii) High rate trickling filters</td>
<td></td>
</tr>
<tr>
<td>(a) Single Stage</td>
<td>75-85</td>
</tr>
<tr>
<td>(b) Two Stage</td>
<td>90-95</td>
</tr>
<tr>
<td>(iii) Activated sludge plants</td>
<td>85-90</td>
</tr>
<tr>
<td>(iv) (a) Stabilisation ponds (Single Cell)</td>
<td>80-90</td>
</tr>
<tr>
<td>(b) Stabilisation ponds (Two Cells)</td>
<td>90-95</td>
</tr>
</tbody>
</table>

Tertiary treatment is adopted when reuse of effluent for industrial purposes is contemplated or when circumstances dictate the requirement of higher quality effluents.

Cost is the prime consideration in the selection of the treatment method. It should include the cost of installation, capitalised cost of maintenance and operation taking into account interest charges and period of amortisation. An alternative considering the annual cost covering amortisation and interest charges for the loan obtained for the installation together with the annual operating and maintenance costs. In our case there is a component of subsidy
granted by the Government for the installation of the treatment works and the maintenance cost is to be borne entirely by the local body.

Other factors that are influencing are ease of construction and maintenance, benefits that accrues from better environmental sanitation, location, availability of land and topographical conditions.

SBR shall render effluent parameter to the extent that treated water can be reuse for the purposes like irrigation, gardening, firefighting, Industrial & institutional supply or discharge inland water ways which can be potential source of water supply in future.
6.5 VARIOUS COMPONENTS OF TREATMENT

PRETREATMENT - SCREENING

Pre-treatment consists of separation of floating and suspended organic and inorganic material by physical processes such as (a) screening by which materials larger in size than the openings of the screening device is strained out; and (b) grit removal by which coarse particles of ash and other inert material which have subsidence velocities substantially greater than those of organic putrescible solids are removed.

SCREENING

Screening is an essential step in sewage treatment for removal of materials which would otherwise damage equipment and interfere with the satisfactory operation of treatment units or equipment Accordingly Screens are proposed as a first step ahead of all treatment works.

A screen is a device with openings generally of uniform size for removing bigger suspended or floating matter in sewage. The screening element may consist of parallel bars, roads, gratings or wire meshes or perforated plates and the openings can be of any shape although generally they are circular or rectangular screens may be coarse, medium or fine.

Coarse Screens

They serve more as protective devices in contrast to fine screens which function as treatment devices. Coarse screens are usually bar screens and sometimes used in conjunction with comminuting devices.

A bar screen is composed of vertical or inclined bars spaced at equal intervals across a channel through which sewage flows. It is usual to provide a bar screen with relatively large openings of 75 to 150mm and ahead of the pumps for raw sewage while those preceding the primary sedimentation tanks have smaller openings of 50mm. Bar screens with large openings are often termed coarse racks or trash racks. Their principal function is to prevent the entry of floating matter like logs, timber or large sized material, carcasses, rags, etc., that is brought in by the flowing sewage.

Bar screens are usually hand cleaned and sometimes provided with mechanical devices. These cleaning devices are rakes which periodically sweep the entire screen removing the solids for further processing or disposal. Some mechanical cleaners utilise endless chains or cables to move the rake teeth through the screen openings. Screenings are raked to a platform with perforations which permits the drainage of water back to the unit. Hand cleaned racks are set usually at an angle of 45 degrees to the horizontal to increase the effective cleaning surface and also facilitate the raking operations. Experience indicates that the area of the vertical
projections of the space between the bars measured across the direction of the flow should be about twice the areas of the sewer.

Mechanically cleaned racks are generally erected almost vertically. Such bar screens have openings 25% in excess of the cross section of the sewage channel. Their area is usually half of that required for hand raked screens. Fabrication of screens should be such that bolts, cross bars, etc., will not interfere with raking operations. Additional provision should be available for manual raking to take care of the situations where the mechanical rakes are temporarily out of order. Plants using mechanically cleaned screens have controls for (a) manual start and stop (b) automatic start and stop by clock control(c) high level switch (d) high level alarm (e) starting switch or overload switch actuated by loss of head and (f) overload alarm.

**Medium Screens**

Medium bar screens have clear openings of 20 to 50mm. Bars are usually 10mm thick on the upstream side and taper slightly to the downstream side. These mechanically raked units are used before all pumps or treatment units such as the stabilization ponds. The bars used for the screens are rectangular in cross-section usually about 10mm x 50mm and are placed with the larger dimension parallel to the flow. A weir on the side of the screen may be used as an overflow bypass.

**Fine Screens**

Fine screens are mechanically cleaned devices using perforated plates, woven wire cloth or very closely spaced bars with clear openings of less than 20mm. Fine screens are used for pretreatment of industrial wastes to remove materials which tend to produce excessive scum or foam on the top of digestion tank contents. Fine screens are not normally suitable for sewage because of the clogging possibilities.

In our case Medium screens will be provide with an opening of 25mm. The screens will be cleaned periodically (once in 15 days manual) for effective performance.

**Disposal of Screenings**

The screenings will be disposed by either burying in ground or using it for making of compost. The screenings will not be left in the open or transported in uncovered conveyors as this could create nuisance due to flies and insects. If conveyors are to be used, they will be kept as short as possible for sanitary reasons. Burial will be done in trenches of 7.5cm to 10cm depth. Screens can also be incinerated but in our case since land is not a problem and therefore Screens can easily be disposed off in adjoining fields. Municipal Corporation may transport Screenings and mix it with town refuse for production of compost at a later stage or may resolve to install an incinerator to be operated by gas obtained by sludge digestion in a digester.
### 6.6 COMPARISON OF DIFFERENT METHODS OF SEWRAGE TECHNOLOGY

#### Biological Treatment Technologies-Comparison

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Parameter</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oxidation pond</td>
<td>Aeration Lagoon</td>
</tr>
<tr>
<td></td>
<td>OLD TECHNOLOGY</td>
<td>OLD TECHNOLOGY</td>
</tr>
<tr>
<td>2</td>
<td>Process in brief</td>
<td>BOD reduction takes place due to oxidation by Sunlight in aerobic, anaerobic, or aerobic-anaerobic environment. Complete treatment happens in series of ponds.</td>
</tr>
<tr>
<td></td>
<td>ADVANCE IMPROVISED TECHNOLOGY</td>
<td></td>
</tr>
</tbody>
</table>

It involves 2 stage treatment. 1: Primary Settling, where the solid separation is achieved due to the formation of bio-flocs assisted by a onetime added biomass. The sludge generated is also reduced in the same chamber and
<table>
<thead>
<tr>
<th>Sr No</th>
<th>Parameter</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oxidation pond</td>
<td>Aerated Lagoon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2: Phytorid Bed:
The clarified water which is 60% remaining BOD and settlable TSS has been removed is now allowed to flow itself by gravity eliminating the use of any electricity, for biological aerobic oxidation in the presence of friendly organisms which is inoculated only once at the time of commissioning.

Nutrient uptake of Nitrogen and Phosphates occur in this tank with the help of plantation.
## Biological Treatment Technologies-Comparison

<table>
<thead>
<tr>
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<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oxidation pond</td>
<td>Aerated Lagoon</td>
</tr>
<tr>
<td>3</td>
<td>&quot;SIZE-WISE&quot; Suitability of the process</td>
<td>Suitable for any size, no limitation. Larger sizes demand much higher space</td>
</tr>
</tbody>
</table>

### PERFORMANCE AFTER SECONDARY TREATMENT

<table>
<thead>
<tr>
<th></th>
<th>Biological Oxygen Demand (BOD)</th>
<th>Chemical Oxygen Demand (COD)</th>
<th>Total Suspended Solids (TSS)</th>
<th>Ammonical Nitrogen (NH₄-N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 mg/lit</td>
<td>250 mg/lit</td>
<td>100 mg/lit</td>
<td>no treatment</td>
</tr>
<tr>
<td></td>
<td>50 mg/lit</td>
<td>250 mg/lit</td>
<td>100 mg/lit</td>
<td>no treatment</td>
</tr>
<tr>
<td></td>
<td>30 mg/lit (UASB+ASP)</td>
<td>100 mg/lit (UASB+ASP)</td>
<td>100 mg/lit (UASB+ASP)</td>
<td>no treatment</td>
</tr>
<tr>
<td></td>
<td>20-30 mg/lit</td>
<td>100 mg/lit</td>
<td>100 mg/lit</td>
<td>no treatment</td>
</tr>
<tr>
<td></td>
<td>5 mg/lit</td>
<td>50 mg/lit</td>
<td>10 mg/lit</td>
<td>5 mg/lit</td>
</tr>
<tr>
<td></td>
<td>5 mg/lit</td>
<td>50 mg/lit</td>
<td>10 mg/lit</td>
<td>5 mg/lit</td>
</tr>
<tr>
<td></td>
<td>5 mg/lit</td>
<td>5 mg/lit</td>
<td>5 mg/lit</td>
<td>&lt;1 mg/ltr</td>
</tr>
<tr>
<td>Sr No</td>
<td>Parameter</td>
<td>Oxidation pond</td>
<td>Aerated Lagoon</td>
<td>UASB (Up flow anaerobic sludge blanket)</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Total Nitrogen (TN)</td>
<td>no treatment</td>
<td>no treatment</td>
<td>no treatment</td>
</tr>
<tr>
<td>2</td>
<td>Total Phosphorus (TP)</td>
<td>no treatment</td>
<td>no treatment</td>
<td>no treatment</td>
</tr>
<tr>
<td>3</td>
<td>Faecal coliforms</td>
<td>no treatment</td>
<td>no treatment</td>
<td>100 MPN/100 (after disinfection)</td>
</tr>
<tr>
<td>4</td>
<td>Additiona l treatment</td>
<td>Being obsolete technology, upgradation or pre-post treatments are not possible</td>
<td>Being obsolete technology, upgradation or pre-post treatments are not possible</td>
<td>Nutrient removal treatment &amp; final tertiary treatment (filtration, etc) are required</td>
</tr>
<tr>
<td>5</td>
<td>Additional treatment required to achieve the latest outlet norms</td>
<td>Sludge digestion takes places in pond itself &amp; by-product gases are liberated in atmosphere directly. There is sludge digestion rakes places in lagoon itself &amp; by-product gases are liberated in atmosphere directly. There is sludge is digested in UASB reactor itself. However, since further treatment such as Lagoon/ASP is required. Excess sludge from these treatment needs</td>
<td>Sludge digestion takes places in pond itself &amp; by-product gases are liberated in atmosphere directly. There is sludge digestion rakes places in lagoon itself &amp; by-product gases are liberated in atmosphere directly. There is sludge is digested in UASB reactor itself. However, since further treatment such as Lagoon/ASP is required. Excess sludge from these treatment needs</td>
<td>Excess bio-sludge needs separate digestion/stabilisation treatment. This is must, else excess bio-sludge at disposal point will create</td>
</tr>
</tbody>
</table>

Vastushilpi Projects and Consultants (P) Ltd.

April, 2016
## Biological Treatment Technologies-Comparison

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Parameter</th>
<th>Oxidation pond</th>
<th>Aerated Lagoon</th>
<th>UASB (Up flow anaerobic sludge blanket)</th>
<th>ASP (activated sludge process)</th>
<th>MBBR (Moving Bed Bio Film Reactor)</th>
<th>SBR (Sequential Batch Reactor)</th>
<th>Membrane Bio Reactor (MBR)</th>
<th>Phytorid</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Usage of treated effluent</td>
<td>no mechanism to control the system or to remove inert matters/sludge settled at the bottom. This creates odour problem in area.</td>
<td>no mechanism to control the system or to remove inert matters/sludge settled at the bottom. This creates odour problem in area.</td>
<td>stabilisation /digestion separately. This is must, else excess bio-sludge at disposal point will create odour problem</td>
<td>odour problem.</td>
<td>create odour problem</td>
<td></td>
<td></td>
<td>sludge at disposal point will create odour problem.</td>
</tr>
<tr>
<td>8</td>
<td>Inlet flow variations</td>
<td>Can handle</td>
<td>Can handle</td>
<td>Cannot handle</td>
<td>Cannot handle</td>
<td>Cannot handle</td>
<td>Can handle</td>
<td>Cannot handle</td>
<td>Handles all flow variations</td>
</tr>
</tbody>
</table>

**7** Usage of treated effluent

Treated effluent "as such" cannot be used for even low end purposes such as construction, floor washing etc.

Treated effluent "as such" cannot be used for even low end purposes such as construction, floor washing etc. Secondary treatment in form of ASP. Followed by tertiary treatment must be provided even for low end uses.

Treated effluent "as such" cannot be used for even low end purposes such as construction, floor washing etc. Secondary treatment in form of ASP. Followed by tertiary treatment must be provided even for low end uses.

Can be used for gardening. However, needs tertiary treatment for other non-potable purposes.

Can be used for non-potable purposes such as gardening, car washing, industrial washings, railways for washings, etc.

Can be used for non-potable purposes such as gardening, car washing, industrial washings, railways for washings, etc.

Can be used for non-potable purposes such as gardening, car washing, industrial washings, railways for washings, etc. However, biological nutrient removal prior to use is recommended.

Can be used for non-potable purposes such as gardening, car washing, industrial washings, railways for washings, cooling tower etc.
### Biological Treatment Technologies-Comparison

<table>
<thead>
<tr>
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<th>Membrane Bio Reactor (MBR)</th>
<th>Phytorid</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Level of automation/energy efficient equipment</td>
<td>No automation</td>
<td>No automation</td>
<td>Very few automation</td>
<td>Very few automation. However, additional automation is possible.</td>
<td>Very few automation</td>
<td>Fully automatic with manual override. Air requirement is optimized through oxygen uptake rate control. Feedback is taken (through PLC/SCADA) from dissolved oxygen meter installed in SBR basins and fed to VFD, which makes the blower to run efficiently all the time. <strong>This total system ensures air is supplied proportionately to the inlet load all times of operation.</strong> Besides, plants being operated through PLC/SCADA control, all treatment unit operations are operated in controlled and optimized conditions. Hence, energy consumption is optimized.</td>
<td>Fully automatic with manual override. However, energy requirement is very high due to type of process itself.</td>
<td>No controlling needed. No automation required. Designed to operate in absence of monitoring. Only flow of sewage to be checked once a day.</td>
</tr>
</tbody>
</table>
### Biological Treatment Technologies-Comparison

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Parameter</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Oxidation pond</td>
</tr>
<tr>
<td>10</td>
<td>Future Augmentation</td>
<td>Not possible</td>
</tr>
</tbody>
</table>

### CAPITAL COSTS

<p>| additional cost for nutrient removal &amp; tertiary treatment, Rs. Lakhs/ML D | Not possible to include additional treatment | Not possible to include additional treatment | 40 | 40 | 40 | 0 | 25 | Cost may increase or decrease based on local conditions |
| Total plant cost to achieve the latest outlet quality, Rs. | Not possible to achieve the outlet quality | Not possible to achieve the outlet quality | 115-125 | 125-130 | 125-130 | 90-100 | 325-350 | 135-150 | Cost may increase or decrease based on local conditions |</p>
<table>
<thead>
<tr>
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<th>Parameter</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Oxidation pond</td>
</tr>
<tr>
<td>12</td>
<td>AREA REQUIREMENTS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approx. Area requirement, for plant (m²/MLD)</td>
<td>10000</td>
</tr>
<tr>
<td></td>
<td>additional area required for tertiary treatment (m²/MLD)</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Total area required for plant to achieve the latest</td>
<td>--</td>
</tr>
</tbody>
</table>
## Biological Treatment Technologies—Comparison

<table>
<thead>
<tr>
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<th>Parameter</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Oxidation pond</td>
</tr>
<tr>
<td>13</td>
<td>outlet quality (m²/MLD)</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td>Approx. POWER requireme nt, for plant kWh/MLD</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Overall O&amp;M COST including power in Rs./m³</td>
<td>negligible</td>
</tr>
<tr>
<td>15</td>
<td>Merits</td>
<td>Very less or no manpower required. No power requirement for main plant. Minimal sludge production. Can handle intermittent flows. Robust and can withstand shock</td>
</tr>
</tbody>
</table>
## Biological Treatment Technologies-Comparison

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<th>Membrane Bio Reactor (MBR)</th>
<th>Phytorid</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Demerits</td>
<td>Obsolete technology. Latest outlet quality norms cannot be achieved. Large footprint. Eutrophication resulting to high suspended solids. Sensitive to industrial waste discharges. Mosquitoes and other pest</td>
<td>(\text{Obosite technology, Latest outlet quality norms cannot be achieved. Large footprint.})</td>
<td>(\text{Power generation schemes have been implemented at many locations in India but have a mixed performance track record. There are only few locations where power is generated successfully. This is due to less flow during the initial years of STP, lesser quantum of organic solids than expected, seasonal power production and power consumption as compare to latest technologies. Additional sludge stabilisation and nutrient removal treatment is required. Latest outlet quality norms cannot be achieved without additional nutrient removal &amp; tertiary.})</td>
<td>(\text{Larger footprint and power consumption as compare to latest technologies. In case, virgin PVC media is not used, plant may not perform well. High power consumption as coarse bubble aeration is used which reduces oxygen transfer efficiency. Latest outlet quality norms cannot be achieved without additional nutrient removal &amp;})</td>
<td>(\text{Secondary clarifiers are eliminated. There is flexibility in adjusting reaction time and tank volume to meet variable loading. No odour problem. Very less personnel is required. Excess biomass is fully stabilised. In built nutrient removal system. Underwater parts are in Stainless steel.}&amp; meeting the latest outlet quality standards except Nutrients.)</td>
<td>(\text{&amp; meeting the latest outlet quality standards except Nutrients.})</td>
<td>(\text{phosphate removal.})</td>
<td>(\text{No electricity required apart from sewage transportation. Aesthetically appealing and zero foul odor.})</td>
</tr>
</tbody>
</table>
## Biological Treatment Technologies-Comparison

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<th>Technologies</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Oxidation pond</td>
<td>Aerated Lagoon</td>
</tr>
<tr>
<td></td>
<td>infestation. Odour resulting nuisance for the nearby dwellers.</td>
<td>variations specially dilution of sewage in monsoons, etc. Further, 30 -40% of the power generated is consumed to run the captive power plant (gas engines and associated auxiliary units) itself. High ammonium remains in effluent which results in ammonia toxicity Vulnerable to pH and temperature changes. Large footprint. Latest outlet quality norms cannot be achieved without additional nutrient removal &amp; tertiary treatment.</td>
</tr>
</tbody>
</table>
As per the above it is observed that SBR method of sewage treatment is most suitable in the light of meeting,

1.0 Effluent characteristics as per the standards set out by MoEF Govt. of India and MP State Pollution Board without any separate tertiary treatment. (Recommended guidelines for treated sewage if discharged into surface water as per Ministry of Environment and Forest Govt. of India)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MOEF Standards</th>
<th>Recommended Valves</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD, mg/l</td>
<td>30</td>
<td>Less than 10</td>
</tr>
<tr>
<td>SS, mg/l</td>
<td>100</td>
<td>Less than 10</td>
</tr>
<tr>
<td>TN, mg/l</td>
<td>100</td>
<td>Less than 10</td>
</tr>
<tr>
<td>Dissolved P, mg/l</td>
<td>5</td>
<td>Less than 2</td>
</tr>
<tr>
<td>Faecal coliforms, MPN/100 ml</td>
<td>Not specified</td>
<td>Less than 230</td>
</tr>
</tbody>
</table>

2.0 Also the Power consumption is optimised through control of aeration rate and duration thereby reducing cost of energy charges.

3.0 Secondary clarifiers are not required reducing the area of construction which is great concern in the present scenario where land is precise in the Urban centers.

4.0 There is flexibility in adjusting reaction time and tank volume to meet variable loading which is primarily due to change in sewage flow during the day looking to peak and off peak hours.

5.0 The plant does not have any odour problem for the surrounding areas. Thus no nuisance to the resident of nearby areas due to operation of plant for next 30 years i.e., design period.
6.0 Very less personnel is required and therefore the cost of personnel is less.

7.0 Excess bio-sludge is fully stabilized and can be used for organic manure thereby reducing the disposal issue and also adding to the financial viability during Operation and maintenance.

8.0 In built nutrient removal system.

9.0 Underwater parts are in Stainless steel. Resulting in very less wear and tear and again reduction in Operation and maintenance cost.

10.0 Sludge generation per day on dry basis - 0.5 MLD – about 125 kg, 1 MLD – about 250 kg. Sludge can be used as manure for farming/gardening/can be disposed of in existing landfill site/if it is further completely dried in sludge solar drying system, it can be used as fuel.
6.7 Sequencing batch reactors

Sequencing batch reactors (SBRs) - SBRs are used all over the world and have been around since the 1920s. With their growing popularity in Europe and China as well as the United States, they are being used successfully to treat both municipal and industrial wastewaters, particularly in areas characterized by low or varying flow patterns. Municipalities, resorts and a number of industries, including dairy, pulp and paper, tanneries and textiles, are using SBRs as practical wastewater treatment alternatives.

Since the 1970s, improvements in equipment and technology, especially in aeration devices, have made SBRs a viable choice over the conventional activated-sludge system and it has been successfully used to treat municipal and industrial wastewater. The pollutant removal efficiency of SBR system is higher for nitrogen and phosphate. The SBR system can remove heavy metal such as Zinc (Zn), Copper (Cu), lead (Pb) with organic pollutant and nitrogen.

The difference between the two technologies is that the SBR performs equalization, biological treatment, and secondary clarification in a single tank using a timed control sequence. A reason for providing SBRs in areas where there is a limited amount of space is available.

According to NRCD (National River Conservation Directorate) there are three SBRs installed in INDIA (Goa, Punjab, Tamilnadu) till 2013.

Preliminary/Primary Treatment of Wastewater: - Preliminary treatment includes screening, grit removal, and flow monitoring. Primary treatment includes sedimentation and floatation. SBRs generally do not have primary settling tanks; therefore, effective removal or exclusion of grit, debris, plastics, excessive oil or grease, and scum, as well as screening of solids should be accomplished prior to the activated-sludge process.

SBRs Operating Principles:

SBRs technology is a method of wastewater treatment in which all phases of the treatment process occur sequentially within the same tank. The sequencing batch reactor is a fill and draw activated sludge system. In this system, wastewater is added to a single “batch” reactor, treated to remove undesirable components, and then discharged.

Various phases in a typical SBR process:

a) Fill Phase - During the fill phase, the basin receives influent wastewater. The influent brings food to the microbes in the activated sludge, creating an environment for biochemical reactions to take place. Types of fill are phase Static fill, mixed fill, Aerated fill.
b) React Phase - During this phase, no wastewater enters the basin and the mechanical mixing and aeration units are on. This phase allows for further reduction of wastewater parameters.

c) Settle Phase - During this phase, activated sludge is allowed to settle under quiescent condition. The activated sludge tends to settle as a flocculent mass.

d) Decant Phase (Draw) - Clarified treated effluent (supernatant) is removed from the tank. No surface foam or scum is decanted.

e) Idle Phase - This step occurs between the decant and the fill phases. The idle period is used when the system is waiting for enough effluent to process.

Advantages of SBR:

1) Equalization, primary clarification, biological treatment and secondary clarification can be achieved in a single reactor vessel.

2) SBR requires small space. SBR has controllable react time and quiescent settling.

3) High nutrient removal capabilities. The BOD removal efficiency is generally 85 to 90% Filamentous growth elimination.

Limitations of SBR:

1) A higher level of sophistication (mixing) is required especially for larger systems, of timing units and controls.

