TECHNO-ECONOMIC ANALYSIS OF DECENTRALISED STPS (DEWATS) FOR PERIPHERAL AREA IN CHENNAI

A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree

of

MASTER OF TECHNOLOGY

in

CONSERVATION OF RIVERS AND LAKES

By

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CANDIDATE'S DECLARATION

I hereby declare that the work which has been presented in the dissertation entitled "**TECHNO-ECONOMIC ANALYSIS OF DECENTRALISED STPS (DEWATS) FOR PERIPHERAL AREA IN CHENNAI**" in partial fulfillment of the requirements for the award of the degree of **Master of Technology in Conservation of Rivers and Lakes,** submitted in Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee, is an authentic record of my own work carried out during the period from July 2006 to June 2008 under the supervision of Dr. M.P. Sharma, Senior Scientific Officer, AHEC and Shri M.K. Singhal, Senior Scientific Officer, AHEC, Indian Institute of Technology Roorkee.

The matter embodied in the dissertation has not been submitted by me for the award of any other degree or diploma.

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Place: Roorkee

CERTIFICATE

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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ABSTRACT

Health is Wealth. Good public Health makes the earth, "Hale & Healthy". Poor public Health makes "Pale & Sick". Sustainable health, especially for children and age old person is not possible without safe and hygienic environmental sanitation. But these, good health issues are hindered by the problems of burgeoning population and sinking resources on one side and the LPG policies (Liberalization, Privataization and Globalization) and Industrialization on the other side. Once worshiped, purified form of running water bodies now becomes putrefied due to free disposal of human wastes and no minimum environmental flow. But Developments and Destructions are both sides of coin in the Universe Hence it is the duty of Environmental Engineers, to adopt the opt Technology for treating the wastewater, harmonizing with BAT(Best available Technology) and LCT(Least Cost Technology) that is appropriate for the adjacent area to Chennai Metropolitan City and there by attaining the goal of ' Sanitation for all'.The adjacent area to Chennai City, Ward No-45 of Ambattur Municipality is selected since and water supply is provided from Chennai Metropolitan Water Supply and Sewerage Board where as the area has not been provided with sewerage system.. Since the area has been developed to its capacity and the area is low lying and is not ease with economic cost to include the area into the Chennai City Sewerage net work. Hence the only solution to go for DEWATs Technology (Decentralized Wastewater Treatments) for upkeeping the area for hygienic at economic cost with sustainability. Hence detail studies has been made on DEWATs technology available internationally and opt technology, locally suitable has been elected from the selected DEWATs namely WSP(Waste Stabilization Ponds),ISF(Intermittent Sand Filtration) and the Modern Technology,SBR(Sequencing Batch Reactor).By designing and estimating these traditional DEWATs, and analyzing their Performances' both Technically and Economically among them also comparing the DEWATS with the Centralized Technology, MASP (Modified Activated Sludge process)..The benefits of smaller dia pipes, reaping the benefit of 3Rs (Reduce, Reuse & Recycle) here, selling the treated effluent to near by Industries, since Ambattur is famous for its Industrial Area, where water scarcity is prevailing. From the analysis of data on selected DEWATs technologies said above, sound decision of 'adoption of SBR Technology' to treat the ward No-45 of Ambattur Municipality located adjacent to Chennai City, has been taken.

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INTRODUCTION

1.1 PREAMBLE

Health is wealth. Good public health makes the earth, "Hale and Healthy". Poor public health makes, "pale and sick ". Sustainable health, especially for children is not possible without good environmental sanitation. Since the earth is borrowed from our children and grand children the same should be handed over with added values or at least as such. But these issues are hindered by the problems of burgeoning population and sinking resources on one side and the LPG policies (Liberalization, Privatization and Globalization) and Industrialization on the other side.

Safe water supplies and hygienic sanitation facilities are the part and partial of the community that needs on top priority for healthy living. Every community produces wastewater (sewage).If the waste water is not treated properly it will go septic, the decomposition of organic matter it contains will lead to nuisance condition, generating malodorous gaseous. Untreated waste contains numerous pathogenic micro organisms which will cause epidemic diseases. The effect of pollution on society is recognized by most citizens and has resulted in a national commitment for the environmental clean – up. In India most of the rivers, lakes and other water bodies are polluted due to the indiscriminate discharge of untreated wastewater by the municipalities and industries.