2) Higher level of maintenance associated with more sophisticated controls, automated switches, and automated valves.
### 7.0 ECONOMICAL SECTION OF PIPES FOR STPs AND INTERMEDIATE PUMP

(A) Design for Economical size of Sewage Pumping Main having length 100 m from Sump to Treatment Plant as per CPHEEO Manual on Sewerage & Sewage Treatment Second edition December 1993 (STP-I of 11.00 MLD for intermediate design period at Waiden)

<table>
<thead>
<tr>
<th>Water Requirement</th>
<th>Water demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>1 DWF</td>
</tr>
<tr>
<td>Intermediate</td>
<td>2 DWF</td>
</tr>
<tr>
<td>Ultimate</td>
<td>3 DWF</td>
</tr>
</tbody>
</table>

2. Length of Pumping Main 100.00 m

3. Static Head of Pump 7.00 m

4. Design Period 30.00 Years

5. Combined efficiency of Pumping Set 60.00 %

6. Cost of Pumping Unit 22000.00 Rs/kw

7. Interest rate 11.50 %

8. Life of motor and pumps 15.00 years

9. Energy Charges 4.00 Rs/Unit

10. Design value of ‘Cg’ for modified Hazen William Equation 1

11. Value of K for minor losses 5
<table>
<thead>
<tr>
<th>S. N.o.</th>
<th>Particulars</th>
<th>I st 15 years</th>
<th>II nd 15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Discharge at installation</td>
<td>13.00 MLD</td>
<td>26.00 MLD</td>
</tr>
<tr>
<td>2.</td>
<td>Discharge at the end of 15 years</td>
<td>26.00 MLD</td>
<td>39.00 MLD</td>
</tr>
<tr>
<td>3.</td>
<td>Design Discharge</td>
<td>19.50 MLD</td>
<td>32.50 MLD</td>
</tr>
<tr>
<td>4.</td>
<td>Hours of pumping for discharge at the end of 15 years</td>
<td>22.00 hours</td>
<td>22.00 hours</td>
</tr>
<tr>
<td>5.</td>
<td>Average hours of pumping for design discharge</td>
<td>16.50 hours</td>
<td>18.33 hours</td>
</tr>
<tr>
<td>6.</td>
<td>Kw required at 60% combined efficiency of pumping set</td>
<td>4.026 H1=KW1</td>
<td>6.709 H2=KW2</td>
</tr>
<tr>
<td>7.</td>
<td>Annual cost of electrical</td>
<td>24105.84 KW1</td>
<td>26784.27 KW2</td>
</tr>
<tr>
<td>8.</td>
<td>Pump Cost Capitalised, Po</td>
<td>C/(1+r)^15</td>
<td>C/5.118</td>
</tr>
</tbody>
</table>

SOLUTION
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Internal Dia (mm)</th>
<th>Head due to friction &amp; other losses</th>
<th>Velocity in m/s</th>
<th>Total Head</th>
<th>KW required for peak discharge</th>
<th>KW required with 50% stand by for peak discharge</th>
<th>Cost of Pumps @ Rs 22000/KW (Rs in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>150</td>
<td>161.09</td>
<td></td>
<td></td>
<td>16.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>108.83</td>
<td>10.45</td>
<td>14.85</td>
<td>214.02</td>
<td>321.02</td>
<td>7062.51</td>
</tr>
<tr>
<td>4</td>
<td>250</td>
<td>46.16</td>
<td>6.69</td>
<td>11.36</td>
<td>99.31</td>
<td>325.06</td>
<td>487.60</td>
</tr>
<tr>
<td>5</td>
<td>300</td>
<td>8.11</td>
<td>4.65</td>
<td>11.21</td>
<td>60.81</td>
<td>174.07</td>
<td>91.22</td>
</tr>
<tr>
<td>6</td>
<td>350</td>
<td>11.03</td>
<td>3.12</td>
<td>10.36</td>
<td>47.61</td>
<td>120.99</td>
<td>67.69</td>
</tr>
<tr>
<td>7</td>
<td>400</td>
<td>6.21</td>
<td>2.61</td>
<td>11.21</td>
<td>36.81</td>
<td>88.60</td>
<td>56.72</td>
</tr>
<tr>
<td>8</td>
<td>450</td>
<td>3.74</td>
<td>2.07</td>
<td>10.74</td>
<td>34.05</td>
<td>72.09</td>
<td>51.07</td>
</tr>
<tr>
<td>9</td>
<td>500</td>
<td>2.39</td>
<td>1.67</td>
<td>9.39</td>
<td>31.95</td>
<td>62.98</td>
<td>47.92</td>
</tr>
<tr>
<td>10</td>
<td>600</td>
<td>1.46</td>
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Velocity, Head loss, KW required, cost of pump sets for different pipe size
### Comparative statement of overall cost structure of pumping main for different pipe size

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<tr>
<th>S. No.</th>
<th>Dia (mm)</th>
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As per to above calculations the economical size of pipe is 600 mm
### Design for Economical Size of Sewage Pumping Main

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<th>Water Requirement</th>
<th>Water demand</th>
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<th>Life of motor and pumps</th>
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<td>Hours of pumping for discharge at the end of 15 years</td>
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<td>Average hours of pumping for design discharge</td>
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<td>6.</td>
<td>Kw required at 60% combined efficiency of pumping set</td>
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<td>Annual cost of electrical</td>
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<td>Pump Cost Capitalised, Po</td>
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<td>9.</td>
<td>Energy Charges Capitalised</td>
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SOLUTION

Particulars

- Discharge at installation
- Discharge at the end of 15 years
- Design Discharge
- Hours of pumping for discharge at the end of 15 years
- Average hours of pumping for design discharge
- Kw required at 60% combined efficiency of pumping set
- Annual cost of electrical
- Pump Cost Capitalised, Po
- Energy Charges Capitalised
### Velocity, Head loss, KW required, cost of pump sets for different pipe size

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<th>S. No</th>
<th>Internal Dia (mm)</th>
<th>Head due to friction &amp; other losses</th>
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<th>Total Head</th>
<th>KW required for peak discharge</th>
<th>KW required with 50% stand by for peak discharge</th>
<th>Cost of Pumps @ Rs 22000/KW (Rs in thousands)</th>
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As per to above calculations the economical size of pipe is 600 mm
1. **Water Requirement** | **Water demand**
---|---
Initial 1 DWF | 13.00 mld
Intermediate 2 DWF | 26.00 mld
Ultimate 3 DWF | 39.00 mld

2. Length of Pumping Main | 100.00 m

3. Static Head of Pump | 7.00 m

4. Design Period | 30.00 Years

5. Combined efficiency of Pumping Set | 60.00 %

6. Cost of Pumping Unit | 22000.00 Rs/kw

7. Interest rate | 11.50 %

8. Life of motor and pumps | 15.00 years

9. Energy Charges | 4.00 Rs/Unit

10. Design value of ‘Cₚ’ for modified Hazen William Equation | 1

11. Value of K for minor losses | 5
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<th>Particulars</th>
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<td>4.</td>
<td>Hours of pumping for discharge at the end of 15 years</td>
<td>22.00 hours</td>
<td>22.00 hours</td>
</tr>
<tr>
<td>5.</td>
<td>Average hours of pumping for design discharge</td>
<td>16.50 hours</td>
<td>18.33 hours</td>
</tr>
<tr>
<td>6.</td>
<td>Kw required at 60% combined efficiency of pumping set</td>
<td>4.026 H1=KW1</td>
<td>6.709 H2=KW2</td>
</tr>
<tr>
<td>7.</td>
<td>Annual cost of electrical energy</td>
<td>24105.84 KW1</td>
<td>26784.27 KW2</td>
</tr>
<tr>
<td>8.</td>
<td>Pump Cost Capitalised, Po</td>
<td>C / (1+r)^15</td>
<td>C / 5.118</td>
</tr>
<tr>
<td>9.</td>
<td>Energy Charges Capitalised</td>
<td>Cc = Cr [1-(1+r)^n] / r</td>
<td>Cc = Cr^* 6.997</td>
</tr>
<tr>
<td>S. No.</td>
<td>Internal Dia (mm)</td>
<td>Head due to friction &amp; other losses</td>
<td>Velocity in m/s</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>-------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>1st Stage average flow</td>
<td>2nd stage average flow</td>
<td>1st Stage average flow</td>
</tr>
<tr>
<td>2</td>
<td>150</td>
<td>161.09</td>
<td>382.23</td>
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<td>200</td>
<td>46.16</td>
<td>108.83</td>
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<td>300</td>
<td>8.11</td>
<td>18.94</td>
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<td>9</td>
<td>500</td>
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<td>800</td>
<td>0.13</td>
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<tr>
<td>14</td>
<td>900</td>
<td>0.08</td>
<td>0.20</td>
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</table>
## Comparative statement of overall cost structure of pumping main for different pipe size

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Internal finished Dia (mm)</th>
<th>Rate per metre of DI K-7 pipe as per UADD SOR rate (In Rs)</th>
<th>cost of pipe for 100 metres (Rs in thousands)</th>
<th>Cost of pumpsets (Rs in thousands)</th>
<th>Annual Energy Charges (Rs in thousands)</th>
<th>Energy Charges Capitalised (Rs in thousands)</th>
<th>Total Capitalised cost (4+5+7) (Rs in thousands)</th>
<th>Cost of pumpsets (Rs in thousands)</th>
<th>Annual Energy Charges (Rs in thousands)</th>
<th>Energy Charges Capitalised (Rs in thousands)</th>
<th>Initial Capital investment for Pumpsets &amp; annual electrical charges (Rs in thousands)</th>
<th>Total Capitalised cost (8+12) (Rs in thousands)</th>
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<tbody>
<tr>
<td>1</td>
<td>150</td>
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<td>147.00</td>
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<td>16310.97</td>
<td>114123.06</td>
<td>136599.17</td>
<td>69945.38</td>
<td>147.00</td>
<td>22329.11</td>
<td>136599.17</td>
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<td>10727.14</td>
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<td>34269.63</td>
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<td>310.20</td>
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<td>657.00</td>
<td>1054.28</td>
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<td>7658.38</td>
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<td>2079.93</td>
<td>9738.31</td>
<td>14798.32</td>
<td>249052.20</td>
</tr>
</tbody>
</table>

As per to above calculations the economical size of pipe is 600 mm
8.0 **STP PUMPS AT WAIDHAN**

**A. Design for the pumps and pumping main for DWF in 1st phase (STP-1) at Ward no.48 Ganiyari Road near River.**

I. Design calculation for the pumps for pumping of 11.00 MLD (1 DWF) for Ist Phase Sewage.

1.1) Quantity of Sewage flow (1 DWF)  
11.00 MLD

1.2) Hour of pumping  
22 Hours

1.3) Static Head  
Embankment level at TP – L.W.L.  
7 m

1.4) Length of Pipe line  
100.0 m

1.5) Diameter of Pipe  
600 mm

1.6) Modified Hazen Williams Coefficients  
1

1.7) No of pumps  
2 Nos

1.8) Duty pump  
1 Nos

1.9) Stand by pumps  
1 Nos

1.10) Ambient temperature  
40 °C

1.11) Average discharge in m³/sec  

\[
\text{Average discharge} = \left(\frac{11.00 \times 10^6}{22 \times 10^3 \times 60 \times 60}\right)
\]

\[
= 0.139 \text{ m}^3/\text{s}
\]

2.0) Head loss due to friction by using modified Hazen Williams equation [\(L (Q/C_R)^{1.81}] / 994.62 \ D^{4.81}\) taking CR value 1

Frictional Head loss  
0.033

Loss due to fittings, bends  
0.008

Static Head  
7.00

Total head  
7.041

Provide pump for 8.00 m head

**Power required for pump:**
Combined Efficiency = 60%

Of Pumps and motors

\[ H_m = 8.0 \text{ m} \]

Power in KW

\[ = \frac{w Q H}{(1000) x (0.60 x 1000)} \]

\[ = \frac{9.81 \times 1000 \times 0.139 \times 8.0}{(0.60 \times 1000)} \]

\[ = 19.00 \text{ Kw 26.00 HP} \]

Hence provide following pumps, motors and transformer for pumping of 11.00 MLD Sewage from Sump to Treatment plant.

a) Two nos. pumps of 19.00 KW having discharge of 139 liters each and pumping head of 8.00 m with 100% stand-by capacity

b) Each pumps shall have motor of 26.00 HP

Step down transformer of 33KV/220 – 35.00 KVA
II. Design calculation for the pumps for pumping of 22.00 MLD (2 DWF) for 1st Phase Sewage.

1.1) Quantity of Sewage flow (2 DWF)  
22.00 MLD

1.2) Hour of pumping  
22 Hours

1.3) Static Head  
Embankment level at TP – L.W.L.  
7 m

1.4) Length of Pipe line  
100.0 m

1.5) Diameter of Pipe  
600 mm

1.6) Modified Hazen Williams Coefficients  
1

1.7) No of pumps  
2 Nos

1.8) Duty pump  
1 Nos

1.9) Stand by pumps  
1 Nos

1.10) Ambient temperature  
40 °C

1.11) Average discharge in m³/sec  
\[
\text{Average discharge} = \frac{(22.00 \times 10^6)}{22 \times 10^3 \times 60 \times 60} = 0.278 \text{ m}^3/\text{s}
\]

2. Head loss due to friction by using modified Hazen Williams equation [ \( L (Q/C_R^{1.81})/994.62 D^{4.81} \) taking CR value 1  
Frictional Head loss  
= 0.116

Loss due to fittings, bends  
= 0.029

Static Head  
= 7.00

Total head  
= 7.145

Provide pump for 8.00 m head

**Power required for pump:**

Combined Efficiency  
= 60%

Of Pumps and motors
\[ H_m = 8.0 \text{ m} \]

Power in KW
\[ \text{Power in KW} = \frac{w Q H}{(\pi x 1000)} \]
\[ = \frac{9.81 \times 1000 \times 0.278 \times 8.0}{(0.60 \times 1000)} \]
\[ = 37.00 \text{ Kw} \]
\[ 50.00 \text{ HP} \]

Hence provide following pumps, motors and transformer for pumping of 22.00 MLD Sewage from Sump to Treatment plant.

a) One nos. pumps of 37.00 KW having discharge of 278 liters each and pumping head of 8.00 m with 100% stand-by capacity

b) Each pumps shall have motor of 50.00 HP

Step down transformer of 33KV/220 – 67.00 KVA
III. Design calculation for the pumps for pumping of 33.00 MLD (3 DWF) for 1st Phase Sewage.

1.1) Quantity of Sewage flow (3 DWF) 33.00 MLD

1.2) Hour of pumping 22 Hours

1.3) Static Head

   Embankment level at TP – L.W.L. 7 m

1.4) Length of Pipe line 100.0 m

1.5) Diameter of Pipe 600 mm

1.6) Modified Hazen Williams Coefficients 1

1.7) No of pumps 1 Nos

1.8) Duty pump 1 Nos

1.9) Ambient temperature 40 °C

1.10) Average discharge in m³/sec

   \[
   = \frac{33.00 \times 10^6}{22 \times 10^3 \times 60 \times 60} \\
   = 0.417 \text{ m}^3/\text{s}
   \]

2. Head loss due to friction by using modified Hazen Williams equation \[ L \left(\frac{Q}{CR}\right)^{1.81} \]/994.62 D^{4.81} taking CR value 1

Frictional Head loss = 0.241

Loss due to fittings, bends = 0.060

Static Head = 7.00

Total head = 7.301

Provide pump for 8.00 m head

**Power required for pump:**

Combined Efficiency = 60%

Of Pumps and motors

\[ H_m = 8.0 \text{ m} \]

\[ \text{Power in KW} = \frac{w Q H}{(\Box \times 1000)} \]
Hence provide following pumps, motors and transformer for pumping of 33.00 MLD Sewage from Sump to Treatment plant.

a) One nos. pumps of 55.00 KW having discharge of 417 liters each and pumping head of 8.00 m with 100% stand-by capacity

b) Each pumps shall have motor of 74.00 HP

    Step down transformer of 33KV/220 – 99.00 KVA
Capacity of Sump well:

Dry Well :-

The Size of the Dry well should be adequate for the number of pumps planned of such size as will handle the sewage load at the desired capacity of pumping allowances should also be made for future requirements so that additional or larger pumps can be installed.

Wet well :-

The size of the wet well is influenced by the storage capacity to be provided. The storage capacity is required to be designed, especially for all sewage and storm water pumping stations, where automatic control and variables speed drives are not provided to match pumping rates exactly with inflow – rates to the station.

The shape of the wet well and the detention time provided shall be such that deposition of solid is avoided and sewage does not turn septic the capacity of the wet well is also concerned with the difference between the highest level of the liquid in the wet well and the minimum level after the depletion by pumping. This should be such that the pump of minimum duty also would run for at least 5 minutes. The capacity of the well is to be so kept that with any combination of inflow and pumping, the cycle of operation for each pump will not be less than 5 minutes and the maximum detention time in the wet well will not exceed 30 minutes of average flow.

Average peak flow = 21.31 cum/min

Take Detention time 30 minutes for wet well

Capacity of the wet well = (21.31 x 30)/4
= 152.34 Cum

Hence Take depth of sumpwell is 2m, then dry well & wet well is 155.00 cum and the req. Area is 75.00 sq.m.
8.0 B. Design for the pumps and pumping main for DWF in 1st phase (STP–2) at Ward no. 42 Devra Village.

I. Design calculation for the pumps for pumping of 10.00 MLD (1 DWF) for Ist Phase Sewage.

1.1) Quantity of Sewage flow (1 DWF) 10.00 MLD

1.2) Hour of pumping 22 Hours

1.4) Static Head

   Embankment level at TP – L.W.L. 7 m

1.4) Length of Pipe line 100.0 m

1.5) Diameter of Pipe 600 mm

1.6) Modified Hazen Williams Coefficients 1

1.7) No of pumps 2 Nos

1.8) Duty pump 1 Nos

1.9) Stand by pumps 1 Nos

1.10) Ambient temperature 40 °C

1.11) Average discharge in m³/sec

   \[ \frac{(10.00 \times 10^6)}{22 \times 10^3 \times 60 \times 60} \]

   \[ = \frac{0.127 \text{ m}^3}{\text{s}} \]

3.0) Head loss due to friction by using modified Hazen Williams equation [ \( L (Q/C_R^{1.81})/994.62 \text{ D}^{4.81} \text{ taking CR value 1} \]

Frictional Head loss = 0.028

Loss due to fittings, bends = 0.007

Static Head = 7.00

Total head = 7.035

Provide pump for 8.00 m head

**Power required for pump:-**

Combined Efficiency = 60%
Of Pumps and motors

\[ H_m = 8.0 \text{ m} \]

\[ \text{Power in KW} = \frac{w \times Q \times H}{(w \times 1000)} \]

\[ = 9.81 \times 1000 \times 0.127 \times 8.0 \]

\[ / (0.60 \times 1000) \]

\[ = 17.00 \text{ Kw 23.00 HP} \]

Hence provide following pumps, motors and transformer for pumping of 10.00 MLD Sewage from Sump to Treatment plant.

c) Two nos. pumps of 17.00 KW having discharge of 127 liters each and pumping head of 8.00 m with 100% stand-by capacity

d) Each pumps shall have motor of 23.00 HP

Step down transformer of 33KV/220 – 31.00 KVA
II. Design calculation for the pumps for pumping of 20.00 MLD (2 DWF) for 1st Phase Sewage.

1.1) Quantity of Sewage flow (2 DWF) 20.00 MLD

1.2) Hour of pumping 22 Hours

2.3) Static Head
   Embankment level at TP – L.W.L. 7 m

1.4) Length of Pipe line 100.0 m

1.5) Diameter of Pipe 600 mm

1.6) Modified Hazen Williams Coefficients 1

1.7) No of pumps 2 Nos

1.8) Duty pump 1 Nos

1.9) Stand by pumps 1 Nos

1.10) Ambient temperature 40 °C

1.11) Average discharge in m³/sec

   \[
   = \frac{(20.00 \times 10^6)}{22 \times 10^3 \times 60 \times 60}
   \]

   = 0.253 m³/s

3. Head loss due to friction by using modified Hazen Williams equation [ L (Q/C_R^{1.81})/994.62 D^{4.81} taking CR value 1

   Frictional Head loss = 0.098

   Loss due to fittings, bends = 0.024

   Static Head = 7.00

   Total head = 7.122

   Provide pump for 8.00 m head

   **Power required for pump:**

   Combined Efficiency = 60%

   Of Pumps and motors
Hence provide following pumps, motors and transformer for pumping of 20.00 MLD Sewage from Sump to Treatment plant.

c) One nos. pumps of 30.00 KW having discharge of 253 liters each and pumping head of 8.00 m with 100% stand-by capacity

d) Each pumps shall have motor of 45.00 HP

Step down transformer of 33KV/220 – 60.00 KVA
III. Design calculation for the pumps for pumping of 30.00 MLD (3 DWF) for Ist Phase Sewage.

1.1) Quantity of Sewage flow (3 DWF) 30.00 MLD

1.2) Hour of pumping 22 Hours

2.3) Static Head

   Embankment level at TP – L.W.L. 7 m

1.4) Length of Pipe line 100.0 m

1.5) Diameter of Pipe 600 mm

1.6) Modified Hazen Williams Coefficients 1

1.7) No of pumps 1 Nos

1.8) Duty pump 1 Nos

1.9) Ambient temperature 40 °C

1.10) Average discharge in m³/sec

\[
\begin{align*}
\text{Average discharge} &= \frac{(30.00 \times 10^6)}{22 \times 10^3 \times 60 \times 60} \\
&= 0.379 \text{ m}^3/\text{s}
\end{align*}
\]

3. Head loss due to friction by using modified Hazen Williams equation \[ \frac{L \left( \frac{Q}{CR} \right)^{1.81}}{994.62 D^{4.81}} \] taking CR value 1

Frictional Head loss = 0.203

Loss due to fittings, bends = 0.051

Static Head = 7.00

Total head = 7.253

Provide pump for 8.00 m head

**Power required for pump:-**

Combined Efficiency = 60%

Of Pumps and motors

\[ H_m = 8.0 \text{ m} \]

Power in KW = \[ \frac{w \times Q \times H}{(\square \times 1000)} \]
\[= \frac{9.81 \times 1000 \times 0.379 \times 8.0}{(0.60 \times 1000)}\]

\[= 50.00 \text{ Kw} \ 67.00 \text{ HP}\]

Hence provide following pumps, motors and transformer for pumping of 30.00 MLD Sewage from Sump to Treatment plant.

c) One nos. pumps of 50.00 KW having discharge of 379 liters each and pumping head of 8.00 m with 100% stand-by capacity

d) Each pumps shall have motor of 67.00 HP

Step down transformer of 33KV/220 – 90.00 KVA
**Capacity of Sump well:**

**Dry Well:**

The Size of the Dry well should be adequate for the number of pumps planned of such size as will handle the sewage load at the desired capacity of pumping allowances should also be made for future requirements so that additional or larger pumps can be installed.

**Wet well:**

The size of the wet well is influenced by the storage capacity to be provided. The storage capacity is required to be designed, especially for all sewage and storm water pumping stations, where automatic control and variables speed drives are not provided to match pumping rates exactly with inflow – rates to the station.

The shape of the wet well and the detention time provided shall be such that deposition of solid is avoided and sewage does not turn septic the capacity of the wet well is also concerned with the difference between the highest level of the liquid in the wet well and the minimum level after the depletion by pumping. This should be such that the pump of minimum duty also would run for at least 5 minutes. The capacity of the well is to be so kept that with any combination of inflow and pumping, the cycle of operation for each pump will not be less than 5 minutes and the maximum detention time in the wet well will not exceed 30 minutes of average flow.

Average peak flow $= 19.14 \text{ cum/min}$

Take Detention time 30 minutes for wet well

Capacity of the wet well $= (30 \times 20)/4$

$= 150 \text{ Cum}$

Hence Take depth of sumpwell is 2m, then dry well & wet well is 150.00 cum and the req. Area is 75.00 sq.m.
8.0 (C) Design for the pumps and pumping main for DWF in 1st phase (STP-3) at Ward no.33 MIG Colony near nalla.

IV. Design calculation for the pumps for pumping of 10.00 MLD (1 DWF) for 1st Phase Sewage.

1.1) Quantity of Sewage flow (1 DWF) 10.00 MLD

1.2) Hour of pumping 22 Hours

1.5) Static Head

    Embankment level at TP – L.W.L. 7 m

1.4) Length of Pipe line 100.0 m

1.5) Diameter of Pipe 600 mm

1.6) Modified Hazen Williams Coefficients 1

1.7) No of pumps 2 Nos

1.8) Duty pump 1 Nos

1.9) Stand by pumps 1 Nos

1.10) Ambient temperature 40 °C

1.11) Average discharge in m³/sec

    = \frac{(10.00 \times 10^6)}{22 \times 10^3 \times 60 \times 60}

    = 0.127 \text{ m}^3/\text{s}

4.0) Head loss due to friction by using modified Hazen Williams equation [L (Q/C_R^{1.81})/994.62 \times D^{4.81}] taking CR value 1

Frictional Head loss = 0.028

Loss due to fittings, bends = 0.007

Static Head = 7.00

Total head = 7.035

Provide pump for 8.00 m head

**Power required for pump:-**

Combined Efficiency = 60%
Of Pumps and motors

\[ H_m = 8.0 \, m \]

\[ \text{Power in KW} = \frac{w \, Q \, H}{(\square \times 1000)} \]

\[ = \frac{9.81 \times 1000 \times 0.127 \times 8.0}{(0.60 \times 1000)} \]

\[ = 17.00 \, Kw \, 23.00 \, HP \]

Hence provide following pumps, motors and transformer for pumping of 10.00 MLD Sewage from Sump to Treatment plant.

e) Two nos. pumps of 17.00 KW having discharge of 127 liters each and pumping head of 8.00 m with 100% stand-by capacity

f) Each pumps shall have motor of 23.00 HP

Step down transformer of 33KV/220 – 31.00 KVA
V. Design calculation for the pumps for pumping of 20.00 MLD (2 DWF) for 1st Phase Sewage.

1.1) Quantity of Sewage flow (2 DWF) 20.00 MLD

1.2) Hour of pumping 22 Hours

3.3) Static Head

Embankment level at TP – L.W.L. 7 m

1.4) Length of Pipe line 100.0 m

1.5) Diameter of Pipe 600 mm

1.6) Modified Hazen Williams Coefficients 1

1.7) No of pumps 2 Nos

1.8) Duty pump 1 Nos

1.9) Stand by pumps 1 Nos

1.10) Ambient temperature 40 °C

1.11) Average discharge in m³/sec

\[ \text{Average discharge} = \frac{(20.00 \times 10^6)}{22 \times 10^3 \times 60 \times 60} \]

\[ = 0.253 \text{ m}^3/\text{s} \]

4. Head loss due to friction by using modified Hazen Williams equation \[ \left( \frac{L}{Q/C_R^{1.81}} \right) \times \frac{994.62}{D^{4.81}} \] taking CR value 1

Frictional Head loss = 0.098

Loss due to fittings, bends = 0.024

Static Head = 7.00

Total head = 7.122

Provide pump for 8.00 m head

Power required for pump:-

Combined Efficiency = 60%

Of Pumps and motors
H_m = 8.0 m

Power in KW = \( w Q H / (\Box \times 1000) \)

= \( 9.81 \times 1000 \times 0.253 \times 8.0 \)

/ (0.60 \times 1000)

= 33.00 Kw  45.00 HP

Hence provide following pumps, motors and transformer for pumping of 20.00 MLD Sewage from Sump to Treatment plant.

e) One nos. pumps of 30.00 KW having discharge of 253 liters each and pumping head of 8.00 m with 100% stand-by capacity

f) Each pumps shall have motor of 45.00 HP

Step down transformer of 33KV/220 – 60.00 KVA
VI. Design calculation for the pumps for pumping of 30.00 MLD (3 DWF) for Ist Phase Sewage.

1.1) Quantity of Sewage flow (3 DWF)  
   30.00 MLD

1.2) Hour of pumping  
   22 Hours

3.3) Static Head

   Embankment level at TP – L.W.L.  
   7 m

1.4) Length of Pipe line  
   100.0 m

1.5) Diameter of Pipe  
   600 mm

1.6) Modified Hazen Williams Coefficients  
   1

1.7) No of pumps  
   1 Nos

1.8) Duty pump  
   1 Nos

1.9) Ambient temperature  
   40 °C

1.10) Average discharge in m3/sec

   \( \frac{(30.00 \times 10^6) / 22 \times 10^3 \times 60 \times 60}{994.62 \times 60} \)

   \( = 0.379 \text{ m}^3/\text{s} \)

4. Head loss due to friction by using modified Hazen Williams equation \[ L \left(\frac{Q}{C_R}\right)^{1.81} / 994.62 \times D^{4.81} \] taking CR value 1

   Frictional Head loss  
   0.203

   Loss due to fittings, bends  
   0.051

   Static Head  
   7.00

   Total head  
   7.253

   Provide pump for 8.00 m head

   **Power required for pump:-**

   Combined Efficiency  
   60%

   Of Pumps and motors

   \( H_m \)  
   8.0 m

   Power in KW  
   \( w \frac{Q \times H}{\theta \times 1000} \)
\[= 9.81 \times 10^3 \times 0.379 \times 8.0 \]
\[/ (0.60 \times 10^3)\]
\[= 50.00 \text{ Kw} \ 67.00 \text{ HP}\]

Hence provide following pumps, motors and transformer for pumping of 30.00 MLD Sewage from Sump to Treatment plant.

e) One nos. pumps of 50.00 KW having discharge of 379 liters each and pumping head of 8.00 m with 100% stand-by capacity

f) Each pumps shall have motor of 67.00 HP

Step down transformer of 33KV/220 – 90.00 KVA
**Capacity of Sump well:**

**Dry Well :-**

The Size of the Dry well should be adequate for the number of pumps planned of such size as will handle the sewage load at the desired capacity of pumping allowances should also be made for future requirements so that additional or larger pumps can be installed.

**Wet well :-**

The size of the wet well is influenced by the storage capacity to be provided. The storage capacity is required to be designed, especially for all sewage and storm water pumping stations, where automatic control and variables speed drives are not provided to match pumping rates exactly with inflow - rates to the station.

The shape of the wet well and the detention time provided shall be such that deposition of solid is avoided and sewage does not turn septic the capacity of the wet well is also concerned with the difference between the highest level of the liquid in the wet well and the minimum level after the depletion by pumping. This should be such that the pump of minimum duty also would run for at least 5 minutes. The capacity of the well is to be so kept that with any combination of inflow and pumping, the cycle of operation for each pump will not be less than 5 minutes and the maximum detention time in the wet well will not exceed 30 minutes of average flow.

Average peak flow = 19.14 cum/min

Take Detention time 30 minutes for wet well

Capacity of the wet well = (30 x 20)/4

= 150 Cum

Hence Take depth of sumpwell is 2m, then dry well & wet well is 150.00 cum and the req. Area is 75.00 sq.m.
9.0 Design Considerations for designing sewer network

1.0 The design population of entire planning area has been divided equally on to the total length of 184706.00 m proposed sewerage system and accordingly the population per running meter of sewer system has been worked out. Accordingly sewage flow has been calculated. Being a small town it has been considered that Singrauli has a potential to grow evenly in all the directions and henceforth, the population density shall be even in future also.

2.0 The discharge has been calculated as 108 lpcd (80% of the water supply). Ground water infiltration has been taken 250 lpd per man hole. (Because Suitable data for Ground water infiltration is not available.) The peak flow @ 2.25 times the average flow has been considered.

3.0 At least once in a day Self Cleansing (0.60m/s) velocity shall be generated and non-scouring (3m/s) velocity shall never be generated in sewers. For Flushing approximate quantity of water needed which is mentioned in CPHEEO Manual on Sewerage & Sewage Treatment on page no. 81 for flushing tanker will be used.

4.0 The Sewer lines has been designed taking 80% full for peak discharge, leaving the remaining space for accumulation of gases as may be. The flow in sewers is gravity flow only.

5.0 The sizes of the pipe are between 160 mm to 900 mm. Looking to the smaller size where in-lining is difficult and also corrosive nature of sewage the material of Pipelines has been adopted DWC HDPE SN 8.0/RCC NP4 class pipe.

6.0 Slopes as recommended by CPHEEO Manual on sewerage and Sewage Treatment have been followed as also given in table below. However this has been deviated in the light of lesser excavation.

7.0 Wherever the other hydraulic parameters satisfies, for these lengths if self cleansing velocity is not generated then flushing will be carried out once in a day as & when required as illustrated in preceding paragraph.
10.0 ENVIRONMENT MANAGEMENT PLAN

The Environment Management Action Plan (EMP) is required to ensure sustainable development of the proposed Sewerage System in Waidhan. The Network & STP will cater the collection and treatment of sewage generated in Waidhan town.

The sewerage project has been designed by dividing the town area into 3 different parts taking in account the general ground topography. For each zone the sewer network is being designed so as to have maximum of gravity flow and minimum of excavation depth. The major components of the proposed project includes,

- Providing, Laying and jointing of sewer network comprising of HDPE DWC /DI K-7 pipe of 160 mm to 900 mm having total length of 184.71 kms.
- Providing of collecting chambers 1 each for 5 houses 7000 chambers.
- Providing, Laying and jointing of 120 mm diameter comprising of HDPE DWC pipe having length of 175.00 km for connecting households to sewer lines.
- Seven STPs based on Sequential Batch Reactor (SBR) technology are being proposed each at Ward no.48 Ganiyari Road near River having capacity of 11.00 MLD, Ward no. 42 Devra Village having capacity of 10.00 MLD, Ward no.33 MIG Colony near nalla having capacity of 10.00 MLD.
- The treated water shall be discharged in Mahar River or reused for the purposes like irrigation, gardening, firefighting, Industrial & institutional supply or ground water recharge etc. The effluent characteristics shall be strictly as per MoEF norms for discharging the treated water in the inland water ways which could be potential source of water supply.

Project specific EMP is given in table 10.1.

In general, SINGRAULI MUNICIPAL CORPORATION (SMC) is responsible for ensuring that the mitigation measures as suggested in the EMP are carried out.

In general, SINGRAULI MUNICIPAL CORPORATION (SMC) is accountable for ensuring that the mitigation measures as suggested in the EMP are carried out.
Commissioner, Municipal Corporation Singrauli

Assistant Engineer, Municipal Corporation, Singrauli

In charge (Sanitation), Municipal Corporation, Singrauli

Team Leader along with support of Supervision team

Project supervision and implementation team consisting of: - a) material monitoring b) design monitoring c) alignment finalization & quality control monitoring and d) environment & social expert.

Project Manager (DBO Operator)

Environmental Officer (DBO Operator)
10.1 Specific activities by Design Built Operate (DBO) Operator

The activities to be performed by the Operator to implement the EMP shall comprise the following:

- Obtain consent to establish from Madhya Pradesh State Pollution Control Board under Water (Prevention and Control of Pollution) Act 1974 for the STP

- Implementation of other mitigation measures, as recommended in EMP attached to the bid document.

10.2 Implementation of EMP

The DBO Operator shall have prime responsibility to implement the EMP. “The DBO engineer” shall monitor the compliance of the EMP. DBO engineer and SINGRAULI MUNICIPAL CORPORATION (SMC) will have secondary responsibility for implementation of EMP.

The Operator shall ensure that:

- Ensure that sewer laying process does not create hazardous movement situation. Also ensure that public is pre-warmed about the activities, construction area is barricaded, all debris is well managed causing minimum inconvenience to public and other measures are implemented as indicated under EMP

- The digested sludge shall be utilised as manure or disposed to suitable site as per criteria defined under EMP and approved by DBO engineer.

- STP design shall be evolved with enough holding capacity to ensure that no untreated sewage is discharged to river during STP breakdown or temporary closure.

- Specific area shall be earmarked for intermittent storage of biodegradable and on-biodegradable waste.

- Tree plantation (minimum two rows) shall be made on the periphery of the SPS & STP to prevent spread of bad odour and undertake landscaping to enhance aesthetic at SPS locations & STP location.

10.3 Specific activities by Design Built Operate (DBO) Operator

The operator shall implement the mitigation measures as recommended in EMP attached to the bid document.
10.4 Implementation of EMP

The DBO Operator shall have prime responsibility to implement the EMP. “The DBO engineer” shall monitor the compliance of the EMP. DBO engineer and SINGRAULI MUNICIPAL CORPORATION (SMC) will have secondary responsibility for implementation of EMP.

The Operator shall ensure that:

- Ensure that sewer laying process does not create hazardous movement situation. Also ensure that public is pre-warned about the activities, construction area is barricaded, all debris is well managed causing minimum inconvenience to public and other measures are implemented as indicated under EMP.

- Specific area shall be earmarked for intermittent storage of biodegradable and non-Biodegradable waste at SPS site.

- Tree plantation (minimum two rows) shall be made on the periphery of SPS to prevent spread of bad odour and undertake landscaping to enhance aesthetic at SPS locations.
Table 10.1: Environment Management Plan

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Negative Impact/ Concern</th>
<th>Duration of impact</th>
<th>Mitigation Measures</th>
<th>Responsible agency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Design and Development Phase</strong></td>
<td></td>
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</tr>
<tr>
<td>Sewage Treatment plant</td>
<td>Treated water disposal into nearby stream</td>
<td>Temporary</td>
<td>• The treated water quality shall comply with the prescribed standards of the bid document and other applicable conditions of consent to establish issued by the state pollution control board.</td>
<td>DBO Operator</td>
</tr>
<tr>
<td></td>
<td>• Pollution of received water body (river) or land due to inefficient treatment or non-operation of STP</td>
<td></td>
<td>• Selection of best available sewage Treatment technology with High BOD removal efficiency.</td>
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<td></td>
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<td></td>
<td>• Ensuring development and compliance to standard operation and maintenance Practices.</td>
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<td></td>
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<td></td>
<td>• Provision of effective screening at inlet of STP for removal of grit, fine plastics and other suspended solids.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Provision of effective separation and controlled disposal of digested sludge.</td>
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<td></td>
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<td></td>
<td>• Provision effective disinfection before discharge of treated water for irrigation or to river.</td>
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</tr>
<tr>
<td>STP Breakdown</td>
<td>• Discharge of untreated sewage leading river pollution.</td>
<td>Temporary</td>
<td>• Provision of adequate holding capacity adequate for storage of sewage to prevent flow of untreated sewage to river.</td>
<td>DBO Operator</td>
</tr>
<tr>
<td>Flooding due to rain water run off</td>
<td>• Rain water may flood the STP</td>
<td>Temporary</td>
<td>• Suitable drainage provision shall be made to divert the rain water likely to be</td>
<td>DBO Operator</td>
</tr>
<tr>
<td>Activity</td>
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<tr>
<td></td>
<td>area in absence of adequate provision of diverting rain water flow towards STP from periphery area.</td>
<td></td>
<td>accumulated from peripheral catchment area of STP, to natural drainage stream or area.</td>
<td></td>
</tr>
</tbody>
</table>
| Sludge disposal | • Disposal of sludge leading to contamination of land and water | Permanent | • Efficient Sludge dewatering with minimum land involvement shall be adopted.  
• Provision shall be made for intermittent storage of digested sludge at STP site.  
• The digested sludge shall be utilised as manure or disposed to suitable site as approved by DBO engineer. If disposal is made for land fill, the site shall be located away from habitation, and water bodies and shall be pre-approved by concerned authorities like Municipal corporation, Pollution Control Board or urban development authority. | DBO Operator |
| Provision for safety of workers and safe operation of STPs | • Accidents leading to injury or death of workers (Fall of workers from Height, Fall into deep water tanks, Short Circuiting) | Permanent | • Ensure adequate provision of Handrails on both sides of walkways close to deeper tanks and STPs need to be ensured;  
• All electric switches (including unit specific on-off switches installed at respective units) and panels should have adequate protection from rain water to prevent short circuiting | DBO Operator |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Sewerage Network (Trunk Sewer Line)</td>
<td>Accidental leakages/ bursts • Due to accidental burst or leakage of sewers, flooding of the nearby areas • Backlogging due to unexpected heavy flow rates</td>
<td>Temporary</td>
<td>• Proper earthling with installation of earth circuit breakers shall be made • Walk ways designs shall be made with proper slope to avoid accumulation of rain water. Material handling and storage shall be so designed that walk way surface remains free from wet or oil surface situation to prevent slips, trip or fall accidents. • Provision of interlock system to either stop STP or divert untreated effluent to holding tanks in case of short circuiting, or mall functioning of STP • Prepare emergency preparedness plan • Including identification of assembly area in case of fire</td>
<td>DBO Operator</td>
</tr>
<tr>
<td>Sewage Pumping Station</td>
<td>Location of Sewage Pumping Station and Pumping of sewage from • Noise and odour nuisance hazards to neighbouring areas.</td>
<td>Permanent</td>
<td>• Designing sewers with adequate capacity and flow velocity • Provision for Regular inspection and maintenance of the sewers • Preparation of safety and Emergency Preparedness plan</td>
<td></td>
</tr>
</tbody>
</table>
# Sewerage Project For Waidhan

## Municipal Corporation, Singrauli

### Activity

<table>
<thead>
<tr>
<th>Activity</th>
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</tr>
</thead>
</table>
| MPS to STP                | Cutting of Trees                   |                    | • Minimize Tree cutting if involved.  
                          |                      |                    | • Tree plantation of at least two rows around the periphery of SPS site and landscaping to prevent spread of bad odour with large canopy/ broad leaves trees like Sesum, Neem, Bargad, Teak, Sal, etc  
                          |                      |                    | • Accumulated sludge and solid waste to be cleared at short intervals and spraying of suitable herbicides on accumulated sludge/solid waste to reduce odour.  
                          |                      |                    | • Provision for regular maintenance and switching off equipment when not in use; |                    |

### B. Construction phase

<table>
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<tr>
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</tr>
</thead>
</table>
| Sewage treatment plant    | Excavation                         | Loss of top soil due to excavation activities. | • Excavation shall be planned in such a manner that such that no damage occurs to existing structures.  
<pre><code>                      |                      |                    | • Top soil should be separately stockpiled and utilized for green belt development or landscaping after completion of work | DBO Operator       |
</code></pre>
<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Construction waste</td>
<td></td>
<td>Temporary</td>
<td>• All the associated construction waste should be properly managed by storing and disposing off at suitable refusal sites approved by DBO engineer</td>
<td>DBO Operator</td>
</tr>
</tbody>
</table>
| Nuisance due to domestic solid waste disposal|                                                          | Temporary          | • Provide two bins for recyclable and non-recyclable wastes.  
• Ensure that recyclable and non-recyclable waste is collected in segregated manner in theses bins before disposal. Recyclable material should be sold. Non-recyclable material should be disposed to designated land fill area of the city.  
• Provide adequate sanitation facility for  
• Workers at construction sites.                                                                                          | DBO Operator      |
| Dust Generation due to construction activities|                                                          | Temporary          | • Excavated material transported by trucks will be covered and/or wetted to prevent dust nuisance.  
• Suppressing dust generation by spraying water on stockpiles and unpaved movement areas  
• Water sprinkling over excavated areas, unpaved movement areas and stockpiles.  
• Transportation of loose construction material through covered trucks.  
• Use dust curtains (polysheets/ sheets) around the construction area for containing dust spread.                          | DBO Operator      |
<table>
<thead>
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<tr>
<td></td>
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<td></td>
<td>• Construction equipment must comply with pollution norms and carry Pollution under Control certificate.</td>
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<tr>
<td></td>
<td>Temporary flooding due to uneven dumping of construction waste</td>
<td>Temporary</td>
<td>• The construction waste material should be stored on the higher areas of the site and or areas where water may accumulate creating flooding like situation.</td>
<td>DBO Operator</td>
</tr>
<tr>
<td></td>
<td>Spillage of fuel and oil</td>
<td>Temporary</td>
<td>• Care to be taken to store fuel and oil (if required) at a place away from any drainage channel/ nalla preferably to be stored in drums mounted on a concrete paved platform with slop draining to small spills collection pit.</td>
<td>DBO Operator</td>
</tr>
</tbody>
</table>
|          | Noise and vibration disturbances to residents and businesses | Temporary          | • Construction activities to be carried out in day time with prior intimation to local residents and shop keepers.  
• Use of low noise and vibrating equipment (such as enclosed generators with mufflers, instruments with built in vibration dampening and improved exhaust), to meet standards as prescribed by CPCB.  
• Provision of protective equipment (PPE) like ear muffs and plugs for construction workers.  
• Provision of noise barriers as feasible in inhabited areas, particularly near sensitive zones like hospitals, schools etc. | DBO Operator       |
<table>
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<tbody>
<tr>
<td>Construction camps</td>
<td>Sanitation</td>
<td>Temporary</td>
<td>• DG set to be fitted acoustic enclosure.</td>
<td>DBO Operator</td>
</tr>
<tr>
<td></td>
<td>Nuisance due to absence of facility of sanitation and solid waste management</td>
<td></td>
<td>• Labour camp if provided, must have adequate provision of shelter, water supply, sanitation and solid waste management.</td>
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</tr>
<tr>
<td>General: safety during construction</td>
<td>Safety and Health Hazard</td>
<td>Temporary</td>
<td>• Comply with the Occupational health and Safety act of India.</td>
<td>DBO Operator</td>
</tr>
<tr>
<td></td>
<td>Safety hazards to labours and public. Workers are seen to working without any PPE even at height.</td>
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<td>• Ensure that the contact details of the police or security company and ambulance services nearby to the site.</td>
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<td>• Ensure that the handling of equipment and materials is supervised and adequately instructed.</td>
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<td>• Follow safe practices for working at height or confined area or underground working for safety of workers</td>
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<td>• Erect warning signs/ tapes and temporary barriers and/or danger tape, marking flags, lights and flagmen around the exposed construction works warn the public and traffic flow of the inherent dangers.</td>
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<td>• Provide adequate PPE to workers such as helmets, safety shoes, gloves, dust masks, gumboots, etc. to workers</td>
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<td>• Provide handrails on both sides of walkways close to deeper tanks and STPs need to be ensured;</td>
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<td></td>
<td>• Smaller on and off switches at STP units to</td>
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</tbody>
</table>
| Sewerage and Sewage Pumping station | Excavation, cutting, back filling, compaction and construction operations | Damage to underground utilities like water, gas line, electricity and telephone conduits, etc. Due to construction activities. | Temporary | • Be installed with protection from rain water to minimize electrical short circuit;  
• Monthly reporting of all accidents and immediate reporting to DBO engineer and owner.  
• Identify existing underground other utility structures, lines through available records and in consultation with concerned authorities and plan construction activities accordingly to minimize damage to such utilities. |
| | | | | DBO Operator |
| | | | These underground utilities encountered in excavating trenches carefully shall be supported, maintained and protected from damage or interruption of service until backfill is complete and settlement has taken place. | |
| | | | | DBO Operator |
| | Accidents/ damages due to erosion/ sliding of vertical sides of excavated trenches while places the pipes | Temporary | • Maintaining the excavation by Shoring trench sides by placing sheeting, timber shores, trench jacks, bracing, piles, or other materials  
• Exposed surface shall be resurfaced and stabilized. Exposed surface will be resurfaced and stabilized by making the sloping sides of trench to the angle of repose at which the soil will remain safely at rest. | DBO Operator |
<table>
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</thead>
</table>
|          | Generation of substantial debris, top soil and muck during construction | Temporary          | • Top soil shall be preserved and may be used for agricultural purpose or development of city parks.  
• Soil and debris may be managed for planned land filling and landscaping;  
• Debris may be suitably stored to filling back the excavated areas after placing the trunk sewer lines. | DBO Operator |
|          | Dust Generation (Air Pollution) due to excavation, cutting, back filling and compaction operations | Temporary          | • Water sprinkling over excavated areas, unpaved movement areas and stockpiles.  
• Transportation of loose construction material through covered trucks.  
• Use dust curtains (polysheets/ sheets) around the construction area for containing dust spread at SPS building construction site.  
• Construction equipment must comply with pollution norms and carry Pollution under Control certificate. | DBO Operator |
|          | Noise and vibration disturbances to residents and businesses | Temporary          | • Construction activities to be carried out in day time with prior intimation to local residents and shop keepers.  
• Construction work near schools and colleges to be carried out during vacations and work near hospitals to be completed on priority basis (in shorter time period with alternate provision of traffic, accessibility of exit/entry gates etc.).  
• Use of low noise and vibrating equipment | DBO Operator |
<table>
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</tr>
</thead>
</table>
| Temporary flooding due to excavation during monsoons or blockage of surface drains | Temporary                                                                                                                                                      |                    | meeting prescribed noise standards.  
• Provision of protective equipment (PPE) like ear muffs and plugs for construction workers.  
• Provision of noise barriers in inhabited areas, particularly near sensitive zones like hospitals, schools etc.  
• DG set to be fitted acoustic enclosure.                                                                                                           | DBO Operator       |
| Increased traffic inconvenience (emissions, congestions, longer travel times, blockage of access) | Temporary                                                                                                                                                      |                    | • Alternate traffic routing must be adopted in consultation with concerned traffic police authorities. Proper traffic planning be made for narrow lane areas.  
• Work should to be completed on priority near business and market place to minimize business loss  
• Care should be taken to minimize congestion and negative impacts at schools and hospitals. Safe access shall be maintained to these places during construction.  
• Provide temporary crossing/ bridges as may be required to facilitate normal life and business                                                                 | DBO Operator       |
<table>
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</thead>
</table>
| Settlement of backfilled area after construction | - The backfilling material shall be free from petroleum products, slag, cinders, ash or other material.  
- Backfilling activity shall be completed within five days of laying of sewer.  
- Proper compaction as per the soil condition and retain the original level of alignment and grade. | Temporary          | DBO Operator                                                                    |                    |
| Spillage of fuel and oil                     | - Care to be taken to store fuel and oil (if required) at a place away from any drainage channel /nalla preferably to be stored in drums mounted on a concrete paved platform with slop draining to small spills collection pit. | Temporary          | DBO Operator                                                                    |                    |
| Nuisance due to solid waste disposal         | - Provide two bins for recyclable and non-recyclable wastes.  
- Ensure that recyclable and non-recyclable waste is collected in segregated manner in theses bins before disposal. Recyclable material should be sold. Non-recyclable material should be disposed for designated land fill area of the city.  
- Provide adequate sanitation facility for workers at construction sites. | Temporary          | DBO Operator                                                                    |                    |
| General: Safety During construction           | Accidents                                               | Safety hazards to labours and public | - Comply with the Occupational health and Safety act of India.  
- Ensure that the contact details of the police or security company and ambulance services nearby to the site. | DBO Operator       |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Negative Impact/ Concern</th>
<th>Duration of impact</th>
<th>Mitigation Measures</th>
<th>Responsible agency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Ensure that the handling of equipment and materials is supervised and adequately instructed.</td>
<td>DBO Operator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Erect warning signs/ tapes and temporary barriers and/or danger tape, marking flags, lights and flagmen around the exposed construction works warn the public and traffic flow of the inherent dangers.</td>
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<tr>
<td></td>
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<td></td>
<td>• Provide adequate safety precautions such as helmets, safety shoes, gloves, dust masks, gumboots, etc. to workers Monthly reporting of all accidents and immediate reporting to DBO engineer and owner.</td>
<td></td>
</tr>
</tbody>
</table>