Once appeared as perennial rivers now become lean water flow that too few days in a year and no minimum environmental flow due to various reasons such as decrease in rainfall, Global Warming, Deforestation, Climate Change, GHG emission, Ozone depletion and so on. Sustainability could not be maintained due to assimilating capacity or the carrying capacity of the rivers is also not able to meet the enormous amount of pollutant load due to anthropogenic activities. Hence it becomes mandatory, the wastewater must be treated by adopting BAT (Best Available Technology) and LCT (Least Cost Technology) into harmony leading the environment safe and sustainable.

The technology of collection and treatment of wastewater has undergone significant changes. Hence opt alternate technology to be adopted in the place of old traditional Conventional sewerage and sewage treatment aiming that simple in operation, reliable in achieving the treatment level as per the norms specified by the PCB (Pollution Control Board) also, handling 3 R's (Reduce, Reuse, Recycle) approach for various beneficial uses so as to reduce the ever increasing demand for fresh water, thereby achieving the sustainability of water resource.

While it is necessary to adopt conventional sewerage and treatment methods in metro and mega cities, it is economical to go in for low cost option wherever feasible particularly in small and medium towns. That is Decentralized STPs (DEWATs System).

1.2 RATIONAL BEHIND THE STUDY

Present scenario is a prime motive for the study. That is,

- Once appeared as perennial rivers now become lean water flow that too few days in a year and no minimum environmental flow resulting waterways into "sick or dead rivers".
- Once freely and plenty in quantity that too easily obtained water now becomes precious, bearing prices hence usage is in calculative manner, hence cleaning by flushing out with water could not be made as such, maintaining Self cleansing velocity in the sewer is a problem. Then stale condition prevails in the sewer causing, emanating foul gases from sewage namely Methane, Hydrogen sulphide, carbon-di-oxide etc., affecting Health of the society. This also develops maintenance problem since obstruction of flow of sewage and vulnerable for pollution issues.
- Sewage contains nutrients and minerals. Hence when discharged on the surface water, eutrophication problem will occur due to growth of weeds and algal blooming known as, "red tides". This also deplete the D.O (Dissolved Oxygen) level in the waterways, producing "Dead Zone".

- ❖ When additional sewage from adjacent areas had been allowed with the prevailing sewerage system then chances of overflow causing issues and problems of nuisance and mosquito breeding.
- ❖ In Centralized STPs all the units are in bigger in sizes hence Investment cost is high due to land, labour & material in addition O&M cost also increases.
- ❖ In Centralized STPs Collection and transporting of sewage is made through pipe materials which bears around 60% of project cost, even though the pipe does not treat the wastewater.
- ❖ Once worshipped, purified form of Running Water bodies now becomes putrefied due to free disposal of human wastes and ultimately transmitting epidemic diseases, affecting human health and inflating the Nation's wealth.
- ❖ To avoid the OLIGOPOLYSTIC approach by the pipe manufacturers particularly D.I. Pipes and thereby delay the project period and reaping the benefit of the public.(Ex., JNNURM-Projects)

This worst, unhealthy condition calls, ethical Scientists and Environmental Engineers, to adopt the opt technology harmonizing with BAT and LCT on DEWATs system that too for the adjacent Urbanized areas with aiming of $3R_s$ (Reduce, Reuse and Recycle) approach for sustainable environmental and attractive aesthetic with creating awareness and transparency to the Enthusiastic public and Smart Non Governmental Organizations (N.G.O) with aiming of $3P_s$ (Public, Private partnership) approach for easy funding, timely execution and effective maintenance of the DEWATs system.

1.3 OBJECTIVE OF THE STUDY

- To attain the goal of " sustainable sanitation for all" within a reasonable time frame with advanced Onsite wastewater system technologies to adjacent urbanized area where new growth is occurring and instantly impossible to extend the centralized collection system and thereby protecting the environment, improving the community health and the quality of life.

- To develop a procedure/ methodology for the selection of appropriate DEWATs for the peripheral area of Chennai and techno-economic analysis on the DEWATs technology.
- The decentralized concept is easier to plan and finance.