C.Operation phase

<table>
<thead>
<tr>
<th>Sewage treatment plant</th>
<th>Treatment and Disposal of Treated Water and Sludge</th>
<th>River, land or ground water pollution due to discharge of untreated or partially treated sewage due to inadequate or inefficient STP operations.</th>
<th>Temporary</th>
<th>Monitor the treated sewage quality and ensure compliance with PCB standards for effluent disposal into surface water bodies, on land or for the agricultural use.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• It should be ensured that 20% of treated effluent to be reused initially &amp; 50% of treated effluent in 5 years.</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td>• Follow standard operating procedures for operation and maintenance.</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Undertake periodic audit as per these procedures.</td>
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<td></td>
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<td></td>
<td></td>
<td>• Comply with all applicable condition of consent to operate.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Quarterly monitoring of influent sewage, treated sewage, upstream and downstream</td>
</tr>
<tr>
<td>Activity</td>
<td>Potential Negative Impact/ Concern</td>
<td>Duration of impact</td>
<td>Mitigation Measures</td>
<td>Responsible agency</td>
</tr>
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</tr>
<tr>
<td></td>
<td>point of treated sewage disposal point to river.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Problems arising due to bad odour, insects, polluted air | Temporary | • Maintain the green belt as per provision of design to prevent spread of bad odour with large canopy/ broad leaves trees like Sesum, Neem, Bargad, Teak, Sal, etc.  
• Accumulated sludge and solid waste to be cleared within 24 hours and spraying of suitable herbicides on accumulated sludge/solid waste to reduce odour.  
• Quarterly monitoring of Ambient Air Quality with respect to PM10, PM2.5, Sox and NOx, CO and Odour at three locations (at STP site, minimum 500 m away from STP site in up-wind and down-wind direction of STP area. | DBO Operator |
| Increase in Ambient Noise Level and discomfort to neighbouring people | Temporary | • Proper handling and regular maintenance of operating machines including pumps, generators, air diffusers, etc.  
• Quarterly Monitoring of Ambient Noise level to check compliance to standards.  
• Quarterly monitoring of ambient noise levels(day and night) at same locations as of ambient air monitoring | DBO Operator |
| Indiscriminate disposal of sludge leading to contamination of land and soil. | Temporary | • Prepares sludge disposal plan as per desire stage provisions and guidelines and adhere to the same.  
• Ensure proper functioning of STP for digestion of sludge and ensure adequate | DBO Operator |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Negative Impact/ Concern</th>
<th>Duration of impact</th>
<th>Mitigation Measures</th>
<th>Responsible agency</th>
</tr>
</thead>
</table>
|                                | River, land or ground water pollution due to discharge of untreated or partially treated sewage due to inadequate or inefficient STP operations | Temporary         | • Ensure compliance with PCB standards for effluent disposal into surface water bodies, on land or for the agricultural use.  
• Follow standard operating procedures for operation and maintenance.  
• Undertake periodic audit as per these procedures.  
• Comply with all applicable condition of consent to operate | DBO Operator     |
| General Safety                 | Workers exposure to hazardous Materials/situations                                               | Serious/health/safety hazards | Temporary  
• Ensure availability of PPE for maintenance workers.  
• Follow safety measures and Emergency preparedness plan evolved at design stage | DBO Operator     |
| Sewer line                     | Leakage/overflows                                                                               | Water pollution and possibility of mixing with water supply line | Temporary  
• Regular monitoring of sewer line and manholes for visible leakages/overflows.  
• Immediate repair shall be carried out to plug the leakages. Restore the sewer and other utility services if damaged due to leakages. | DBO Operator     |
| Sewage Pumping Station         | Waste Handling                                                                                  | Bad odour, Health hazard and public nuisance | Temporary  
• Provision for regular clearance of sludge and solid waste to minimize odour nuisance  
• Ensure maintenance of Green belt as planned Periodic disposal of accumulated | DBO Operator     |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Negative Impact/ Concern</th>
<th>Duration of impact</th>
<th>Mitigation Measures</th>
<th>Responsible agency</th>
</tr>
</thead>
</table>
| General Safety                            | Workers exposure to toxic gases in sewers and hazardous materials during sewer maintenance work | Serious/health/safety hazards. The toxic gases are likely to contract communicable diseases from exposure to pathogens present in the sewage. | Temporary                                                          | • During cleaning/ maintenance operation, the sewer line will be adequately vented to ensure that no toxic or hazardous gases are present in the line.  
• Ensure availability of PPE for maintenance workers.  
• Follow safety and Emergency Preparedness plan prepared at design stage Monthly reporting of all accidents and immediate reporting to DBO engineer and owner. | DBO Operator      |
11.0 Statutory Clearances required for the execution of the project

For the execution of the proposed Sewerage project following Clearances/NOCs shall be required. It is very important that for timely completion of the project these clearances/NOCs should be obtained for which an application with the suitable competent authority shall be made by Municipal Corporation, Singrauli.

11.1 SPCB: Disposal of effluent in River

In the proposed project the permission for discharging effluent in river body will be required from State Pollution Control Board. Also yearly inspection of the Waste treatment site will be carried out by SPCB for assuring that the plant is working with desired efficiency. Accordingly treatment mechanism is being proposed as SBR, so as to have effluent parameter within norms.

11.2 PWD : ROW usage for laying of pipeline along the existing road

In the proposed project for laying of Sewer lines having length of 184706 meters of diameters ranging from 160 mm to 900 mm approximately 0.50-1.5 meter wide strip along the road is required. For usage of ROW along road which is under the jurisdiction of Public Works Department Govt. Of Madhya Pradesh prior approval will be required. For this an application has to be made to the Executive Engineer PWD, Singrauli division. The permission will be given mainly on following two grounds,

a) Redoing and remaking of ROW as per original condition as far as possible after laying of pipeline: At present the ROW comprises of WBM on shoulders and Black cotton soil upto the private farms. For laying of pipe approximately 3.00 m deep and 1.50 m wide trench shall be excavated. After laying of pipe the excavated material shall be filled back and rolling to the desired density shall be made. WBM /Bituminous surface shall be made after the rolling of excavated material so as to achieve the original condition of ROW.

b) Minimum obstruction to the vehicular traffic during the course of work: During the course of work due care should be taken that the pipe should be unloaded keeping the carriage way free for vehicular traffic. Also the excavated material should be stacked properly along the trench. Further the excavated trench should be demarcated with the construction band and signage so as to avoid any accident on account of moving traffic or the pedestrians falling in the trench.
c) **Security Deposit:** Municipal Corporation, Singrauli shall be depositing a security deposit (refundable) for repair of any damages if so left out after the completion of work.

### 11.3 District Administration, Singrauli:

For construction of waste treatment facility, pump house, providing and laying of pipeline etc. Acquisition of private and revenue land will be required. For getting the desired land an application will be made to the District administration of Singrauli district. The land to be acquired will be surveyed and measured as per the government revenue records. Accordingly Municipal Corporation has to deposit the price of land for transferring the title on the name of Singrauli Municipal Corporation.

### 11.4 MPPKVVC0: For Supply of adequate power:

In the proposed project for running of pumps and motors alongwith treament facilities at STPs to ensure the uninterrupted power supply to the substations a HT feeder shall be laid having length of approximately 5 kms. The work of laying of HT feeder shall be carried out by the Municipal Corporation. However, a prior consent of MP State Electricity Board will be essential for connecting the HT feeder to the proposed tapping point alongwith the uninterrupted power supply.

The proposed project shall be commissioned by June, 2018 therefore the proposed power supply is required only after Dec, 16. It is proposed to obtain the firm commitment prior to the commissioning of project. Municipal Corporation, Singrauli shall deposit the charges as may be fixed by MPMKVVC0. For laying the HT feeder and drawl of desired power.

### 11.5 Land availability:

The project includes construction of various civil structures like Sewerage Treatment Plant total cumulative capacity of 31.00 MLD.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Particulars</th>
<th>Area Required</th>
<th>Khasra No.</th>
<th>Ownership Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Sewage Treatment Plant 1</td>
<td>0.48 Hac.</td>
<td>2084</td>
<td>Govt. Land</td>
</tr>
<tr>
<td>2.0</td>
<td>Sewage Treatment Plant 2</td>
<td>0.45 Hac.</td>
<td>238</td>
<td>Govt. Land</td>
</tr>
<tr>
<td>3.0</td>
<td>Sewage Treatment Plant 3</td>
<td>0.45 Hac.</td>
<td>177</td>
<td>Govt. Land</td>
</tr>
</tbody>
</table>
12.0 Time Schedule

In order to assure the financial viability and functional utility of the project it is very important that the project execution should be planned initially giving due to consideration to the various components of the project. The time schedule so framed should be abided during the entire course of project.

The following is the suggestive time frame for the completion of the various activities related to the execution of the project starting from 01/06/2016. This may vary during the course of the execution stage. However, the suggested time frame has been decided taking into account the most reasonable time required for completion of the activity of that stage.

Further more the designs and estimates i.e., the technical and financial viability of the project is based as per the following time schedule of the project implementation. Any gross variation in this may affect the same adversely.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the activity</th>
<th>Duration (Weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Preparation of Detailed Project including detail designs, estimates, survey and all other features as may be required for the various approvals and execution of the project.</td>
<td>6.00</td>
</tr>
<tr>
<td>2.0</td>
<td>Approval of the Detailed Project Report by the Municipal Corporation, Singrauli and forwarding the same to State Government for the needful.</td>
<td>6.00</td>
</tr>
<tr>
<td>3.0</td>
<td>Clearance from State Government including Administrative and Technical Sanction of the project along with the financial assistance directly to the Municipal Corporation or in the form of Guarantee to the loan from any Financial institution.</td>
<td>8.00</td>
</tr>
<tr>
<td>4.0</td>
<td>Making the applications and getting the desired Clearances detailed out in the Chapter 11.0 from various Statutory authorities like PWD, District Administration, etc.</td>
<td>12.00</td>
</tr>
<tr>
<td>5.0</td>
<td>Preparation of Tender documents for the execution of various components under the project as per the State Government guidelines.</td>
<td>3.00</td>
</tr>
<tr>
<td>6.0</td>
<td>Calling of the National level open tenders including short listing of the eligible Contractors, scrutinizing bids and selecting the most responsive bid.</td>
<td>6.00</td>
</tr>
<tr>
<td>7.0</td>
<td>Forwarding the most responsive bid to State Government and getting the clearance from the State Government.</td>
<td>4.00</td>
</tr>
<tr>
<td>8.0</td>
<td>Placing the work order on to the successful Tendered, drawing the necessary agreement completing all formalities and starting the work.</td>
<td>4.00</td>
</tr>
<tr>
<td>9.0</td>
<td>Execution of the various works detailed out in the detail project report as per the desired specifications and commissioning the works for the desired results.</td>
<td>131.00</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>180.00</strong></td>
</tr>
</tbody>
</table>
13.0 Financial Aspects

The sum of all expenditure required to complete designing, detailed engineering, construction of all the components including support activities and conducting investigation studies as may be required for the project constitutes the project cost. To estimate the cost of each component of the project the allowances for physical contingencies and inflation likely to be there during the implementation period has been considered. Estimates are being prepared as per UADD SOR in force from 10/May/2012 and prevailing market rates.

Working as per above the detailed estimates has been prepared for the project. The total cost of the project is coming as Rs 10255.00 Lacs. As in the changing scenario the basic amenities like sewer is a responsibility of concerned Local body, it shall be the responsibility of Municipal Corporation, Singrauli to execute the project. It is proposed to execute the project under AMRUT (Atal Mission for Rejuvenation Urban Transformation).

Under AMRUT guidelines 90 % of the project cost shall be provided as grant–in–aid by GOI/GoMP Balance 10 % of the cost shall be borne by ULB. For this 10 % shall Municipal Corporation, Singrauli can avail loan. An O&m estimate comprising of loan repayment on ROI (Rate of Interest) of 10.25 % & O&M expenses like staff / electrical / chemical / upkeep civil structure O&M structures etc. has been prepared.

90% of the project cost (Rs 9229.50 Lacs) will be given as Grant in aid from GOI/GoMP.

10% of the project cost (Rs 1025.50 Lacs) will be taken as loan from State govt/HUDCO.

The 10% of the loan amount shall be repaid by ULB. The repayment of loan shall be made by:

(a) The Income of ULB due to its own sources.

(b) By the revenue realized out of user charges for the water supply to the consumers.

(c) Grant-in-aid from the state government

(d) Loans from Financial institutions if required. The repayment period for loan including moratorium period of two years has been taken as 13 years. The loan shall be repaid in 13 years having quarterly installments on reducing balance having interest @ 10.25% annually.
Financial viability of the project has been worked out by preparing a cash flow of the project taking

(a) Revenue realized due to collection of sewer tax from domestic / non-domestic consumers and collection of one time connection charges from the consumers asking for new sewer connections.

Considering repayment of loan for extent of 10% of project cost and realization of recurring expenditure on account of operating and maintenance cost of the entire project. This will include expenditure on staff, chemicals, energy, spare parts and other materials for system operation, transportation, upkeep of the systems and administration by urban local body.

The annual financial burden imposed on to the project comprises of the annual recurring cost and repayment of loan & interest (debt servicing). This has to be met out from the revenue realized as water tax.

In the light of above, the future sewer tariff has been identified and a statement showing annual revenue realized and expenditure and loan servicing for the loan repayment period, beginning with the year when the project will be operational i.e, from the year 2018-19 has been prepared. The revenue realized will be the sewer tax to be collected from the consumers & a onetime connection charges to be charged on the new connections. The sewer tax has been calculated separately for Domestic / Commercial consumers. Year wise calculation of expenditure along with loan repayment is enclosed.

At this stage it is assumed that the required loan will be available for the project considering the financial status of the Municipal Corporation, Singrauli by examining its cash reserves, yearly revenue income & the assets in the form of shops, lands, community, halls, etc.

An IRR has been prepared for the discount factor 5 % which calculate to ....% in case of infrastructure projects to be executed by ULBs the FIRR = EIRR.

**Assumptions to be considered for preparation of cash flow statement**

1. The population is being worked out yearly on the basis of Incremental increase method adopted for the population forecast.

2. Water availability @ 135 lpcd. And the sewer released as 80% of water supply rate i.e 108 lpcd and 250 liter per manhole.
3. The rate for domestic / commercial connection has been taken as Rs 110/month which increase of 5% in the sewer cost has been proposed in every year.

4. One time connection charges for new connections will be Rs 3000/- for Domestic / Non-Domestic connections.

5. In production cost the assumption is made as per actual establishment, chemicals, repairs, maintenance & the energy charges.

6. Opening balance, net surplus & closing balance is worked out from the income resources due to sewer tax of Municipal Corporation, Singrauli.

7. Loan repayment if any is calculated after adding interest of 10.25% on the loan amount.

8. The revenue realized is 70% of the total revenue taken on the basis of the average of past 5 years.

9. The Municipal Corporation, Singrauli share for 10.00% of the project cost will be attributed to the internal sources of the Municipal Corporation, Government Grants/loans.

10. The execution of the project is likely to be started from June 2016 & is planned to be completed by Dec. 2018.

11. Repayment of loan will be done in 52 quarterly installments of equal principle amounts.

12. Maintenance expenditure will increase by 5% every year.

13. Salary & Wages expenditure will increase 5% in every year.

a) Power expenditure will as per actual calculation. The initial power tariff has been taken as Rs 4.00/Unit to be increased by 5% per year.
SOCIAL ASSESSMENT
AND MANAGEMENT PLAN

SEWERAGE PROJECT FOR SINGRAULI
1.0 ENVIRONMENTAL AND SOCIAL IMPACTS

The purpose of the ESMF is to facilitate the management of environmental and social issues of the lake pollution mitigation investments. In other words, the objective is to identify the adverse environment and social impacts and provide specific guidance on the policies and procedures to be followed for environmental and social assessment along with roles and responsibilities of the implementing agencies.

In this perspective, a detailed assessment of the environmental impacts of the project, with proper highlight of the issues and their effective mitigation measures that has been or has to be considered during the design, construction and operation of the project at the municipality.

Potential Environmental and Social Impacts

The following environmental parameters have been evaluated to assess/analyse the impact of the Project:

- air quality;
- noise;
- water quality;
- waste management and;
- Occupational health and safety
- Traffic flow

1.1.1 Air Quality

During the construction of new sewer line, pumping station and STP; there will be temporary increase in the level of suspended solid particles and other minute particles from the construction activity and the construction material. The Residual impact will not be significant and also a short term impact and will not have an adverse impact on the residents. Moreover in Singrauli all sites for construction of lifting stations are within walled protected area and the suspended solid particles will not spread much to the residential portion.

During the operational phase, when the project households are connected to the new sewer line, pumping station and STP is in operation, there is a less possibility of sewer odour spreading into the air. However, it may arise only when there is a fault or malfunctioning of pumping station and STP which can easily being avoided with proper mitigation measures.
1.1.2 Noise

Noise will generate during construction which will be above the acceptable criteria. During construction proper use of technology can considerably control the noise levels from the construction sites.

During the operational phase, noise level will not create any adverse effect as proper technology will adopted. The noise level generated during this phase will based on the sound power level of the pump, but would be within the criteria due to the large attenuation afforded by the pumping station building. Thus, it is concluded that the operational noise levels would not create any adverse impacts to local residents.

1.1.3 Water Quality

Water quality will be impacted during construction phase due to suspended solids runoff from excavation sites and spoil heaps and from dewatering of trenches and foundations, when water containing high concentration of suspended solids may be discharged to water courses.

However, with the implementation of suitable mitigation measures it is concluded that there will be no adverse impacts. No residual construction impacts are predicted.

Once operational, the overall system of sewage discharge will be upgraded as no untreated or chronically discharged water will effects the water courses. Thus, the scheme offers a significant environmental benefit to the area in terms of improvements in the quality of Mayar River and Bijur River.

The only potential water quality issue during the operational stage will arise from the emergency overflow of sewage into the local receiving waters. To protect against this, all pumping station have been designed to include a stand-by pump and emergency power supply. Based upon these mitigation measures, it is extremely unlikely that a failure will occur. However in case a failure does occur, it would be repaired promptly and the discharge would be short-term.

1.1.4 Waste Management

A large proportion of the soil material that will be excavated during the construction phase can be used for several other purposes like backfill material for the sewer alignment. The remaining earth and the broken surface material will require off-site disposal on the basis that it will be surplus to requirements or unsuitable for backfilling respectively.

The waste material generated during the operational phase will be limited to screening materials removed during the maintenance of the pumping station.
and materials removed from manholes after removal of blockages. Assuming proper handling and disposal methods are adopted, no adverse impacts are predicted.

1.1.5 Occupational Health and Safety

Workers need to be mindful of the occupational hazards which can arise from working in trenches and excavation works. Potential impacts are negative and long-term but reversible by mitigation measures.

1.1.6 Traffic Flow

Traffic congestion will be caused by pipeline construction and increased construction traffic in urban areas. Roads may be fully or partially closed during construction, causing temporary inconvenience to residents, commercial operations and institutions. However since traffic flow analysis indicates that there is a domination of cycles, rickshaws and two wheelers de-routing can be a possibility without major disruptions.

1.1.7 Project Impacts

The Following impacts as described above can be summarised into Construction and operational phases.

<table>
<thead>
<tr>
<th>Impacts during Construction Phase</th>
<th>Impacts during Operational Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airborne dust will be caused by excavation, demolition, vehicle movement and materials handling, particularly downwind from the construction sites. Air pollution will be caused by emissions from vehicles and construction machinery</td>
<td>Nuisance odours generated by screening, grit removal, primary tanks, secondary (aeration) tanks, and sludge handling processes. The pumping stations could also be a source of such odours.</td>
</tr>
<tr>
<td>Noise will be caused by construction equipment and vehicular movement, potentially affecting residents of nearby villages and schools.</td>
<td></td>
</tr>
<tr>
<td>Traffic congestion will be caused by pipeline construction and increased construction traffic in urban areas. Roads may be fully or partially closed during construction, causing temporary inconvenience to residents, commercial operations and institutions.</td>
<td></td>
</tr>
</tbody>
</table>
### Impacts during Construction Phase
- Waste discharge from construction camps. The discharge of wastewater from construction camps could create new pollution sources. The camps could also be sources of solid waste and waste oil from machinery maintenance.
- Excavated materials. Pipeline construction and demolition will generate huge chunk of materials for disposal, while site preparation for the treatment plants will need large amount of fill material.
- Interruption of municipal services. Construction of project facilities may require relocation of underground municipal utilities such as sewers, gas, water supplies, communication cables, and power poles.
- Occupational hazards which can arise from working in trenches and excavation works. Potential impacts are negative and long-term but reversible by mitigation measures.
- Health and hygiene issues for construction workers can be at stake unless proper facilities are created.
- Livelihood disruptions can be caused due to construction in market areas particularly for roadside hawkers. However some work opportunities will also be created.

### Impacts during Operational Phase
- Open sewage drains carrying the raw sewage and waste water to the STP can create Odour nuisance. Through the construction of sewers to collect wastewater, many of these open ditches will be improved or covered. The wastewater treatment plants in the project will substantially improve the water quality of the receiving waters and this will also reduce odours downstream.
The project component specific impacts at different phases of project execution have been elaborated below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Details</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction phase</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Construction of STP, Lifting Stations</strong></td>
<td>Percolation of leachate into groundwater which may contain high concentrations of organics and heavy metals.</td>
<td>The leachate may contaminate ground and surface water unless it is contained by an impermeable layer which allows it to be collected for subsequent treatment.</td>
</tr>
<tr>
<td></td>
<td>Cutting and excavation of roads</td>
<td>Longer Travel time Inconvenience in traffic movement</td>
</tr>
<tr>
<td></td>
<td>Accidental and emergency overflow of sewage into the local receiving waters.</td>
<td>Increased toxic materials in drains and water bodies</td>
</tr>
<tr>
<td></td>
<td>During construction air and noise and odour during operation phase</td>
<td>Bad Odour, Air and Noise pollution will be nuisance as the STP is located in Residential area.</td>
</tr>
<tr>
<td><strong>Construction of Sewer Line</strong></td>
<td>Laying of pipe line along very important and sensitive road and area like hospital area, Station Road, Market - Main arterial road of the town.</td>
<td>There will be disruption to the movement of vehicles.</td>
</tr>
<tr>
<td></td>
<td>Digging of roads, pavements Removal of soil and pipe. Storing removed materials beside the trench. Generation of solid waste Heavy machinery will be on the road blocking free flow of vehicles safe disposal of silt. All lanes and by lanes with 4 mt to 6 mt width will cause traffic congestions.</td>
<td>There will be disruption to the movement of vehicles and reduced access to residences and business.</td>
</tr>
<tr>
<td>Machines will operate, day and Night</td>
<td>Generates heavy noise during night times</td>
<td></td>
</tr>
<tr>
<td>Suspended solids runoff from excavation sites and spoil heaps</td>
<td>Water containing high concentration of suspended solids may be discharged to water courses</td>
<td></td>
</tr>
<tr>
<td>Digging of earth will generate debris</td>
<td>Dust Generation</td>
<td></td>
</tr>
<tr>
<td>Occupational Hazards in both STP and Lifting Station</td>
<td>Health impacts due to absence of housing and sanitation facilities in labour camps.</td>
<td></td>
</tr>
</tbody>
</table>

**Renovation of Pumping Station**

- Installation of mechanized screenings equipment
- Installation of grit removal equipment
- Replacement of pumps
- Construction materials on site will generate Dust from construction materials

**OPERATIONAL PHASE**

| STP Location and Lifting Station | Treatment and Disposal | Percolation of leachate into groundwater which may contain high concentrations of organics and heavy metals. The leachate may contaminate ground and surface water unless it is contained by an impermeable layer which allows it to be collected for subsequent treatment. As the drain receives both sewage and sullage, the drain sludge will be high in pathogens |
| Bad odour, air pollution by dust, Noise pollution | Indiscriminate disposal of Sludge | Provide Buffer Zone in the STP location. Contamination of soil and water |
| Indiscriminate disposal of Sludge | | Contamination of soil and water |
1.2 Stakeholder Feedback on Perceived Impact

Environmental and social impact was assessed through physical observation and verification. The purpose of the assessment was to understand the environmental situation in the municipality and also understand the probable environmental impacts due to the projects as conceived by stakeholders.

Since there is no land acquisition other than for STPs which is revenue land free from encumbrances there is no significant social impact related to displacement of population and related rehabilitation and resettlement. However social impacts is likely to occur in respect to temporary disruptions in daily life, or impacting the livelihood of people and sensitive areas where there is daily commuting of people specially children like schools and disrupting the normal routine. Health impacts, disruption of daily life and livelihood are the various aspects which were discussed during consultation with stakeholders.

Social impact assessment was done through a two stage process of

- Identification of sensitive wards and locations through consultation with Ward Councillors / Municipal officials
- Assessment of social and environmental conditions in the context of the project with inhabitants or beneficiaries
1.2.1 Identification of sensitive locations

City Scenario:

While Singrauli is well connected by rail and road, but because of the poor transportation facilities accessibility of the city is poor. National Highway-75E passing through Singrauli connects it to Rewa, Singrauli and Varanasi and other cities. The city is also connected to other regional nodes like Gobindgarh by state highways and major district road. Table below shows the distance of major cities from Singrauli. Renukoot and Shakitinagar are the adjoining cities of Singrauli. Varanasi is the foremost city located from the distance of 208 K.m. Singrauli city lies on broad gauge railway line connecting Katni to Choppan. The nearest airport is at Varanasi and one at Mayurpur owned by Hindalco.

The most sensitive area of the city are as follows:-

- Bagelkhand regional wholesale market.
- Morwa Main Market
- Meat Market
- Shankar Market
- Gurdwara Market
- Lakshmi Market
- Grain Market, Bargavan
- New Market, Morwa

Apart from the market place, industrial areas are also suspected sensitive areas, they are as follows:-

Name of Unit and Location of Industries in study area

- Ms. Rewa Gases Private Limited Industrial Area, Waidhan
- Ms. Solar Capitals Limited Industrial Area Waidhan.
- Ms. Basant Enterprises
- Ms. Waidhan Engineering and Industries, Industrial Area Waidhan
- Ms. Bulk Explosive Industrial Area Waidhan
- Ms Emulsion Private Limited Industrial Area Waidhan
- Ms. Rajasthan Explosive and Chemical Limited Industrial Area Waidhan
- Ms Special Explosive Limited Industrial Area Waidhan
- Ms Orient Explosive Private Limited

All sewerage component points like STP, Lifting Station, Markets, Major Junctions, Schools and hospitals were considered to be sensitive points.

1.2.2 Assessment of environmental and social impact by stakeholders

Discussion with stakeholders were performed in selective wards keeping in mind the sensitive areas, presence of existing structures under GAP and presence of proposed sites under the present Project. The objective of the discussion has been to understand the state of environment in the municipality, the level of awareness among the common people regarding Bijur River and Mayar River water pollution, their awareness about proposed project, its importance and need for such projects in the municipality. There
was also detailed discussion on the social and environmental impacts due of the project both during construction and post construction phase. People were also asked to respond to the mitigation measures that can be taken for reducing the impacts and how awareness among the people can be improved for the same.

**Findings of the Consultation**

**Meeting with MUNICIPALITY STAFF AND COUNCILORS**

Discussion with councillors and municipal staff was held during the month of Sep / Oct 2015.

The objective of the discussion was to understand the following –

- Nature of pollution in the town
- The main points of Bijur river and Mayar river pollution
- Importance and need for STP project in the town
- Consequences resulting in construction and operation of the proposed sewerage project
- Mitigation measures that can be taken to reduce and altogether stop such consequences
- Level of awareness among the community
- Means for raising the awareness level of the community
- Responsible person for communication and public awareness.

The councillors were well aware of the pollution levels in Bijur River and Mayar River and was of the opinion that more than anything else, it is the municipal sewerage which is the main source of pollution.

They identified that those points where the entire sewer and storm water falls into the Bijur River and Mayar River is the outfalls or nallahs which are the main points of pollution.

Over the years the pollution in the Bijur River and Mayar River has increased due to increased use of plastics. Open defecation is still in practice and continues to pollute the lake. As a result in the decade the lake water appears to be dirtier. The colour is murky and oil is seen floating on the surface. Thus all the participants readily agreed on the need and importance of the City sanitation project being launched.
Connecting every household to the sewerage network is needed and people will be interested and willing as this would reduce their recurring cost on septic in having so but certain issues to be addressed.

Since the major portion of roads network in the town is of 4mts, connecting each hh with the network will be a daunting task and would involve great deal of digging of roads and earth causing blockage of roads. Therefore in the absence of proper planning and systematic implementation it will cause great inconveniences to the people. They are sceptical that if the project is not completed in time, the people may go against it.

Another important issue raised by the councillors is that after the digging of roads, on time repair and restoration of roads needs to be taken up at the earliest and such responsibility should lie with the implementing agency.

The Bus stand area and the Ghas bazar has main transport corridors and also does not have a feasible diversion road. Hence traffic congestion in these roads due to work along road side would halt the entire traffic. Hence some measures should be taken to minimise the effects. Trenchless technology can be a option in this case

According to the councillors the people are not aware of the city sanitation project and the STP and sewerage network system under the GAP. This serious gap in awareness needs to be mitigated. The means of awareness generation or communication as is the opinion of the councillors should be

• Miking
• Door to door leaflet distribution and
• Awareness camps

The above mentioned public outreach programme can be taken up by

• Ward Committee
• CDS members
• SHGs and local clubs

So far the consequences of the construction of STP and laying of sewer lines the councillors pointed out the following –

• Accumulation of soil heaps on roadside
• Generation of dust from the soil heaps.
• Formation of water pools in the STP site
• Runoff of silt and sullage from the construction site

• Odour during operation phase of the STP where all the polluted solid waste and all waste water of the town will be collected for purification.

• Traffic inconveniences like traffic jams, slow movement, increased travel time due to diversion of pedestrian and vehicle movement.

Some of the mitigation measures suggested by the councillors include –

• Covering of soil heaps

• Water sprinkling in the construction site

• Scheduling of work in such a manner that pressure does not fall on important roads at the same time.

• Work schedule to be given beforehand in order to reduce inconveniences.

• Coordination between the Implementing agency, contractor and the Municipality needs to be maintained regarding work plan, progress etc.

**AWARENESS OF RESIDENTS OF THE TOWN IN ALL SENSITIVE LOCATIONS**

In order to understand how people understand the city sanitation plan and thereafter their awareness on the present project a number of questions were put up regarding the following-

• Nature of pollution in the town

• The main points of Mayar river and Bijur river pollution

• Sanitation practices

• Willingness to connect their HH to the sewerage network proposed project

• Knowledge about the proposed project

• Importance and need for STP project in the town

• Consequences resulting in construction and operation of the Sewerage project

• Mitigation measures that can be taken to reduce and altogether stop such consequences

• Level of awareness among the community

• Means for raising the awareness level of the community
• Responsible person for communication and public awareness.

Almost everybody among the respondents said Mayar river and Bijur river pollution has increased manifold in recent years. They can see a visible change in the colour of water which is now greyish and sometimes odour comes from near the nallahs. They however appreciated the efforts made by the municipality like Door to Door solid waste collection and electric crematorium which are right steps in reducing pollution in the city.

The reasons for lake water pollution according to the people are-

• Entire sewerage and drainage water falls into the lake
• Industrial waste water discharged into the lake
• Open defecation still continues specially in slums which finally discharges into the lake
• Drains are polluted by waste disposals, siltation and sullage

People were more than willing to have their houses connected to sewer network. The overall feedback was positive and encouraging as people mostly agreed Mayar river and Bijur river pollution needs to mitigate.

Regarding the proposed project 50% of them were vaguely aware that such a project has been taken up. “All drainage water will be collected in three places and will be refined before discharging in the lake.” However they had no idea regarding the environmental and social impacts that the implementation of the project can create.

Local youths in areas where the STP plant are to be located said that they know about the project, “dirty water will be treated”. They expressed their apprehension that the ground where the STP is to be located is Ward no.48 Ganiyari Road near River, Ward no. 42 Devra Village, Ward no.33 MIG Colony near nalla, Ward no.10 Bhagat Singh Colony, Ward no.7 Carbon House Road Nehru nagar near Nallah, Ward no.3 Raghav nagar road Railway colony, At ward no. 6 Anpara road near river bridge

Shopkeepers in the Bazar area said that “traffic inconvenience will occur but for development of the town, they will bear the temporary problem”

Shopkeepers also said that when the networks will be laid down cutting the roads it may cause major traffic jams on main Road

People coming into the bank near Bijur River and River said that proper fencing around the site and alternative drainage channels should be made so
that dust and waste water from the construction does not affect the main access to the bank.

Auto drivers in the Station area said that “it will cause temporary inconvenience but they can make use of the alternative roads wherever possible. However there will be problem for buses since they ply the main arterial road and there is no alternative bus route.

Excellence School mentioned that traffic disruption will not be major but care should be taken so that noise pollution does not affect studies.

In general all the groups mentioned that there will be no impact on flora and fauna. They also mentioned that there will not be loss of livelihood since locations for sewerage components are in open grounds. In spite of all apprehension most of the residents expressed the opinion that there is need for this project and are more than willing to have their house sanitation facility connected to the sewerage network.

The key identified social issues emerging have been tabulated as follows:
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Place of consultation</th>
<th>No of Participants</th>
<th>Nature of Participants</th>
<th>Key identified Positive and negative feedbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ward no. 5 Govt. Hospital</td>
<td>6</td>
<td>Local residents and shopkeepers</td>
<td>The ground from the Bazar will not cause major problem. However there can be air and water pollution</td>
</tr>
<tr>
<td>2</td>
<td>Bazar</td>
<td>10</td>
<td>Shopkeepers and daily commuters</td>
<td>As one of the most important road junctions and serving three to four wards, construction will cause Traffic inconvenience with congestion and increased travel time. It will also lead to reduced access to residences and businesses. Dust generation and garbage of debris on site road during construction</td>
</tr>
<tr>
<td>3</td>
<td>Road</td>
<td>12</td>
<td>Mixed profession group</td>
<td>A main arterial road of the town. There is very limited alternative traffic diversion and hence laying of underground sewer network will lead to inconvenience of movement of traffic and access to residences.</td>
</tr>
<tr>
<td>4</td>
<td>Ward no.10 Bhagat Singh Colony, Ward no.7 Carbon House Road Nehru nagar near Nallah, Ward no.33 MIG Colony near nallah</td>
<td>10</td>
<td>Local residents</td>
<td>Road narrowing, dust generation causing inconvenience to the residents. Noise and odour nuisance to people residing in the opposite side of the road</td>
</tr>
<tr>
<td>5</td>
<td>Proposed Lifting Station</td>
<td>15</td>
<td>Daily commuters, Shopkeepers and local residents</td>
<td>Noise and Air Pollution during construction</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Affected Group</td>
<td>Impact</td>
<td></td>
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<td>----------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Station Road</td>
<td>Daily commuters</td>
<td>Reduced access to the railway station Some traffic disruption</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auto drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Excellence school</td>
<td>Senior School Students</td>
<td>Since there is very limited scope for traffic diversion it will cause serious traffic jam Noise pollution during construction.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Government hospitals</td>
<td>General public</td>
<td>The medical facility will face problems in terms of transportation of patients, visits by patient party and handling emergencies</td>
<td></td>
</tr>
</tbody>
</table>

Source Public Consultation

People in general were aware of pollution due septic tanks and sewer disposal. But it does not go much beyond the fact that due to industrial waste, garbage dumping, open defecation and dirty untreated water near Bijur River and Mayar River

The extent of pollution in the city, the groundwater contamination and pollution of Ponds and streams are not clear to the people. At the same time the idea about the project is very vague. Young people who live near the proposed STPs site are aware that some project had been undertaken to treat the dirty water but has no idea about what the mechanism is and what components are covered.

The filthy views of open drains, bad odours, flies, mosquitoes, pathogens right in the heart of the town makes people realise the dangers and health hazards.

There is fear of contamination of sewer water mixing with piped water for drinking as the sewer are to be laid on the streets having distribution network of water. However all care shall be taken for keeping sufficient distance horizontally and vertically between the two pipes. Also difference in colour of pipes will helping identification during O&M.
2.0 ENVIRONMENTAL MITIGATION AND MANAGEMENT PLAN

2.1 Environmental Mitigation and Management Plan

The Mitigation and Management Plan (EMP) covers all phases of the Project from preparation and construction to commissioning and operation, and aims to monitor environmental impacts and their mitigation. The EMP has been incorporated into the design stage, and will be incorporated into the construction and operation management plans.

Plans for public involvement during the design, construction and operation phases have been developed during the project preparation stage. These plans include public participation in:

a. monitoring impacts and mitigation measures during the construction and operation phases,

b. evaluating environmental and economic benefits and social impacts, and

c. Interviews after the Project have been completed. There will be several types of public involvement, e.g., site visits, workshops, investigation of specific issues, interviews, and public hearings.

Costs of all mitigation measures during the construction phase will be included in the tender and contract documents and will be borne by contractors. Costs related to mitigation measures for the operation phase will be borne by IAs. Costs of environmental management consultants and of training will be borne by the project as a whole.

During the construction and operation phases, the implementing agencies (IAs) will be responsible for monitoring the performance of the facilities and the environmental impact of the project. Each IA will make appropriate arrangements for monitoring in consultation.

Besides compliance monitoring, detailed internal environmental monitoring programs during the construction and operation phases with higher monitoring frequency will be prepared at the beginning of project implementation. These monitoring programs and budgets will be included in the construction and operation contracts and programs.

Annual environment monitoring cost during operational phase on account of following parameters shall be worked out separately

a) Ambient Air Quality Monitoring
b) Ambient Noise Level Monitoring
c) Noise Monitoring (D.G sets)
d) **Drinking/ Ground Water Quality**  
e) **Surface water Monitoring**  

**Cost of ESMP**  
- Dust Generation  
  - Water sprinkling on excavated material to suppress dust  
  - Provision of top cover, during transportation of materials  

- Noise and Vibrations  
  - Usage of sound barriers or sheets  

- Labour camps  
  - Health hazard and nuisance due to absence of facility for sanitation and SWM  
  - Cost of construction of pit and toilet building for sanitation  
  - Dustbins for SWM  

- Spreading awareness to ensure community participation  
  - Social Surveys, FGDs, Stakeholders' consultation workshops, Hoarding  
  - Meetings, workshops etc  

- Project awareness and preparedness  
- Included in the section on Communication and Public Outreach section  
- Environmental Monitoring during Construction & Environmental Monitoring during operation through third party assessment  

- Development of Greenbelt / Buffer Area
3.0 COMMUNICATION AND PUBLIC OUTREACH PLAN

3.1 Introduction

The success and sustainability of the proposed sewerage project hinges on public awareness and public participation. There is also a need to create and maintain public confidence and interest in the proposed project through sustained communication and public involvement efforts.

Presently the total installed capacity of Singrauli Water Supply system is 9.00 MLD. The water is being supplied mainly from underground sources. However the present and future population taking 135 1pcd as the basic parameter for this consideration.

Hence any major project concerning to the Mayar River and Bijur River need to take into account the feelings, understandings and concerns of a wide range of stakeholders. These stakeholders comprises of religious opinion-leaders, Elected Representatives, women, youth and children, local communities that depend upon the lake.

The long-term deliveries of the program will depend not just on public participation and awareness but also on appropriate behavioural change vis-à-vis public activities that impact the quality of the lake, e.g., religious and bathing practices, solid waste management practices, etc.

In this context, the Principle objective of the Communication and Public Outreach Plan is to convey the purpose and benefits of the proposed project and the role of the citizens in building and maintaining the project to obtain the greatest possible benefits in Singrauli Municipality.

3.2 Communication plan and public outreach activities

3.2.1 Objective/Approach

The Public Participation and Public Awareness strategy under the proposed sewage project envisages to:

• Provide information to all interested parties and stakeholders.

• Improve the pace and quality of decision-making by making use of the knowledge, experiences and initiatives of the relevant stakeholders.

• Increase awareness among different segments of the target population about the issue of environmental pollution including the pollution level of the Mayar River and Bijur River how such a situation would impact people’s health and their quality of life and what should be done to improve the situation.
• Mobilise public support by seeking their participation in planning, designing and implementation, monitoring as well as in operations and maintenance of infrastructure facilities to be created under the project.

• Ensure optimum utilization of infrastructure facilities to be created under the project by educating the public through behaviour change communication impacting their knowledge, attitude and behaviour pattern of the target audience.

• Inculcate a sense of ownership and responsibility among the target audience towards the use, operation and maintenance of infrastructure services and provisions.

• Make the city governance system transparent, efficient, accountable and responsible to the people.

• Strengthen the legitimacy and acceptance levels of ULBs by the citizens.

The approach to the exercise will traverse the following stages:

- Monitoring
- Understanding the context (CAN)
- Defining target audience
- Defining communication objectives for each segment
- Development of message and selection of medium
- Stakeholder consultation
- Development of materials
- Communication Strategy
- Finalization
- Pretesting

The approach to plan and implement Communication and Public Outreach (C&PO) programme needs to be participatory. Common wisdom suggests that the environmental issues are best handled with the participation of all concerned stakeholders and public at large. Unless the citizens of the city feel that they have been involved and their views are heard, they feel alienated and no matter how well the project has been conceived and executed, it does not accomplish its intended goals / objectives.
For the result oriented and sustainable Impacts of (C & PO) programme, it is important to focus on the following key issues.

**Situation Analysis**

- Identification of major primary and secondary target groups
- Assessment of KAP (knowledge, attitude, behaviour & practices with regard to sanitation and Bijur River and Mayar River pollution), socio-economic conditions and cultural pursuits etc.
- Assessment of Communication Needs

  **Development of communication plan including**

  - Identification and prioritization of locally based media
  - Development of communication plan
  - Development of Public outreach plan.

  The communication plan will also include sensitisation and advocacy components.

**Public Outreach Plan**

- Activity identification
- Evolving mechanism for Public Participation in execution of campaign.

### 3.2.2 Situation Assessment

**Identification of Stakeholders/Audience**

As already noted all the municipalities /ULBs covered by this programme are part of Kolkata Metropolitan Area (KMA) and are broadly similar in both geographic and demographic character in addition to being very close to each other. The area is predominantly urban, densely populated with high percentage of literacy among both males and females.

The **major stakeholders** are:

(a) **The municipalities, its elected members and staff** who will be required to oversee the construction of the sewerage networks and STP as well as be directly responsible for the maintenance of the installations

(b) **Local residents** who will take initiative to connect their houses with the sewer line.
(c) **Local business people and traders who will take** precautionary steps to ensure that the sewerage and drainage systems remain unclogged

(d) **Local factories and Mills especially the Jute Mills**

(e) **School Students and College Students**

(f) **Community whose livelihood is related to the lake e.g., Washer men, boatmen**

(g) **The opinion makers** are intimately acquainted to and well regarded by the community. They need to be enlisted in spreading environmental awareness within the community as well as in conveying the benefits of the project.

(h) **Community organisations** These persons may belong to the following organizations:

   - Community Development Societies,
   - Ward committees/Nagarik Committees/Education Committees / Area Sabha
   - Local NGOs and clubs
   - Local Women’s organization: Community Development Societies and Self Help Groups
   - School and College Teachers
   - Leaders of trade unions and other labour organizations
   - Representatives of media viz. editors of local Magazines/correspondents of local press

**Assessment of Knowledge Awareness and Practice and identification of education needs**

- Survey was conducted (refer to Previous section) with 108 households to understand the existing awareness level.
- Key informant interviews were conducted local youths, conservancy supervisor and Ward councillor to understand their perspective of the media particularly in relation to the pollution of the lake.
- Focus group discussions were held with Community Development Society (CDS), municipal staff, other communities like presence of large number of Sikhs. Slum dwellers in wards to gather opinions about media coverage of the issues pertaining to the pollution and relation of livelihood and the lake.
Household survey revealed that marginal awareness has been generated for this project. As per survey analysis Meeting and Information Dissemination by the Councillor is the most important means for awareness generation as indicated in the chart below.