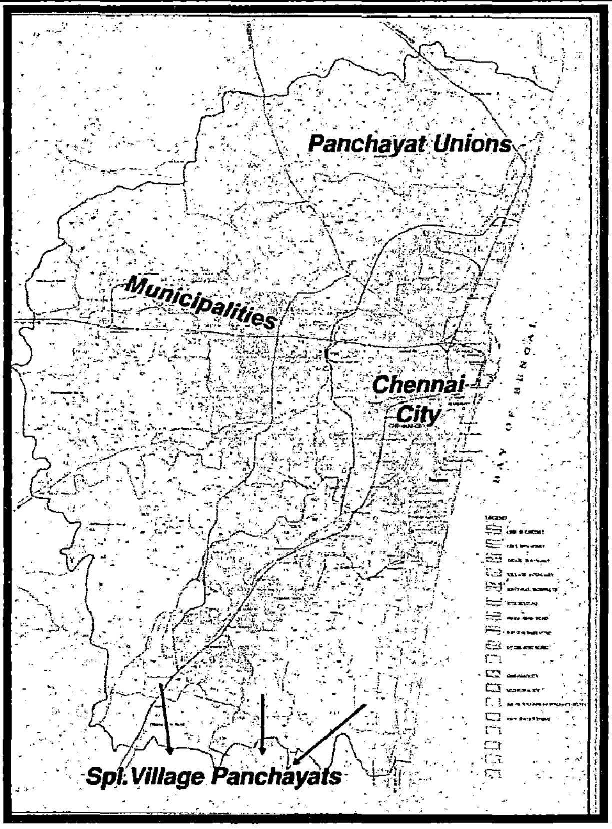
1.4 STUDY AREA

The study area here selected is ward number 45 of "Ambattur" Municipality which is located at the peripheral area of Chennai, the capital of Tamil Nadu. Ambattur is designated as special grade Municipality and lies north of Chennai with an extent of 40.36 sq.km,

The ward water supply is being maintained by Chennai Metropolitan Water Supply and Sewerage Board (which is responsible to promote or secure the planned development, efficient operation, maintenance and effective regulation of water supply and sewerage systems in the Chennai Metropolitan Area.) and does not possess sewerage system. Wards people are willingness to contribute the amount ,for providing Sewerage facilities to their areas at economic basis.

In view of time consideration for connecting this sector with the Chennai Sewerage System network since prior to this other wards are inline also shortage of D.I pipes and high cost involves in Construction of manholes, pumping station and other facilities also high Operation and maintenance cost thereafter, an alternative novel technology of DEWATs is chosen with public participation for up keeping these wards for hygienic at economic cost with sustainability.

CHENNAI METROPOLITAN AREA (CMA)



- **The Chennai Metropolitan Area comprises the City of Chennai and its outlying urban and rural areas**
- **The extent of CMA excluding St.Thomas Mount cantonments is 1189 Sq.km**
- **The Chennai City covers 175.18 Sq.km**
- **The outlying areas consists of the following:**
  - **1 Cantonment**
  - **16 Municipalities**
  - **20 Special Village Panchayats**
  - **214 Villages Panchayats in 10 Panchayat Unions**

Fig 1. Chennai Metropolitan Area

1.5 METHODOLOGY ADOPTED

If provision of sewerage system has been decided to this sector, then it is the duty of Scientists and Engineers to look into deep in the Technologies and their feasibility, That is, which type of DEWAT system is opt in that locality considering on the following approach. The approach adopted here is, "Globally". That is think globally and acts locally. This approach has to be analyzed on the following aspects also viz., whether the system is

- Technically feasible
- Economically viable
- Financially reasonable
- Politically agreeable
- Socially acceptable

- Environmentally compatible
- Locally reasonable
- Functionally sustainable.

Of the above, the first two approaches have strong effects since it bears considerable values on the other aspects mentioned above.

1.6 TECHNOLOGY CONSIDERED

The traditional philosophy of wastewater management is pipe it away first, then think about what comes next is not a sustainable approach for developing countries' There is another system to treat the wastewater at or near the locations where wastewater is generated. That is "on-site" sanitation system or DEWATs (Decentralized Wastewater treatment system). There are also many technologies available like Centralized STPs with their own merits and demerits.

Hence the method of, "Techno Economic analysis" has been applied in selecting the opt DEWAT system for the said peripheral area of Chennai. Comparison studies of the "off-site" conventional Centralized sewerage treatment plant with that selected DEWATs also covered in this study. In order to arrive the best DEWATs from a techno-economic point of view, broadly the following criteria's have been adopted for selection and evaluation.

- Level of the treatment.
- Locally suited Technology
- Very less power consumption.
- Treatment option should be simple to construct, easy to operate and low O&M cost
- To adapt $3R_s$ (Reduce,Reuse,Recycle)

1.7 ECONOMICS OF TREATMENT TECHNOLOGIES

For sustainability of selected system, economics of treatment technology is must. Since India lives in villages economics is a lives line. Whether the system is economically viable selected financial management tools are used for comparing the cost of the various Sewage Treatment Technologies namely Net Present Value (NPV), Internal Rate of Return (IRR) and Cost-Benefit Ratio (CBR) are used. Reuse of effluent becomes more cost efficient if nonpotable water demands such as landscape irrigation, toilet flush supply and cooling tower makeup are required.

1.8 AWARENESS CREATION

It is the way of to overcome barriers on implementing DEWATs option. To create awareness to the people that there are other alternative technologies available for on-site wastewater treatment system for small quantities of wastewater so that the currently unsewered areas may also be safe sewered, thus the possibility of up keeping the hygienic facilities.

Lack of knowledge and misperception of DEWATs has to be removed. Public health officials, engineers, regulators, system designers, inspectors and developers often possess only limited knowledge of the broad range of DEWATs because these technologies are not adequately covered in university engineering curricula. DEWATs are perceived to be inadequate for meeting specified public health and water quality goals. Typically, Onsite systems are perceived as the standard septic tank and leach field. However, alternative onsite systems include other types of decentralized systems, such as mound system or sand filters.

House owners are frequently uninformed about how their conventional onsite systems are working, how to maintain them and about the potential for human and eco system risks from poorly functioning systems.

To overcome the above barriers, Education is critical efforts to encourage the acceptance and use of DEWATs . As such awareness about the DEWATs has been made among municipal engineers of various districts of Tamilnadu by conducting Brainstorming session on, "DEWAT system" and the free ideas were collected for further analysis.

Fig1.2 Conducting Awareness programme on DEWATs to Municipal Engineers throughout TamilNadu.

Fig 1.3 Deep observation of the Municipal Engineers with the DEWATs

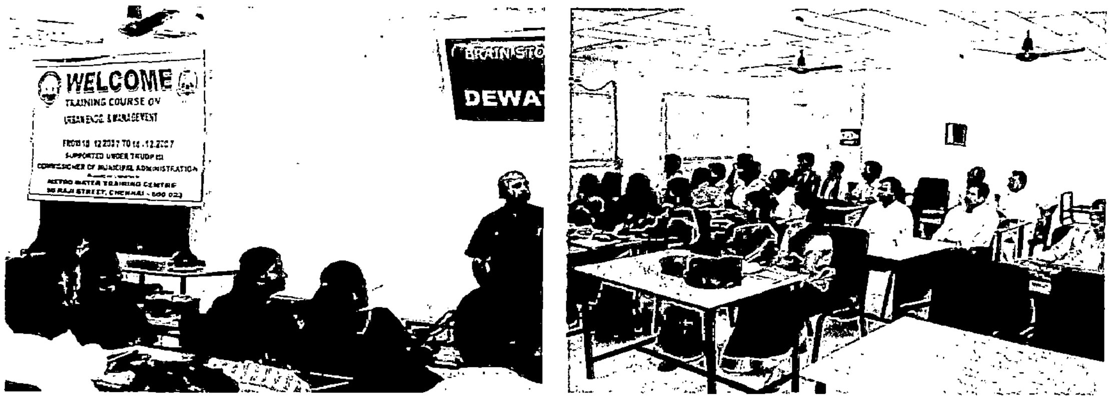


Fig 1.4 Continuation of Brainstorming Session on DEWATs

1.9 PUBLIC, PRIVATE, PARTICIPATION (PPP)

The implementation of any project will be easy and smooth, only when there is initially a lot of conflicts arise at concept and before DPR preparation level. Hence the PPP approach is the best way of removing the problems on gray area and to implement the transparency on management, Liability and engineering fee issues and the state- of- art technology also financial limitations.

Public involvement and education are critical to successful onsite wastewater management. Engaging the public in wastewater treatment issues helps build support for funding, regulatory initiatives, and other elements of a comprehensive program. Educational activities directed at increasing general awareness and knowledge of onsite management efforts can improve the probability that simple, routine operation and maintenance tasks(e.g., inspecting for pooled effluent, pumping the tank) are carried out by system owners. Specialized training is required for system managers responsible for operating and maintaining systems with more complex components. Even conventional, gravity-based systems require routine pumping, monitoring, and periodic inspection of sludge and scum buildup in septic tanks. Failing systems can cause public health risks and environmental damage and are expensive to repair. System owners should be made aware of the need for periodically removing tank sludge, maintaining system components.