![Probable medium of awareness Generation](chart)

FGDs revealed that there is need for raising awareness regarding the project, people opined that this is very important and should be taken up in each ward. They suggested that following means of communication would be effective –

- Miking in each ward
- Hoardings in important places of the town
- Local Cable channel
- Communication from leaders / ward representative

Since the level of awareness among of the people was low, they could not visualise much on the consequences on environment and its mitigation measures except for the inconveniences of traffic movement and generation of dust and silt due to construction.

3.3 Development of Communication Plan

The stakeholder feedback provided strategic pointers to the development of the communication plan.

The communication plan involves the following stages:

3.3.1 Identification and prioritization of channels of communication

In order to prepare a communication calendar, media mapping exercise is necessary. Media mapping helps us to understand the extent of access and the suitability of the communication channels. For this exercise we need to gather
information about the media sources of the population and the role media plays. Following tools were used.
The channel of communications selected depends on both the target audiences that have to be reached out to as well as the message content. Typically, an assortment of channels is used to reach out the target audiences for maximum impact. Getting the correct media mix is crucial importance.

**Mass Media (TV, Radio and Print Media)**
The mass media are diversified media channels and technology that are intended to reach a large audience by the use of radio, Television, music and CD etc. It has great mass appeal as it is seen as a credible means of information and entertainment by masses. It brings through images, pictures, videos that create inspirational values in the mind of viewers. It has enormous power to bringing about awareness on an issue. However, poor content and treatment can often cause serious misconceptions.

Use of local cable channel is an effective Mass Media as per the stakeholder feedback.

Similarly, print media also has great reach, but is restricted to literate segment of the target audiences. It constitutes newspaper, magazines, reports and best practice books etc.

**Outdoor Media**
The outdoor media is in the form of hoardings, paintings, bill boards, posters and wall painting etc., This media creates the visibility around the key messages and the project. It works as recall and reminder to the target audiences. Outdoor media could be used during the course of communications intervention; however monitoring the quality is very difficult. ‘Melas’ during festive occasions are very common and they attract huge gatherings. Miking is a very effective means as mentioned by the stakeholders.

**IEC materials**
IEC materials are not often seen as separate channel of communication but greatly facilitate communicating specific thoughts and ideas. Poster, Banners, leaflets flipcharts, games and activities, CD are all help in attracting target audiences and creating enabling environment.

Cartoon based posters have a great appeal.

**Interpersonal Communications**
Interpersonal communications (IPC) provides a feedback oriented two way communications among target audiences. This is most effective as it clarifies doubts and queries. Specific and detailed messages can be provided which is not feasible to provide with other channels of communications. Literacy, technology and language are also not the bar therefore potentially most effective in bringing about and sustained behaviour. The flip side is that it is
time consuming depends heavily on the skills /knowledge of the communicator.

3.3.2 Communication Plan

These will include:

• WHO are the targets
• WHAT would be communicated or the objective of communication based
• WHEN they will be done
• HOW and WHERE activities will be carried out

The communication strategy has been suggested for the different phases of commissioning like

• Pre-construction
• Construction
• Post construction or O& M Phase
### Pre-construction phase

<table>
<thead>
<tr>
<th>WHO</th>
<th>WHEN</th>
<th>WHAT</th>
<th>HOW and WHERE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal counsellors and staff, eminent citizens, NGOs, social workers, government officials, teachers, doctors and other professionals, business leaders, human rights activists, community leaders</td>
<td>6 months</td>
<td>Details of GOMP/ULB and public participation in all stages of programme implementation</td>
<td>Organizing seminars and workshops involving eminent persons and organizations (1 each month) involving 75-100 (by invitation).</td>
</tr>
<tr>
<td>Local Residents and other community groups</td>
<td>1 years</td>
<td>To create awareness among households and businesses about the GOMP/ULB project how it proposes to reduce pollution on the lake</td>
<td>Establishment of contacts and personalised interactions with citizens through meetings at schools, local clubs, street corners, and religious/public festival sites</td>
</tr>
<tr>
<td>Local residents with emphasis on excluded sections</td>
<td>6 months</td>
<td>Explaining the need for House to house sewer connections and explaining how important collection of user-charges are for sustainability of the project.</td>
<td>Interpersonal communication means including door to visits, small group meetings, Focus Group Meetings</td>
</tr>
</tbody>
</table>
## Construction Phase

<table>
<thead>
<tr>
<th>WHO</th>
<th>WHEN</th>
<th>WHAT</th>
<th>HOW and WHERE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All stakeholder</td>
<td>Stage 1: Just at the time of initiation of the project</td>
<td>Raising environmental awareness in the context of the importance of reducing pollution on the lake.</td>
<td>Installation of <em>hoarding</em> stating the importance of reducing pollution on the Ganges at each of the following 8 strategic locations for the 6 month period.</td>
</tr>
<tr>
<td></td>
<td>Time Line</td>
<td>HOW and WHERE (Installation of hoarding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All stakeholder</td>
<td>Stage 2: Once construction starts in full swing</td>
<td>To create awareness about the project in its entirety - how it proposes to reduce pollution on the lake and updating project progress</td>
<td>Change of contents of hoarding to provide upcoming project information at the above 8 locations every 3 months.</td>
</tr>
<tr>
<td></td>
<td>2 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change of contents of hoarding</td>
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<td></td>
<td></td>
<td>(Installation of flexes (one in each ghat area, total 6 ghats) on the Dos and Don'ts)</td>
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<td></td>
<td></td>
<td>Advertisements in local newspapers/magazines.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 full page Ad in each paper once each month (content to change every 6 months incorporating updates in progress $= 24 \times 3 = 72$)</td>
<td></td>
</tr>
<tr>
<td>WHO</td>
<td>WHEN</td>
<td>WHAT</td>
<td>HOW and WHERE</td>
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<td>Stage</td>
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<td>full page Ads</td>
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<td></td>
<td></td>
<td>Advertisements in the local cable channels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Zone wise miking during execution according to work plan</td>
</tr>
<tr>
<td>All stakeholder especially targeting the opinion makers, community organisations through whom the further dissemination will take place</td>
<td><strong>Stage 3:</strong> During the final construction and completion phase</td>
<td>6 months</td>
<td>Explaining the need for House to house sewer connections and explaining how important collection of user-charges are for sustainability of the project.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Installation of hoarding containing project information, the need for sewer connections and user charges in all the 20 wards</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Installation of flexes (one in each ghat area) on the Dos and Don’ts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Advertisements in the local cable channels 60 words everyday for 6 months</td>
</tr>
</tbody>
</table>
Post construction - After commissioning and during O&M of five years.

<table>
<thead>
<tr>
<th>WHO</th>
<th>WHEN</th>
<th>WHAT</th>
<th>HOW and WHERE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Corporation, officials and staff on</td>
<td>Stage 1, Time Line 1 year</td>
<td>Importance and procedures of setting up house to house sewer</td>
<td>Handbills</td>
</tr>
<tr>
<td>Local residents and Opinion Makers</td>
<td>Stage 1, Time Line 1 year</td>
<td>Importance and procedures of setting up house to house sewer</td>
<td>Handbills</td>
</tr>
<tr>
<td>WHO</td>
<td>WHEN</td>
<td>WHAT</td>
<td>HOW and WHERE</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>Stage</td>
<td>Time Line</td>
<td>connections and sanitary latrines Notifying the procedure of setting up house to house sewer connections and inviting citizens to set up such connections</td>
</tr>
<tr>
<td>Local Residents with emphasis on the excluded sections</td>
<td>Stage 2</td>
<td>1 year</td>
<td>To sensitize people still without sanitary latrines to set up such latrines and connect them to the sewer network</td>
</tr>
<tr>
<td>All stakeholders</td>
<td>Stage 3</td>
<td>3 years</td>
<td>To provide regular updates to people regarding progress of the project (e.g. no of connections set up/ new sanitary latrines etc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Billboards and TV and cable advertisements describing the benefits of sanitary latrines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flexes in the campuses of Main School colleges</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Installation of flexes (one in each ghat area) on the Dos and Don’ts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IPC through ward members, CDS and Health Workers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Advertisements in local newspapers/ newsmagazines providing incentives to own up the projects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 full page advt. in 4 local newsmagazines once every months=24x 4 =96 ads</td>
</tr>
</tbody>
</table>
3.4 Development of Public Outreach Plan

The major supports required from citizens are:

(a) Constructing pucca toilets at home and connecting them to the sewerage networks
(b) Establishing sewerage connections even for houses with septic tanks
(c) Willingness to pay to the user charge to cover O&M cost

Hence the communication content and objective will be driven by it. Hence the activities to be carried out will include:

- Preparation of Exhibition Material/Posters and organizing these events
- Special cultural events performances of folk media, (folk theatre, folk Music) Street Plays (Performances specially for Slum localities) on the occasion of Saraswati Puja and Durga puja
- Environmental awareness at school levels (talks, essay, painting competition, debates, other activities)
- Quiz and debates involving school children on the “Pollution of lake and Citizen’s participation in its abatement”,
- Seminars at Colleges
- Audio-visual shows for the Slum residents by putting make shift screens.
- Organizing neighbourhood meetings involving local clubs and NGOs.

3.5 Monitoring Mechanism

One of the most important aspects of the Communication and Public Outreach Plan is systematic monitoring and performance evaluation (M&E) of communication materials, process and effects. To determine IEC can help bring about changes in knowledge, attitude and practices, a monitoring and evaluation framework has to be in place. Monitoring and evaluation is also required to track progress, troubleshoot problems, perform mid-course action, and quantify effects and impact and to help improve future communication strategies.

The M&E framework for the current IEC campaign should be based on participatory assessment. Each activity shall be assessed concurrently to
ensure right message and effective medium is used and take mid-term corrective measures. An end term evaluation shall be conducted to assess the overall effectiveness of the campaign and to assess how far the objectives of the campaign has been achieved.

The overall objective of the M&E of the campaign shall be to assess the reach and impact of the campaign activities in terms of increase in the awareness level and extent of change in the practice regarding waste management among target segments. The specific objectives of the M&E may be:

- To assess the quality, quantity and timeliness of the campaign inputs.
- To identify operational constraints to campaign effectiveness.
- To determine if the process of implementation is meeting the set standard and methods of implementation.
- To determine whether the campaign is addressing the issues effectively.
- To help identify the effects of the campaign, this can be attributed to the campaign.
- To assess the overall impact of the campaign in improving solid waste management in the designated areas.

IEC activities that might need to be monitored include:
- Number of events (meetings, folk shows, posters, banners etc.) organized
- Levels of community participation in activities carried out under the campaign
- Volume and quality of materials produced
- Distribution of materials
- Quality of interpersonal communication
- Work schedules
- Availability, accessibility and acceptability of messages and materials by the target groups
- Effective utilisation of materials
- Ease or difficulty of use and understanding of messages and materials
- Number of participants (male and female) in the meetings, discussions, street play shows, school completions, rallies, etc.
- Number of households being serviced by waste collection service
- Number of CBOs, NGOs, Schools, Institutions and Commercial establishments involved in the IEC programme
- Number of households, institutions, commercial establishment, schools, etc covered under the IEC programme through door-to-door campaign
• Number of calls received regarding provisions or services
• Number/places requisite infrastructure is provided
  To be more specific the purpose of monitoring exercise is to ensure:
• The IEC activities are working
• The messages are acceptable by the communities it is intended for and being correctly understood and interpreted
• Right channels and media being used to convey information
• People are showing signs of change in their knowledge, attitudes or behaviour as a result of the IEC activities?
• The change was as a result of the IEC intervention

3.6 Conclusion
There is widespread recognition that the success and sustainability of the GOMP/ULB Program hinges on public awareness and public participation. Common wisdom suggests that the environmental issues are best handled with the participation of all concerned stakeholders and public at large. Unless the citizens of the city feel that they have been involved and their views are heard, they feel alienated and no matter how well the project has been conceived and executed, it does not accomplish its intended goals / objectives. This calls for the development of the Communication and Public Outreach Programme. The approach to plan and implement Communication and Public Outreach (C & PO) programme needs to be participatory.
In this context the views of the stakeholder groups including the community was assessed. In general, the respondents opined that Mayar River and Bijur River pollution has increased manifold in recent years. They can see a visible change in the colour of water which is now greyish and can experience the odour that comes from the drains or Nallahs which drain out in the Mayar River and Bijur River pollution. They appreciated the efforts made by the municipality in cleaning the environment through Door to Door solid waste collection and the construction and operationalisation of the electric crematorium which they consider as right steps in reducing pollution in the city. However with their limited level of awareness on the project, they could not visualise much on the consequences on environment and its mitigation measures except for the inconveniences of traffic movement and generation of dust and silt due to construction. In spite of all apprehension most of the residents expressed the opinion that there is need for this project and they are more than willing to have their house sanitation facility connected to the sewerage network.

They strongly expressed that awareness generation is very important and that can be done through
• Miking in each ward
• Hoardings in important places of the town
• Messages and events in Local Cable channel
• Communication from leaders / ward representative

The communication strategy and public outreach plan thus suggested, include a combination of mass communication through audio visual and printed media, focussed communication through cultural media and interpersonal communication methods for directed communication depending on the target stakeholders which comprise the community, the Municipal functionaries, the NGO-s, CBOs, the Line Department operatives. Thus along with the awareness generation means suggested by the stakeholders other communication and public outreach means have been envisaged as

• Special cultural events performances of folk media, (folk theatre, folk Music) Street Plays (Performances specially for Slum localities)
• Environmental awareness at school levels (talks, essay, painting competition, debates, other activities)

The communication strategies would be implemented in the initial 2 years of the project. The proposed budget for the Communication and Public Outreach Plan would be

3.7 Cost Estimates for Communication Plan

A. MEDIA PLAN
Bill Board
Flexes
Local Cable
Local Paper
Handbill

B. ADVOCACY PLAN
Workshop
Door to door
Meeting and FGD
Training

C. COMMUNITY OUTREACH PLAN
Exhibition
Street Theatres and campaigns
Quiz and Debates
Stalls in Fairs and Festivals

### Cost of Environmental Monitoring: Operational Phase (5 Years)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Monitoring</th>
<th>Parameter</th>
<th>No. of Stations/Samplers</th>
<th>Frequency (Yearly)</th>
<th>Unit Cost</th>
<th>Cost (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ambient Air Quality Monitoring</td>
<td>As per NAAQS, 2009</td>
<td>1</td>
<td>2</td>
<td>10,000.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td>2</td>
<td>Ambient Noise Level Monitoring</td>
<td>Noise level monitoring (During Day &amp; Night Time) As per CPCB standards</td>
<td>1</td>
<td>2</td>
<td>10,000.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td>3</td>
<td>Noise Monitoring (D.G sets)</td>
<td>As per CPCB standards</td>
<td>1</td>
<td>2</td>
<td>8,000.00</td>
<td>16,000.00</td>
</tr>
<tr>
<td>4</td>
<td>Drinking/Ground Water Quality</td>
<td>As per IS: 10500</td>
<td>2</td>
<td>2</td>
<td>12,000.00</td>
<td>48,000.00</td>
</tr>
<tr>
<td>5</td>
<td>Surface water Monitoring</td>
<td>Ground water Level Monitoring</td>
<td>2</td>
<td>2</td>
<td>10,000.00</td>
<td>40,000.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,44,000.00</td>
</tr>
</tbody>
</table>

Annual environment monitoring cost during operational phase is Rs 144000. Therefore for five years of operation period, the environment monitoring cost is Rs. 720000.00 (Rupees Seven Lacs Twenty Thousand only).
# Estimated Cost of ESMP

<table>
<thead>
<tr>
<th>S. No</th>
<th>Component of ESMP</th>
<th>Mitigation Measures</th>
<th>Particulars</th>
<th>Remarks</th>
<th>Unit Cost</th>
<th>Total (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dust Generation</td>
<td></td>
<td>Water sprinkling on excavated material to suppress dust</td>
<td>5 tankers<em>60 days</em>Rs. 300*2years</td>
<td>LS</td>
<td>1,80,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision of top cover, during transportation of materials</td>
<td>Top cover for dumper</td>
<td>30 sqm of top cover per vehicle</td>
<td>L.S</td>
<td>80,000.00</td>
</tr>
<tr>
<td>2</td>
<td>Noise and Vibrations</td>
<td>Usage of sound barriers or sheets</td>
<td>Setting up of barricades</td>
<td>L.S (2 construction locations @ INR 40,000 and across pipeline laying stretches)</td>
<td>80,000.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Setting up of noise barriers</td>
<td>Installing G.I. Sheets</td>
<td>L.S (App 2 metric tonnes @ Rs 40000 per metric ton)</td>
<td>80,000.00</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Labour camps</td>
<td>Health hazard and nuisance due to absence of facility for sanitation and SWM</td>
<td>Sanitation</td>
<td>Cost of construction of pit and toilet building</td>
<td>L.S (App 4 blocks @ Rs 22,500)</td>
<td>90,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SWM</td>
<td>Dustbins</td>
<td>L.S</td>
<td>25,000.00</td>
</tr>
<tr>
<td>4</td>
<td>Environmental Monitoring during Construction</td>
<td>Third Party Assessment</td>
<td></td>
<td></td>
<td></td>
<td>4,00,000.00</td>
</tr>
<tr>
<td>S. No</td>
<td>Component of ESMP</td>
<td>Mitigation Measures</td>
<td>Particulars</td>
<td>Remarks</td>
<td>Unit Cost</td>
<td>Total (INR)</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------</td>
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<td>------------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Monitoring during operation</td>
<td></td>
<td>Third Party Assessment</td>
<td></td>
<td>4,00,000.00</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Development of Greenbelt / Buffer Area</td>
<td></td>
<td>L.S</td>
<td></td>
<td>3,00,000.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16,35,000.00</td>
</tr>
</tbody>
</table>
## Estimated Cost of Communication Plan

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>Period</th>
<th>Frequency</th>
<th>Size/ Duration</th>
<th>Rate (INR)</th>
<th>Amount (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. MEDIA PLAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bill Board</td>
<td>5 (strategic Locations)</td>
<td>2 yr</td>
<td></td>
<td>200 sq ft</td>
<td>4500/= per year</td>
<td>45,000.00</td>
</tr>
<tr>
<td></td>
<td>41 wards</td>
<td>2 yr</td>
<td></td>
<td>100 sqft</td>
<td>2500/= per year</td>
<td>2,05,000.00</td>
</tr>
<tr>
<td>Flexes</td>
<td>12 (4 areas)</td>
<td>2 years</td>
<td></td>
<td>100 sqft</td>
<td>17000/= per year</td>
<td>68,000.00</td>
</tr>
<tr>
<td>Local Cable</td>
<td>2 channels</td>
<td>6 months</td>
<td>everyday</td>
<td>Once/channel/ day</td>
<td>2000/ channel/month</td>
<td>24,000.00</td>
</tr>
<tr>
<td></td>
<td>2 channels</td>
<td>6 months</td>
<td>everyday</td>
<td>Once/channel/ day</td>
<td>2000/ channel/month</td>
<td>24,000.00</td>
</tr>
<tr>
<td>Local Paper</td>
<td>2 papers</td>
<td>6 months</td>
<td>1/month</td>
<td>Full page</td>
<td>3500/=</td>
<td>42,000.00</td>
</tr>
<tr>
<td>Handbill</td>
<td>19442 units</td>
<td>6 months</td>
<td>3</td>
<td></td>
<td>3</td>
<td>1,74,978.00</td>
</tr>
<tr>
<td><strong>B. ADVOCACY PLAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop</td>
<td>12 (1-day) workshops</td>
<td>6 months</td>
<td></td>
<td>75-100 participants</td>
<td>22000/=</td>
<td>2,64,000.00</td>
</tr>
<tr>
<td>Door to door</td>
<td>41 wards</td>
<td>6 month</td>
<td>1 over the pd</td>
<td></td>
<td>2000/per ward</td>
<td>82,000.00</td>
</tr>
<tr>
<td>Meeting and FGD</td>
<td>41 wards</td>
<td>6 months</td>
<td>1 over the pd</td>
<td></td>
<td>3000/per ward</td>
<td>1,23,000.00</td>
</tr>
<tr>
<td>Training</td>
<td>6 training programmes</td>
<td>6 months</td>
<td></td>
<td>75-100 participants</td>
<td>17000</td>
<td>51,000.00</td>
</tr>
<tr>
<td>Item</td>
<td>Number</td>
<td>Period</td>
<td>Frequency</td>
<td>Size/ Duration</td>
<td>Rate (INR)</td>
<td>Amount (INR)</td>
</tr>
<tr>
<td>-----------------------------</td>
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<td>-------------</td>
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<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>C. COMMUNITY OUTREACH PLAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibition</td>
<td>40 exhibit</td>
<td>6 months</td>
<td>6 events</td>
<td></td>
<td>1200/exhibit</td>
<td>42,000.00</td>
</tr>
<tr>
<td>Street Theatres and campaigns</td>
<td></td>
<td>6 months</td>
<td>6 events</td>
<td></td>
<td>11000/event</td>
<td>66,000.00</td>
</tr>
<tr>
<td>Quiz and Debates</td>
<td>1 college and 4 Schools</td>
<td>6 months</td>
<td>2 events/ year</td>
<td></td>
<td>17000/event</td>
<td>2,04,000.00</td>
</tr>
<tr>
<td>Stalls in Fairs and Festivals</td>
<td>3 stalls/event</td>
<td>2 years</td>
<td>2 events / year</td>
<td></td>
<td>15,000/per stall</td>
<td>1,80,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>16,45,978.00</strong></td>
</tr>
</tbody>
</table>
4.0 GOVERNANCE AND ACCOUNTABILITY ACTION PLAN (GAAP)

4.1 Introduction

Looking to the scenario there is a need for a Governance and Accountability Action Plan (GAAP) since the ULB’s would be fully responsible for owning the project and interfacing with the citizens at different levels of project execution. The citizens are a key takers of the project which will associate expectations, responsibilities and grievances which will have to be handled at the ULB level.

This document provides an over sight of the main issues, the risks identified and the mitigation measures proposed.

4.2 Main issues

Directorate of Urban Administration and Development GoMP, and the Singrauli Municipality both recognize that there are certain governance issues in the proposed GOMP/ULB Project which need to be focused on. Governance issues relate to

- Implementation

- Citizen’s Interface and Involvement

The GAAP seeks to strengthen the implementation process for ensuring accountability in implementation and to improve transparency arrangements in order to ensure citizen’s participation and involvement in a most effective, efficient and responsible manner. Strengthening of implementation and ensuring accountability and transparency requires identification of risks and subsequently designing governance plans for mitigating risks.

4.3 Main Risks

Both implementation and citizen’s interface associate some risks which needs to be anticipated and mitigated for the entire course of the program execution.

Implementation

The envisaged risks in the domain of implementation are as follows:

- Lack of Clarity in Roles

As indicated in the introductory section, various agencies are involved in project implementation—right from the [Preparation of DPR to Tendering as well as Contractors. This would need clarity in terms of their roles and very strong coordination and synergy.
Without these, there is a risk that roles may overlap, duplicate or even be missed out.

- **Lack of Ownership and shifted Project priority**

Changing tenure of Board and Leadership at the ULB level which is confined to a 5 year term may lead to a risk of project priority and continued ownership especially considering the complexity and duration of the proposed project.