LITERATURE REVIEW

2.1 HISTORY OF ONSITE WASTEWATER TREATMENT SYSTEMS

King Minos installed the first known water closet with a flushing device in the Knossos Palace in Crete in 1700 BC. In the intervening 3,700 years, societies and the governments that serve them have sought to improve both the removal of human wastes from indoor areas and the treatment of that waste to reduce threats to public health and ecological resources. The Greeks, Romans, British, and French achieved Considerable progress in waste removal during the period from 800 BC to AD 1850, but removal often meant discharge to surface waters; severe contamination of lakes, rivers, streams, and coastal areas; and frequent outbreaks of diseases like cholera and typhoid fever. By the late 1800s, the Massachusetts State Board of Health and other state health agencies had documented links between disease and poorly treated sewage and recommended treatment of wastewater through intermittent sand filtration and land application of the resulting sludge. The past century has witnessed an explosion in sewage treatment technology and widespread adoption of centralized wastewater collection and treatment services in the United States and throughout the world. Although broad uses of these systems have vastly improved public health and water quality in urban areas, homes and businesses without centralized collection and treatment systems .

2.2 BACKGROUND AND USE OF ONSITE WASTEWATER TREATMENT SYSTEMS

Septic tanks for primary treatment of wastewater appeared in the late 1800s,and discharge of tank effluent into gravel-lined subsurface drains became common practice during the middle of the 20th century (Kreissl, 2000).Scientists, engineers, and manufacturers in the wastewater treatment industry have developed a wide range of alternative technologies designed to address increasing hydraulic loads and water contamination by nutrients and pathogens. These technologies can achieve significant pollutant removal rates.

With proper management oversight, alternative systems(e.g., recirculation sand filters, peat-based systems, package aeration units) can be installed in areas where soils, bedrock, fluctuating ground water levels, or lot sizes limit the use of conventional systems. Alternative technologies typically are applied to the treatment train beyond the septic tank.

The tank is designed to equalize hydraulic flows; retain oils, grease, and settled solids; and provide some minimal anaerobic digestion of settle able organic matter. Alternative treatment technologies often provide environments (e.g., sand, peat, and artificial media) that promote additional biological treatment and remove pollutants through filtration, absorption, and adsorption.

All of the alternative treatment technologies in current use require more intensive management and monitoring than conventional OWTSs because of mechanical components, additional residuals generated, and process sensitivities (e.g., to wastewater strength or hydraulic loading).Replacing gravity-flow subsurface soil infiltration beds with better-performing alternative distribution technologies can require float-switched pumps and/ or valves.

Specialized excavation or structures might be required to house some treatment system components, including the disinfection devices (e.g., chlorinators, ultraviolet lamps) used by some systems. In addition, it is often both efficient and effective to collect and treat septic tank effluent from clusters of individual sources through a community or cluster system driven by gravity, pressure, or vacuum. These devices also require specialized design, operation, and maintenance and enhanced management oversight.

2.3 THE CONVENTIONAL WASTEWATER MANAGEMENT APPROACH

The conventional wastewater management concept, consisting of a water-borne wastewater collection system leading to a central treatment plant, has been successfully applied over many decades in densely populated areas of industrialized countries and contributed to a great extend to the improvement of hygienic conditions in these areas.

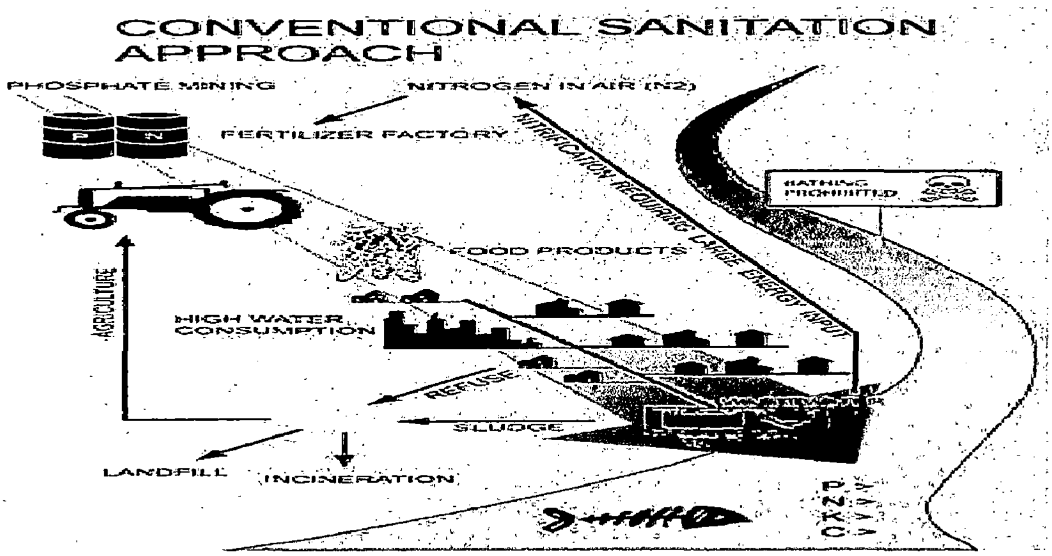


Fig 2.1 Conventional Waste Water Treatment

2.4 SEWAGE COMPOSITION

Sewage consists of 99.9% liquid and the remaining 0.1% only solids and this causes such great nuisance in addition to that sewage also contains millions of micro organisms.

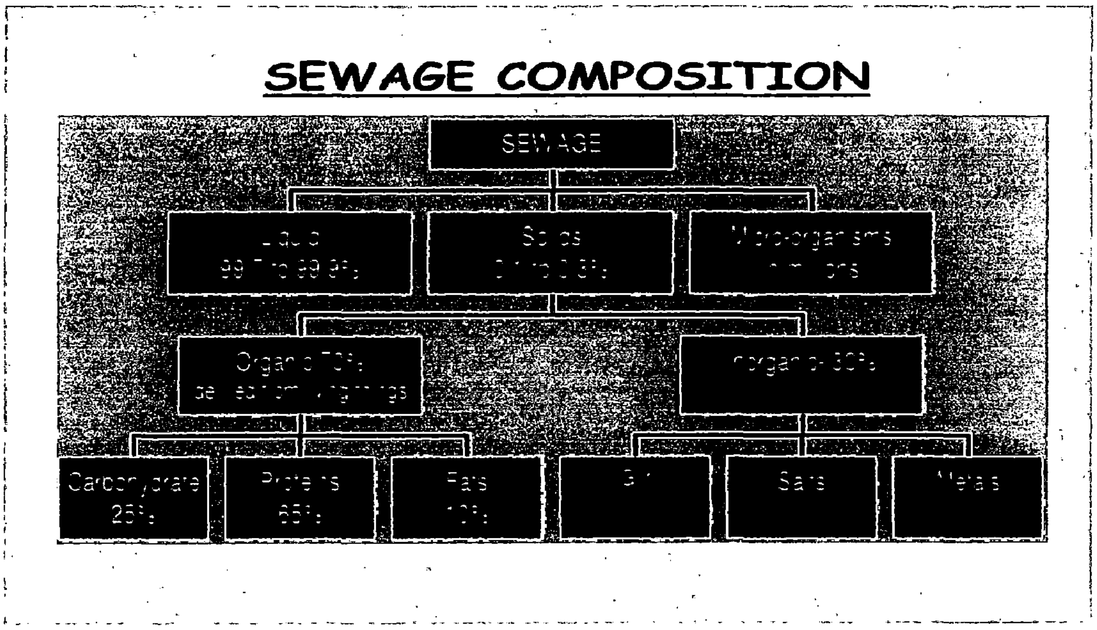


Fig 2.2 Composition Present in the Sewage

2.5 THE CONVENTIONAL TREATMENT METHOD INCLUDES

- Primary or Physical treatment
- Biological or Secondary treatment
- Tertiary or advanced treatment