- **Poor Asset Maintenance**

Public bodies in general have a poor record in asset maintenance. The proposed project envisage substantial investments in infrastructure including STPs, pipe lines and stations. In order for these to work effectively, it is essential that the asset maintenance is regular and of high quality. However the ULBs suffer from a range of financial constraints, including: (i) a lack of buoyant revenue streams, with existing local sources being both inadequate and poorly mobilized (e.g. property tax, user charges) and fiscal transfer from higher levels being unpredictable; These in turn results in weak asset maintenance poor leading to lack of sustainability.

- **Lack of ULB capacity to handle Procurement and Contract Management**

The volume and type of investments proposed under the project would require extremely strong and efficient procurement systems and contract management. It would not only require transparency and Value for Money in the initial contract award but also in the maintenance phase where revisions in cost or scope may become necessary. But ULB-s often lack technical capacity for appropriate procurement and management at the ULB level making it difficult to ensure the success of the project.

- **Inadequate ULB capacity to undertake Inspections and Quality Audit**

The capacity for Quality Audit including quality assurance and quality control are existent among the EA and ULB technical staff. However the staff may not have the requisite pointers for QA & QC in the context of such large scale projects.

- **Limited ULB capacity to handle Internal Audit and assist in External Audits in line with GOMP/ULB guidelines**

Internal audits of the project will be carried out in line with the Government Guidelines.

- **Limited use of technology and e-governance in Municipality functions**

Although Singrauli Municipality has moved ahead in e-governance yet the scope is limited to some systems and functions. It would require extensive use of e-governance tools for project design, management and review

The anticipated risks in citizen’s interface and involvement are the following:
• **Lack of systems for in building Citizens’ Voice**

In order for the proposed project to succeed, it is necessary to involve the citizens. Without citizens’ active participation and valuing of citizen’s feedback, the project would face serious risks of acceptability, viability, and efficacy. Often streamlined systems are not available at the ULB level to attend to Citizen’s feedback.

• **Inadequate Complaint management systems**

Current systems of Complaint Management in ULBs as well as State bodies are generally routine and out dated. Citizens are neither able to access them easily, nor can they be updated regularly about the status of their complaint. This results in an insensitive or irresponsive complaint management procedure.

• **Inability to Pay**

One of the aspects considered in the proposed project is the ‘Ability to Pay’ of the beneficiary groups. While these figures have been mentioned in various parts of the report, there is a risk that this may not translate in to a ‘willingness’ to pay by them. Further often there is reluctance of elected Municipal Corporations to charge for improved services even though some users are willing to pay. Subsidy mechanisms are also nontransparent.

• **Inappropriate composition of Citizen Monitoring Committees**

The very design of the Citizen’s Monitoring Committees (CMC) induces concentration of powers in the hands of dominant sections. Further, this provision reduced the strength of third-party monitoring as it overlaps the responsibilities with that of the local government.

4.4 **Mitigation Measures**

Mitigation measures are deliberated upon to address the envisaged risks as mentioned above. Following the structuring of risks under the two heads, the range of mitigation measures have also been grouped in to 2 categories.

1. Implementation Arrangements;

2. Proper Citizen’s Interface and Involvement each has been elaborated in the following sections.

   **Implementation Arrangements**

   Mitigation measures related to implementation arrangements will include

   • Institutional capacity strengthening and

   • Streamlining procurement, contract and financial management issues
**Strengthening Institutional capacity** will include the following mitigation pointers

- **Ensuring Clarity in Institutional Arrangements**

  In order to ensure role clarity among various players, a framework and guidelines providing specific forms of organizations. Similarly, ULBs are guided by their laws and business processes. In order to remove any ambiguity in the roles, specific Memorandum of Agreement(s) bringing out the specific roles and responsibilities of various agencies and ensure that there is a clear understanding of the complementary roles of each agency.

- **Board Resolutions**

  In order to ensure that there is continuity and ownership of the projects, the ULBs have been involved at every step of the design and implementation process. All proposals have to be placed and approved in the Board of Council or meeting and only then can be placed for the approval. This helps to enhance organizational ownership and ensure its continuity over the project duration.

- **Skills Infusion and Training**

  In order to meet the requirements of the proposed project, there will be need to induct specialized personnel and / or enhance skills of existing personnel in the ULBs and EAs. This would be especially relevant in terms of technology and maintenance issues of the STPs etc. that would be introduced by the contracted agencies over time. For this a comprehensive skill building plan will need to be drawn up and training provided to bridge the gap between the current and required capacity and skills.

- **Citizens Monitoring Committee**

  In implementation, there is a strong need to involve the beneficiaries / community at large in order to restrict polarization of power in CMC. A Citizens Monitoring Committee is proposed to be setup consisting of people who would have a role / stake in the proposed project and / or knowledge of service delivery norms / community issues / social audit. The role of this Committee would be to effectively oversee the activities and call attention to any issues / diversions / problems that could adversely affect the project achieving its intended objectives.

- **Asset Maintenance**

  In order to address the concern of poor asset maintenance, several steps have been taken. These include:

  (i) Structuring of the projects in such a way that the assets are designed, built and operated for long term (such as including O&M expenses);
ii) Using appropriate appraisal criteria to assess whether asset maintenance issues have been adequately addressed;

(iii) Ownership of the project and commitment from the ULB through imposition of user charges for the sustainable management of the project.

Streamlining procurement, contract and financial management is a critical area where capacity of the various players needs to be enhanced. However, at present, some mitigation measures for these areas follows:

• **Inspections and Quality Audits**

In order to ensure compliance, the ULB will conduct regular inspection and audits to carryout quality assurance checks and review the investment implementation on the basis of the detailed on-site review, examination of appropriate documents and discussions with EAs and other stakeholders.

• **Systems and Capacity Building**

With the help of a simple and clear financial management manual, standardization in processes will be sought to be achieved. Along with this, capacity of the agencies, especially the EAs and ULBs will be enhanced through staff training, clear specification of powers and procedures, fund flow and disbursement arrangements etc.

• **Internal and External Audits**

Internal audits of the project and the Agencies will be carried out in line with the Govt. Guidelines. Wherever any weakness is identified, mitigation measures would be carried out.

• **Establish and Strengthen Procurement Systems**

To ensure efficient, fair and transparent procurement procedures, the project will ensure that Procurement Systems are well established, transparent and being followed by all entities. The system will be based on the e-tendering procedure followed by UADD GoMP which includes methods of procurement, model bidding documents, roles and responsibilities of various agencies, and prior and post review arrangements. Procurement training will also be provided to ensure that maximum Value for Money is achieved and all aspects i.e. procurement planning, implementation monitoring, and over sight are addressed.

• **Use of Technology in Procurement and Financial Accounting**

The use of innovative practices, like e-procurement, will be piloted, and transparency will be increased through computerization of all recordkeeping and procurement data, and the disclosure of all tender notices, bid documents and status of contracts on the project website and in the local print media.
• Regular Reviews

Regular reviews including Third Party Inspection Reports shall be an important way of assessing the systems and performance of the programme. Efforts will be made to involve the District Magistrate (DM) in regular monitoring of the project related issues and quarterly review meetings will be held by DM’s office in coordination with CMCs.

• Development of indicators for performance monitoring

It is proposed to have a set of performance indicators to monitor progress on field. Along with this a set of indicators could be designed to assess the issues related to institutional arrangements and citizen interface.

**Citizen’s Interface and Involvement**

Mitigation measures related to Citizen’s interface and Involvement will be addressed from 2 angles

• Transparency

• Grievance redressal

**Transparency** issues can be addressed through the following suggestive measures

• **Adherence Right to Information (RTI) Act, 2005**

The RTI Act, 2005 guarantees citizens the right to secure information controlled by public authorities as a means to promote transparency and accountability within the public sector. The project shall provide information voluntarily and on demand as prescribed under the RTI Act. There shall be separate section on the UADD site as well as on ULB’s site proactively disclosing information about the three Fs–Funds, Functions and Functionaries related to the proposed project. This would include (but not limited to) project components and sub-components, cost estimates, procurement plans, details of tender notices, details of award of contract sand contract amounts, selection of consultants, and details of officials implementing the project. In addition, the various agencies would be bound to supply any information requested under the Act.

• **Proactive disclosure following the guidelines**

In addition the ULB and various agencies will comply with the disclosure, reporting and transparency requirements as well as the relevant municipal laws. This information will be provided through website as well as alternative models in English & Hindi. In keeping with the Action Plan, Work Progress plan will be made four months in advance with tangible deadlines which may be placed in the Website. Newspaper advertisements may also help in this regard. Proactive disclosures will be made on UADD & ULB websites. Dissemination of project
related information’s will be done through IEC materials both (audio visual) including radio/FM and in response to RTI applications.

• **Social Audit**

Social audits provide a beneficiary perspective of the project’s performance and achievements. It also holds up a mirror for the implement or providing insight and learning from a third party without vested interests. The social audits shall be conducted on a sample basis of 10% of investments. They shall be conducted through the Citizen Monitoring Committee constituted earlier. For this the SPMG will develop brief check lists and train CMCs to hold community meetings, organize focus group discussions, record social audit observations and pursue follow up action. Key lessons from this process will be feedback into the design and the appraisal and selection processes.

• **Project Progress Communication**

During implementation, it is necessary to have regular communication with the community about the progress. These would carried out in line with the Communication and Outreach Plan developed separately but would include hoardings, cable news and ads, social activities etc. to let people regularly know about the progress of the project.

• **Creating Stakeholder Platforms**

A high degree of participation and oversight by civil society groups for greater accountability and responsibility. Hence, the programme shall lead in creating stakeholder forums and platforms through which various social groups can be involved. Even in the design phase, there has been regular involvement of communities and their views have been considered while finalizing the proposed project. This process needs to be formalized and extended during the implementation process as well. For this, role of various SHGs / CSOs and even Local Para (locality) Clubs –which are quite well spread and active in Singrauli – need to be involved. In addition, schools, colleges and community forums would also need to be involved.

• **Citizen’s Feedback / Survey**

An annual Citizen’s Feedback on the programme activities may be carried out as a snap shot of performance, satisfaction and citizen concerns. This will be based on indicators which will measure the achievement of the programme and data will be collected through survey questionnaire. This ‘Report Card’ will provide essential information about the interests, perspectives and expectations of stakeholders and help the ULB and EAs in meeting their expectations every year.

**Grievance Redressal** call for an important set of measures to enhance citizen’s interface and involvement is by strengthening the grievance redress mechanism. The suggestive mitigation measures have been provided below
• **Establish Grievance Redressal Cell in ULB**

The ULB will develop/enhance its Grievance Redressal Cell to address issues related to the GOMP/ULB projects. It will identify officers and officials department-wise to address these. They will be trained to deal with the online system which will require officers to reply or address the complaint within seven days. If delayed, the complaint will be forwarded to his immediate reporting authority and eventually to the Chairman. Forms will also be made available at the Municipality office for anyone to file their complaints. A half year report on Grievance Redressal will be prepared and submitted to the UADD.

• **Updating the Website to address Grievances related to GOMP/ULB**

The Singrauli Municipality is Citizen-centric. Their website already contains a feedback form which allows everyone to submit their feedback online. However, to address the concerns of the project, the following measures shall be proposed. An integrated Grievance Redressal Cell (GRC) will be formed keeping in mind the gender balance. Members of ULB will be kept at various levels in order to address the different issues. A website will be launched by the UADD cell to accept the online registration of the issues and complaints.

• **Develop/Use Integrated Grievance Redressal Software**

In order to facilitate and streamline the process of Grievance Redressal, especially for the proposed project, an Integrated Online Grievance Redressal Mechanism will be established/used. The purpose of an easy and responsive grievance redressal is to ensure that any query or complaint with regard to any aspect of project implementation is promptly recorded, routed, addressed and responded. The Online Grievance Redressal Mechanism will be an electronic solution to which people will have access through various ways—mail, post, phone, email etc. The software will allow seamless integration of feedback from the public, effective handling of complaints, and immediate automatic updates on the status of response.

• **Grievance Redressal Forum for Community**

A Grievance Redressal Forum shall be established as a sub-committee of the Citizens Monitoring Committee. They shall be responsible for hearing any complaints related to the GOMP/ULB projects and shall have access to direct it to the highest level in the ULB/GOMP/ULB for immediate redress. They shall in particular, be responsible for addressing issues related to relocation/rehabilitation/ of Project Affected Person (PAPs) etc. Efforts will be made for the redressal of the grievances of the unattended applications in the CMC, if they are not addressed in the Grievance Redressal.

• **Toll Free Call Centre**
In order to provide easier access to people, a Toll Free Call Centre for any information needed on the projects and / or recording any complaints about the project will be established. The Toll Free numbers will be appropriately publicized so that maximum people can benefit from it.

**Kiosks and Mobile Usage**

Further, as additional means of communication, Touch and Voice Kiosks shall be set up at Project locations to make it easier for people to know about the project and/or provide feedback / record grievance about the project. It is proposed that 4 such Kiosks may be setup in the ULB including at the ULB office itself. In addition, innovative use of technology including email and SMS should be used both for sending and receiving information (such as a short code to SMS complaint sat, Voice Recorded messages for communicating to the people etc.). It is also proposed the use of IEC materials like wall paints, banners, pamphlets, radio and IVRs (Interactive Voice Responses).

**4.5 Conclusion**

GOMP/ULB envisions a tiered governance structure where the positioning of ULB indicates the need for a Governance and Accountability Action Plan (GAAP) since the ULB’s would be partly responsible for owning the project and interfacing with the citizens at different levels of project execution. The citizens are the key takers of the project which will associate expectations, responsibilities and grievances which will have to be handled at the ULB level. The Governance and Accountability Plan seeks to strengthen the implementation process for ensuring accountability in implementation and to improve transparency arrangements in order to ensure citizen’s participation and involvement in a most effective, efficient and responsible manner.

Both the issues associate some risks which need to be anticipated and mitigated for the entire course of the program execution. Implementation risks relate to lack of clarity, lack of ownership and shifted project priority with change in Board, Poor asset maintenance due to lack of resources and ill-defined processes. Lack of ULB capacity in managing procurement and contracts and handling the technical and financial aspects of the project. The risks associated with citizen’s interface issues involve lack of systems for in building Citizen’s Voice, inadequate Complaint Management Systems, inadequately constituted Citizen Monitoring Committees.

The mitigation measures would thus revolve around strengthening institutional capacity of ULBs through workshops and trainings to clarify the role of ULB in the governance structure and to build skills for improved project management including procurement and contract management, use of technology. The issue of continuity and ownership would be addressed through appropriate Board Resolutions. Citizens Monitoring Committee would include beneficiaries to restrict polarisation of power. Transparency and Citizen’s Interface and
involvement would be addressed through adherence to RTI, proactive disclosure, social audit, and citizen’s feedback surveys. Grievance redressal would call for establishment of Grievance Redressal Cell in ULB, updating website and making it interactive along with creation of Toll Free call Centres, Kiosks and Mobile Usage etc.

4.6. Cost Estimates for GAPP

Cost Estimates for GAPP shall be prepared for following works,

1.0 Multipurpose Kiosk
   a) Proactive disclosure, Grievance Redressal, Updating of Website
      - One person for each kiosk with Telephone, Computer and Internet for 7 years
      - Kiosk operator will be a person engaged from the Municipality on additional duty. The IT Coordinator can handle this

2.0 Citizens Monitoring Committee
   b) Co-opted members 3 member committee, one Executive, one Eminent Citizen and one from Executive
      - Quarterly meeting will be held and sitting fee will be paid for each meeting

3.0 Software
   - Customized software to deal with grievance
   - Maintenance of computer and Software

4.0 Training, Meeting Workshop
   - ULB’s / CMC / GRC / CSOs
   - Cost included in section on Communication and Public Outreach Plan
   - Citizen’s Feedback survey and Social Audit

5.0 Citizen’s Feedback survey and Social Audit
   - Cost included in section on Communication and Public Outreach Plan
Chapter 4

SPECIFICATIONS FOR SEWAGE TREATMENT PLANT

All the work shall be carried out as per relevant clause of CPHEEO Manual

(1) Construction of Sewage Treatment Plant. The Job includes the construction of three numbers of STPs each of capacity 11.0 MLD, 10.00 MLD and 10.00 MLD

(2) TREATMENT:

Specifications of all the treatment units shall be as per CPHEEO Manual and relevant IS standards. Bidder shall require to submit a brief write up on the Sewage treatment plant along with the TENDER. On acceptance of TENDER the successful Bidder shall submit a detailed design and drawings of the Sewage treatment plant based on CPHEEO Manual and relevant IS specifications for the approval of competent authority.

The Sewage treatment plants shall be for Primary and Secondary treatment of MUNICIPAL SEWAGE. Typical composition of untreated domestic waste water,

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Concentration</th>
<th>Weak</th>
<th>Medium</th>
<th>Strong</th>
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</thead>
<tbody>
<tr>
<td>Suspended Solids</td>
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<td>100</td>
<td>220</td>
<td>350</td>
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<tr>
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<td>mg/l</td>
<td>110</td>
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<td>Grease</td>
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The Effluent Characteristics should meet the MP Pollution Control Board norms for discharging water in inland water ways or to be used for community purpose as per Pollution Control Authorities with up to date amendments. The effluent discharge limits are described below.
Contaminants unit Inland surface water discharge limits
---
Ph 5.5-9
Temperature °C Shall not exceed 5°C above receiving water bodies
Oil and grease mg/l 10
Total residual chlorine mg/l 1
Suspended Solids mg/l 100
Ammonical Nitrogen mg/l 50
Total Kjeldal Nitrogen mg/l 100
Free ammonia mg/l 5
BOD₅ mg/l 30
Fluoride mg/l 2
COD mg/l 250
Dissolved phosphate mg/l 5
Sulphide mg/l 2
Phenolic compounds mg/l 1
Bio-assay test - 90% survival of fish after 96 hours in 1005 effluent
Manganese mg/l 2
Nitrate Nitrogen mg/l 10

All the treatment units shall be as per CPHEEO Manual and relevant IS standards. Bidder shall require to submit a brief write up on the Sewage treatment plant along with the TENDER. On acceptance of TENDER the successful Bidder shall submit a detailed design and drawings of the Sewage treatment plant for the approval of competent authority. The general specifications and guidelines for STP are as below,

1.0 **General Guidelines for level of STP and proposed Trunk Main Sewer.**

The contractor is advised to have a site visit and verify the site levels. The STP should be designed, such that the complete process is completed with least of power consumption, also STP should be at sufficient height to avoid flooding during monsoon. It is the responsibility of contractor to match the outfall chamber level with proposed by pass channel meant for excess flow and discharge of treated sewage Sewerage.

2.0 **Raw Sewage Intake System & Raw Sewage Sump & Pump**

The raw sewage shall be intercepted from the last manhole and shall be taken to the raw sewage intake and pump sump via gravity. A minimum self-cleaning velocity shall be maintained throughout the sewer line in order to avoid the settling of the particles. The raw water sewage pumping station shall comprise of the following system: Inlet chamber, Mechanically cleaned coarse bar screen, pump sump and raw sewage pumps.
A bypass line to the Pumping station shall be provided which shall discharge Sewage to the drain, in case of overflow or raw sewage pump failure. This Pipe line shall be designed to maximum hydraulic capacity.

3.0 Sewage Treatment Plant

3.01 Inlet chamber cum distribution chamber

The raw sewage shall be pumped to the inlet chamber before the fine screens.

3.02 Fine Screen Chamber.

One No mechanical and one no. manually operated fine screen of 6 mm openings shall be installed in a reinforced concrete chambers for fine screens. These two chambers shall be in parallel with common wall construction. Manual bar screen shall be standby in case the mechanical fine screen is out of service. The screen channels shall be designed for peak flow. The bar screens shall be of Stainless Steel (SS-304) flats. Conveyor Belt and chute arrangement shall be provided to take the screenings to the screenings dropped from chute will be collected in a trolley (to be supplied by contractor) of approx. 0.5 m³ capacity. Manually operated gates are provided at the upstream and downstream ends to regulate the flow and for isolation. The Sluice gates shall be thimble mounted and confirm to IS: 13349. RCC Platforms shall be provided at the upper level to enable operation. Railings shall be provided around the entire periphery of the Chamber as well as for the platform. The entire structure is as per relevant IS code including the platform for the gates. RCC staircase 900 mm wide shall be provided for access from the ground level to the top of the unit & to the operating platforms.

All other accessories, whether specified or not, but required for completeness of the contract shall be in contractor’s scope.

A level switch shall be provided in the channel upstream of screen chambers to start/stop the screen drive mechanism. Signal for Tripping of mechanical screen due to heavy blockage shall be announced through alarm for corrective action. ON-OFF and trip indication shall also sensed and indicated in the panel room. Level increase in the channel from the upstream of screens due to clogging of screens including manual screen shall be sensed and alarm announcement shall be initiated in the panel room for corrective action. ON-OFF trip indication of conveyor belt due to fault of overload shall be sensed in panel room for corrective action.

The screened sewage shall flow by gravity to the grit chambers, through suitably branched and sized channels.

3.03 Grit Separator Units

Grit Separators are to be provided after the screening and before the biological treatment. There shall be one number mechanically operated detritor type grit separator designed for Q peak flow. Another parallel manually cleaned grit channel shall also be designed and provided for peak flow and will work as a standby unit. The grit chamber should have a low head loss. All equipment and components (including but not limited to scrapper, classifier, organic return pump) necessary for a fully functional system shall be provided regardless of whether or not such items are specifically listed or described in the Tender Document. Washed grit shall be collected in a trolley positioned at ground level below the Grit Classifier discharge. De-gritted sewage shall exit the Grit Basins over the outlet weir. Liquid streams from grit classifier shall be returned to the de-gritted sewage stream.

The bidders are to note that the silt & grit removed from grit chamber, does not form a part of the TSS in the incoming wastewater quality indicated in the tender document. Accordingly sludge calculations shall be done by bidders.

The grit separator should preferably have a scrapper and suitable grit lifting screw/rake transferring the settled grit to a grit classifier with an integral grit washer.

3.04 Flow Measurement

Flow measurement in the common outlet channel after screening and grit removal shall be in the form of a Parshall flume housed in the RCC channel. There shall be a straight length of at
least 10 times the throat width of the channel housing the flume in both upstream and
downstream of the flume. The flume shall be constructed in RCC and finished in cement
mortar. An ultrasonic level measurement device shall measure sewage depth in the flume
and the flow computation shall be through the dedicated digital display with integrator near
the flume. The readings of this meter shall be transmitted to the control room. Parshall flume
channel shall lead to the distribution chamber of Biological treatment.

3.05 Distribution chamber

Sewerage from the Parshall flume shall be fed to the distribution chamber which will distribute
the Sewerage into separate streams for the Biological treatment.

3.06 Biological treatment of sewage

- Process Design

Sewerage from the distribution chamber shall enter process basins as per relevant IS code.
Screened and De-gritted sewage shall be fed for biological treatment to remove BOD, COD,
Suspended Solids, Nitrogen and Phosphorous.

It shall perform biological organic removal, Nitrification, De-nitrification and Biological
Phosphorous removal. It shall be capable of simultaneous sludge stabilization. Complete
operation including decanting rate, sludge recirculation and wasting of excess sludge shall be
controlled by PLC. Treated Sewage shall be disposed in the adjacent drain through
Sewerage Pipe after chlorination.

The Biological and tertiary treatment shall be based on technology based on which atleast
one Municipal Sewage Treatment Plant running successfully at present in India having
capacity 30% or more of the capacity of Sewage Treatment plant proposed in the project on
the same technology. The effluent characteristics should meet the CPCB norms for disposal
on land or water resource. Also the sludge should be digested ad stabilized before been
disposed by the Contractor

The basic continuous signal instrumentation system

It shall include flow measurement and the necessary water level readings from a pressure
transducer device installed in each reactor. The measuring elements for all instruments
including floats shall be located together on the side of the reactor in a well-mixed area easily
accessible for maintenance.

- Level transducers

One level transducer shall be used in each reactor and in any other basin where water level
is to be monitored to assure the automation of the operation. One spare pressure transducer
shall be supplied to enable a quick replacement of a faulty part. The pressure transducers
shall be maintenance-free with a maximum deviation of less than 2% over a period of 6-
month operation.

- Dissolved oxygen (DO) transducer

One DO transducer shall be supplied for each reactor. This instrument is meant to control
the aerobic environment in the reactor by controlling the blower operation (start/stop). Proper
logic control is to be established by the bidder. One spare sensor shall be supplied to enable
a quick replacement of a faulty part.

- Sequence control strategy

The TECHNOLOGY PROVIDER shall be responsible of providing all the logic control
programming and related hardware into an enclosure panel described further complete with
all the equipment specified herein.

The contractor shall be responsible to install the logic control panel and to provide and install
separate MCC and power distribution panels as specified in the electrical section of this
specification. The contractor shall also be responsible to interconnect electrically all the instrumentation and float signals specified herein with the logic control and the MCC panels as needed for a complete automated operation.

- **Logic control hardware and panel**

  The program controller shall be provided with key pad and display to enable the operator to easily re-adjust all cycle time and sequence. The programmable logic controller (PLC) shall have sufficient memory to perform automatic control of the process described herein and shall be sized to provide an additional number of input/output capacity of 10%.

  All control equipment installed in the control panel shall be accessible for operation or mounted on the front face of the panel. This panel shall control the operation of the various process equipment including:

  - influent valves or gate weirs
  - air blowers
  - decant equipment
  - waste sludge pumps (or valves)
  - any additional process equipment specified herein

  The PLC shall receive all input signals or described and take the necessary decisional action in regards to the operation of the above process equipment.

  The panel for the logic control shall be NEMA enclosure and shall be provided with necessary control breaker transformers and supplementary contacts as noted herein.

  The panel wiring shall be sized per applicable codes using AWG 16 gauge minimum wire size. Wiring terminal blocks shall be rail mount control terminal type thermoplastic rated at 600 Volts. No more than two wires shall be allowed to terminate in anyone terminal.

  The panel face shall be provided with an individual 3-position selector switch (HOR) for each automated valve, blower (4-position selector if dual-speed blower), pump, decanter or auxiliary equipment and instrumentation specified herein. It shall be equipped with one pilot light dedicated to each equipment.

  The pilot light shall be wired in parallel with the related motor starter auxiliary contact or relay other limit Switch contact to indicate that the equipment is activated or deactivated. Pilot lights shall be 415 VAC direct types or led type.

  All internal devices shall be clearly marked and identified as to its application, including selector switches, pilot lights, pushbuttons and other devices exposed in front of the panel. Identification nameplates shall be black with letters or numbers in white, carved in plastic.

  For all automated valves and decanter operation, feedback signal shall be also provided and connected to the logic controls to acknowledge and confirm the good operation. In the event of one equipment failure, the reactor shall be temporarily bypassed and an alarm shall be activated to notify the operator. In the meantime, the flow shall be managed by the other reactor(s) in accordance with the programming.

  The control panel shall be equipped with circuitry to shutdown automatically the pump motor when required, to protect this equipment from damages caused by excessive humidity, temperature, or current overload. The contractor shall be responsible for connecting these pumps and motor sensors to the appropriate circuit in the control panel to protect the pumps in accordance with the pump manufacturer instructions. One pilot light shall be mounted on the control panel surface to indicate an alarm condition; all alarms shall appear on the operator interface. In both cases, these alarm conditions shall open the circuit of the pump starter to prevent it from starting.

  The control panel shall be shipped completely factory wired, assembled and factory tested.

- **Programmable Logic Controller**
The programmable logic controller (PLC) shall be Allen-Bradley or approved equal.

- **Operator Interface Unit**
  The operator Interface Unit shall be ABB Panel View or approved equal.

### 3.07 Disinfection System

**Chlorine Contact Tank**

For Chlorination of final treated sewage a provision shall be made so that no harm is caused to the receiving water body. Decanted treated water from Biological treatment Process shall be taken to chlorine contact tank by RCC channel/pipe.

Tank shall be provided for dosing of chlorine from the chlorination system to the sewage from Biological Process. The tank shall be constructed as per the relevant IS code. RCC platform 1000 mm wide as per specifications shall be provided. RCC staircase 900 mm wide shall be provided for access from the ground level to the top of the unit and to the operating platforms. Baffle walls shall be provided to achieve proper disinfection. The baffle walls shall be constructed in concrete and 20 cm thick plaster in CM 1:3 on either side.

The inlet and outlet pipe shall be designed for peak flow.

- **No. of Units:** 1 no.
- **Detention Time:** 30 minutes of average flow (minimum)
- **Freeboard:** 0.5 m

**Chlorination System:**

- **Number of Units:** 2 nos. (1W + 1S)
- **Type:** Vaccum Chlorination system
- **Chlorine Dosing:** 5 mg/l
- **Residual chlorine:** 0.2 mg/l
- **Capacity of system:** Rounded to the upper Kg./hr.

Chlorine house of adequate plinth area shall be provided. It shall have sufficient ventilation as per the latest norms for safety purpose with necessary lifting arrangement and EOT etc. complete. All other accessories, whether specified or not, but required for Chlorination shall form part of contractors scope.

### 3.08 Outlet Pipe

Treated sewage after chlorine contact tank shall be taken to disposal to the discharge point. The length of the Pipe shall be as per site condition. Capacity of the pipe should be such that it can carry peak flow.

### 3.09 By-Pass Arrangements

Adequate by-pass arrangement shall be provided from Raw Sewage pump sump & inlet chamber at the entry of STP, to the outfall of the drain in case of necessity

### 4.0 Solids and sludge handling

#### 4.01 Sludge Holding tank

A tank shall be provided to store sludge from the WAS pumps and to act as a sump for sludge transfer to centrifuge.

Sludge sump will have mixing using coarse bubble aeration through PVC piping with openings. Separate dedicated air blowers will be provided for sludge mixing.

All other accessories, whether specified or not, but required for completeness shall form part of contractors scope.
4.02 Sludge Pump House
Screw pumps for sludge transfer from sludge holding tank to centrifuges, polyelectrolyte dosing system and air blowers for mixing of sludge in sludge holding tank will be housed in the sludge pump house. It shall be RCC framed structure with sufficient openings in the form of doors, windows, ventilators etc. and 1 MT capacity chain pulley block will be provided in it, for material handling purposes. Minimum carpet area of this building will be 20 sqm.

4.03 Polyelectrolyte Dosing
The polyelectrolyte will be dosed and blended with the sludge in the sludge sump. Min dose of polyelectrolyte shall be 1.5 kg/T of dry solids in sludge. There shall be one poly-dosing tank. Min volume of each dosing tank shall be suitable for 8 hrs requirement of dosing. Each tank shall be equipped with slow speed mixer (100 RPM) to prepare polyelectrolyte solution. To feed the solution into sludge sump by dosing pumps.

4.04 Centrifuge Feed Pump
The sludge pumps will be positive progressive cavity displacement types. There shall be two pumps (One Working + One Standby) for pumping this sludge to the centrifuge. The minimum capacity of the pump shall be 1 m³/hr. Pumps will have solid handling capacity of not less than 40 mm sphere. M.O.C. of pump shall generally be C.I.

Pump and motor will be mounted on a common MS fabricated base frame. The coupling will be flexible coupling. The motor will be TEFC and driven through belt drive.

4.05 Centrifuge
Thickened sludge shall be pumped to the centrifuge unit for dewatering. It shall be provided at suitable elevation for the dried sludge from centrifuge to be collected in a trailer/container situated below it.

Centrifuge shall be operated for 16 hours in a day and floor mounted. It shall be suitable to handle thickened sludge from thickener. The minimum solid contents in the sludge at centrifuge inlet shall be 3 %.

The material of construction of all parts coming in contact with the liquid shall be in CS.

Number of Units : 2 (1W + 1S)
Operation : 16 hours running per day
Dry solids in dried sludge : 15 – 18 percent
All other accessories, whether specified or not, but required for completeness shall form part of contractors scope.

4.06 Centrifuge Shed
Sludge dewatering system shall comprise of centrifuge shed of appropriate size, which includes thickened sludge pumps, poly dosing tank with mixers, centrifuge unit.

Filtrate from the sludge shall be taken to plant drainage system by gravity.

4.07 Disposal of Solid Waste
Disposal of all solid wastes except wet cake as generated from the STP during construction, commissioning, and O & M shall be responsibility of the contractor. The solid wastes shall be disposed of in accordance as per instructions of the Engineer. The Sludge Land Fill (SLF) identified for disposal may be assumed maximum at a distance of 10 kms from the proposed new STP site for bidding purposes. Loading, unloading, transportation shall be to Contractor’s account.

Grit & Screenings
The evacuated grit and screenings are to be disposed from the site by the Contractor at landfill site identified by the Employer’s representative from time to time.
**Wet cake**

The contractor can sell wet cake generated from STP during O & M period at his own level. If it is not possible to sale then wet cake shall be disposed off at land fill site identified by the Employer’s representative from time to time considering at least 10 KM from STP site (for bidding purpose)

**5.0 Ancillary Structures**

**5.01 D.G. Room** (area as per DG manufacturer’s requirements)

**5.02 Outdoor Transformer Yard**

**5.03 Admin Bldg, MCC Room, Blower Room, Operator Room, SCADA Room, Laboratory**

Sub-station /Transformer yard (outdoor), Master Control Rooms, D.G. Room shall be constructed at suitable at the location. The buildings shall be designed as per requirement.

The building shall have RCC frame work of minimum not less than M25 consisting of RCC columns, RCC roof and beams with brick panels and foundation, suitably designed to take the load of the walls. Rolling shutters of adequate size shall be provided for the above rooms on the external walls. At the entrance of the transformer yard, M.S. gate shall be provided of adequate size.

The floor of the MCC rooms and D.G. room shall consist of 40 mm thick cement concrete laid over 1:2:4 including 15 mm thick ironed finish 150 mm thick 1:3:6 cement concrete. The floor of other rooms shall be with 20mm thick mosaic laid over 150mm thick 1:4:8 cement concrete. The above floors shall be laid over well consolidate sand with rammed earth filling below floor. The walls shall be provided with 15 cms high skirting with 20 mm thick mosaic finish as per direction of the Engineer.

The brick walls of the buildings shall be plastered internally and externally with cement mortar 1:2:4 (1 cement : 2 coarse sand : 4 fine sand) and provided with distemper inside and water proof cement paint outside as approved by the Engineer. Ceiling shall be plastered with 1:4 cement mortar (1 cement and 4 fine sand) and three coats of white wash. All steel work in the doors/windows/ventilators, rolling shutters etc. shall be provided with a superior class paint/primer etc. approved by the Engineer to give a smooth finish.

The buildings shall be provided with plinth protection all around, 750 mm wide as specified. Necessary slopes shall be given in the plinth protection so as to drain away the rain water from the building. The roof shall be provided with water proofing as per DEPARTMENT specifications. A RCC stair case of required width shall be provided to access different floor levels.

The plinth level of the buildings shall be 600 mm above formation level. Suitable ramps shall also be provided wherever required as desired by the Engineer.

The offer shall include for internal electric wiring of the buildings with light/fan fittings.

The buildings shall be of sufficient size to accommodate all machineries / equipments and controls and an office for operation, toilet, store etc. The tenderer shall verify and provide the required size from the practical point of view and ease of operation.

**5.04 Interconnecting Piping and Valves**

All piping including valves, specials and other appurtenances, auxiliaries and accessories required as per process design and scope of work. All the piping, valves, specials shall be designed for peak flow.

In case of pumping mains thrust blocks shall be provided whenever required. In case of buried pipes warning tapes shall be provided of the appropriate colours.

**5.05 Security Room**
The security room at entry of road shall be provided. This shall be a ground floor construction with 3m x 5m carpet area and be of RCC frame structure building with in filled rock faced stone masonry and shall be provided with glass panels on three sides and an air cooler. Necessary fans and lights shall be provided as directed by the Employer’s representative. Toilet and bathroom shall be attached with security room. There shall be a working platform made of Granite stone.

5.06 Landscaping

Landscaping involves beautification of Sewage Treatment Plant site by cultivating plants, shrubs and trees of environmental value and suitably modifying the appearance of STP site. It shall add scenic value to the STP site to obtain maximum visual impact. Contractor has to develop proper landscaping in the STP site as per guidance from the Engineer in charge. Area for future expansion shall also be considered for landscaping.

5.07 Compound Wall and Retaining wall of STP site and its Main Gates

R.R Masonry Compound wall of not less than 2.4 m above the finished ground level, 34 cm thickness with suitable foundation, for covering the entire plot boundary around the proposed site.

5.08 Earth Filling Cutting and Dressing

Area shall have to be filled up, consolidated, levelled and nearly dressed upto required formation levels. In case earth is required over and above the surplus excavated for the same, the tenderer shall have to arrange good sheet earth from its own resources and provide for same in their offer. Filling of such earth in layers with proper consolidation as per specifications shall be done.

5.09 Walkway and Pathway/Footpath

All Elevated RCC walkway 1.2 m wide shall be of RCC with M-20 grade concrete. The floor of the walkway shall be finished smooth with 40 mm thick cement concrete. It shall be provided with one meter high GI pipe railing on both sides of the walkway with connecting platforms.

All pathway and footpath over ground connecting individual units to bituminous road shall be 1.2 m wide and be 100 mm thick cement concrete (1:3:6) finished with 40 m thick (including base mortar 1:4) checkered cement concrete tiles. The base concrete to be laid on 150 mm thick hard core with 40 mm down stone ballast and murram rammed and consolidated properly as per direction of Engineer.

5.10 Roadway

Roads as per lay out shall be provided around all units as directed.

5.11 Parking Space

Adequate parking space should be provided. The area shall be paved as per WBM specification.

5.12 D. G. Set

D. G. Set shall be provided to cater for the power failures. Capacity of D.G. set shall be minimum 50% total connected electrical load (STP + RSPS). D.G. Set will be placed in DG Room, to be provided in the STP premises.
The equipment of following brand shall be required & accepted.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Equipment</th>
<th>Acceptable makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Transformer</td>
<td>NGEF, Crompton, Alsthom, Kirloskar, Voltempbctcl, TESLA</td>
</tr>
<tr>
<td>2.</td>
<td>3 KV VCB</td>
<td>CROMPTON, ALSTHOM, ABB, JYOTI, SIEMENS, BHEL, NIEPE-BANGLORE</td>
</tr>
<tr>
<td>3.</td>
<td>AIR CIRCUIT BREAKER</td>
<td>L &amp; T, SIEMENS, ABB, JYOTI, CROMPTON, C &amp; S</td>
</tr>
<tr>
<td>4.</td>
<td>CTS PTS</td>
<td>CROMPTON, ALSTHOM, UNIVERSAL, JYOTI, C&amp;S</td>
</tr>
<tr>
<td>5.</td>
<td>44 KV LIGHTING ARRESTER</td>
<td>IGE, OBLUM ALPRO, CROMPTON</td>
</tr>
<tr>
<td>6.</td>
<td>RELAYS</td>
<td>L &amp; T, SIEMENS, ABB, JYOTI, C&amp;S</td>
</tr>
<tr>
<td>7.</td>
<td>AIR BREAKS SWITCHES</td>
<td>SIL, WSL, KIRON TEXTILE</td>
</tr>
<tr>
<td>8.</td>
<td>POST AND DIS INSULATORS</td>
<td>SIL, WSI, KIRON TEXTILE, ATLAS JAIPURIA, JYOTI</td>
</tr>
<tr>
<td>9.</td>
<td>ALUMINUM TUBULAR BUSBAR</td>
<td>AS PER IE RULE AND AS PER RELATIVE STANDARD</td>
</tr>
<tr>
<td>10.</td>
<td>CABLES</td>
<td>FINOLEX UNIVERSAL HAVELLS NICCO CCI</td>
</tr>
<tr>
<td>11.</td>
<td>DROP OUT FUSES</td>
<td>SIL, WSI, KRON TEXTILE, ATLAS JAIPURIA</td>
</tr>
<tr>
<td>12.</td>
<td>EARTHING MATERIAL</td>
<td>AS PER IE RULES AND AS PER RELATIVE STANDARD D</td>
</tr>
<tr>
<td>13.</td>
<td>SAFETY DEVICE</td>
<td>AS PER IE RULE AND AS PER RELATIVE STANDARD</td>
</tr>
<tr>
<td>14.</td>
<td>METERS</td>
<td>AE, MECO.</td>
</tr>
</tbody>
</table>
The following manufacturers are recommended to be used for the proposed work. The Bidders may substitute alternative equivalent brand names with prior approval of Engineer in charge.

<table>
<thead>
<tr>
<th>Item / Component</th>
<th>Recommended makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT and Centrifugal Pump</td>
<td>Kirloskar / Jyoti / Mather+Platt / WPIL/ Darling</td>
</tr>
<tr>
<td>Pump motor</td>
<td>Kirloskar / Jyoti / Crompton / ABB / Elsthom / Siemens</td>
</tr>
<tr>
<td>Sluice Valve / Scour Valve/Butterfly</td>
<td>Kirloskar / IVC / VAG / IVI / MARCK</td>
</tr>
<tr>
<td>Non-return / Check Valve</td>
<td>Kirloskar / IVC / VAG / IVI / MARCK</td>
</tr>
<tr>
<td>Kinetic Air Valve</td>
<td>Kirloskar / IVC / VAG / IVI / MARCK</td>
</tr>
<tr>
<td>Valve Actuator</td>
<td>Auma / Rotork / Limitork</td>
</tr>
<tr>
<td>Single faced Sluice Gate / Stop-log</td>
<td>Kirloskar / JASH / VAG</td>
</tr>
<tr>
<td>Flow &amp; Pressure regulating Valve</td>
<td>Darling Muesco / VAG / Keystone</td>
</tr>
<tr>
<td>Electro-magnetic Flow meters – Battery operated</td>
<td>Emerson / Krohne Marshall / Yokogawa</td>
</tr>
<tr>
<td>Water Hammer Control</td>
<td>Sureseal or equivalent</td>
</tr>
<tr>
<td>D.I. pipe Specials &amp; Fittings</td>
<td>Electrosteel / KISWOK / Jindal / Kejariwal</td>
</tr>
<tr>
<td>Electro-fusion &amp; Compression fittings</td>
<td>Glynwed / Georg Fisher/Astore/Magnum</td>
</tr>
<tr>
<td>Power Transformers</td>
<td>ABB / Crompton / Emco / Siemens / Alstom</td>
</tr>
<tr>
<td>HT Switch Gear</td>
<td>Alstom / Jyoti / Crompton / Siemens</td>
</tr>
<tr>
<td>Vacuum Circuit Breaker (VCB)</td>
<td>Siemens / Schneider M.G. / Jyoti / L &amp; T</td>
</tr>
<tr>
<td>Air Circuit Breaker (ACB)</td>
<td>Siemens / Schneider M.G. / Jyoti / L &amp; T</td>
</tr>
<tr>
<td>Moulded Case Circuit Breaker MCCB</td>
<td>Siemens / Schneider M.G. / Jyoti / L &amp; T</td>
</tr>
<tr>
<td>Soft starters</td>
<td>Siemens / Alstom / Jyoti / ABB</td>
</tr>
<tr>
<td>Relay and Contactors</td>
<td>Siemens / Alstom / Jyoti / ABB / L&amp;T</td>
</tr>
<tr>
<td>Cables</td>
<td>Tropodur / Finolex / Asian / Gloster / Incab / Universal / Polycab</td>
</tr>
<tr>
<td>EOT crane</td>
<td>Hitech / Indef / Hiking / Ambika</td>
</tr>
</tbody>
</table>
### FOR INSTRUMENTATION, AUTOMATION AND SCADA SYSTEM:

<table>
<thead>
<tr>
<th>Category</th>
<th>Brands/Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmable Logic Controllers (PLC)</td>
<td>Rockwell <em>Allen Bradley</em> / Siemens / Honeywell</td>
</tr>
<tr>
<td>Panel Enclosures and Consoles</td>
<td>Rittal / President / Cutler Hammer</td>
</tr>
<tr>
<td>Ultrasonic Type Level Measurement Device</td>
<td>Endress+Hauser / Krohne Marshall / Hycontrol UK.</td>
</tr>
<tr>
<td>Float &amp; Board Type Level Measuring system</td>
<td>Nivo (Toshniwal), Endress + Hauser, Pune Techtrol</td>
</tr>
<tr>
<td>Switch fuse Disconnector</td>
<td>L &amp; T, FN Type, Siemens, GEPC</td>
</tr>
<tr>
<td>Multi-Function Energy Meters</td>
<td>Enercon, L &amp; T, SOCOMEC</td>
</tr>
<tr>
<td>Capacitor bank</td>
<td>Crompton Greaves, Khatau Junker, Malde, L &amp; T</td>
</tr>
<tr>
<td>Cable Termination kit</td>
<td>Raychem, Denson, M-Seal</td>
</tr>
<tr>
<td>Battery</td>
<td>HBL NIFE, Exide, Amco</td>
</tr>
<tr>
<td>Battery Charger</td>
<td>Chaabi Electrical, Masstech</td>
</tr>
<tr>
<td>Tacho Meter on line</td>
<td>Kana Electric, Proton, Jay Shree Electronics</td>
</tr>
<tr>
<td>Pressure switch</td>
<td>Indfoss, Switzer, Tag Process Instruments</td>
</tr>
<tr>
<td>Flow switch</td>
<td>Switzer, General Instrument, Forbes Marshall</td>
</tr>
<tr>
<td>Pressure gauge</td>
<td>WAREE, WIKA, AN Instruments, Guru, Hitek</td>
</tr>
<tr>
<td>Pressure Transmitter</td>
<td>Emerson, Foxbro, Druck, Endress – Hauser, ABB, Honeywell</td>
</tr>
<tr>
<td>Engineering cum Operator work Station</td>
<td>IBM, Compaq, Dell</td>
</tr>
<tr>
<td>Printer</td>
<td>EPSON, HP, CANNON, WIPRO</td>
</tr>
<tr>
<td>Local Supervisory Station</td>
<td>IBM, Compaq, Dell</td>
</tr>
<tr>
<td>HMI Software</td>
<td>Wincc, Rs View, Monitorpro, Intellution, Indusoft</td>
</tr>
<tr>
<td>Alarm Annunciator</td>
<td>Minilec, Peacon, ICA, APLAB</td>
</tr>
<tr>
<td>Uninterruptible Power Supply</td>
<td>HI-Real, Pulse, Tata Libert, APC, APLAB</td>
</tr>
<tr>
<td>Instruments &amp; Control Cables</td>
<td>Delton, Asian, Servel, TCL, Thermopad</td>
</tr>
<tr>
<td>Receiver Indicator/Digital panel meter</td>
<td>Masibus, Yokogawa, Lectrotek, NISHKO, SaiTech, MTL INSTS</td>
</tr>
<tr>
<td>Intercom system</td>
<td>Betel, Samsung, Tata, Panasonic, Matrix</td>
</tr>
<tr>
<td>Conductivity level switch</td>
<td>Pune techtrol, Krohne Marshall, E+H</td>
</tr>
<tr>
<td>Multifunction power monitor</td>
<td>MASIBUS, L&amp;T, ENERCON, SOCOMECH, SECURE, DAE</td>
</tr>
<tr>
<td>Temperature Scanner</td>
<td>SaiTech, Masibus, Nishko, Lectrotek</td>
</tr>
<tr>
<td>Analog Signal Multiplier</td>
<td>MASIBUS, Sai Tech, MTL INSTS, NISHKO</td>
</tr>
<tr>
<td>Portable vibration measuring equipment</td>
<td>Shrenk Every, IRD, STM Instrument, TIME</td>
</tr>
<tr>
<td>Portable sound measuring equipment</td>
<td>CENTER, MECORD, CYNGET</td>
</tr>
</tbody>
</table>