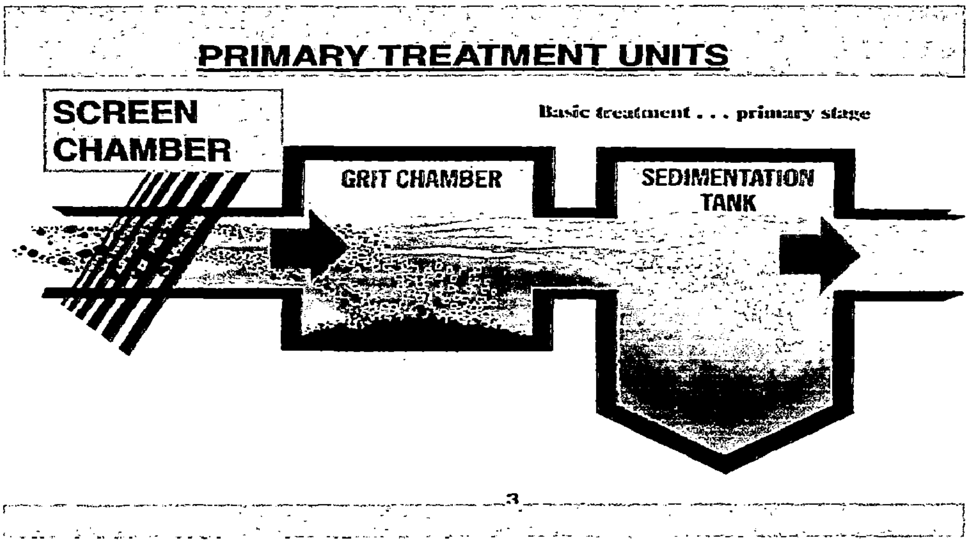


Fig2.3 Primary or Physical Treatment Units

2.5.1 BAR RACKS & SCREENS:

Here removal of floating and settle able solids those are larger than the size of opening in screens.

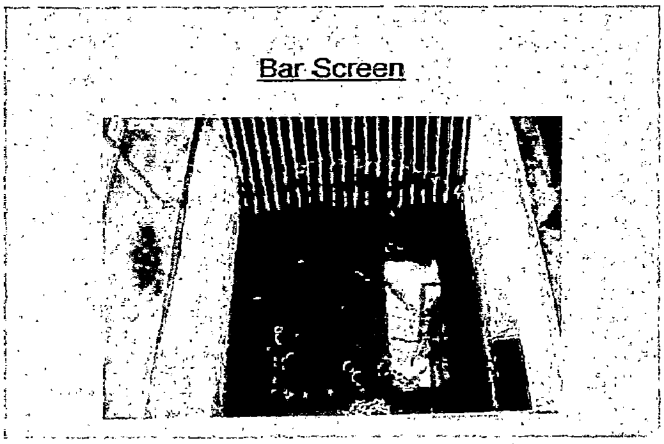


Fig 2.4 Bar Screen Picture

2.5.2 GRIT CHAMBER

Removal of inert inorganic heavy and tough particles such as grit, sand, stones, etc. which will other wise affect the pumps and other downstream equipments.

Fig 2.5 Grit Chamber

2.5.3 SEDIMENTATION

Removable of settle able solids and scum

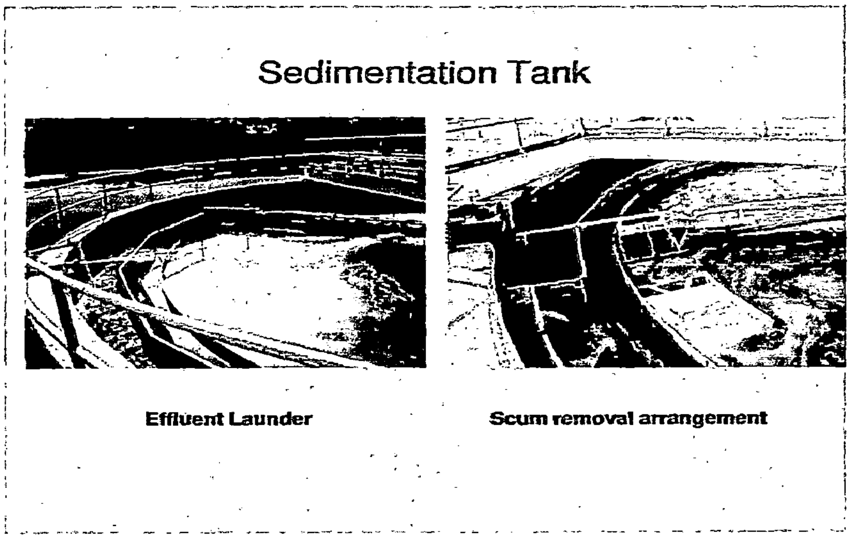


Fig 2.6 Sedimentation Tank

2.6 BIOLOGICAL OR SECONDARY TREATMENT

The objective of biological treatment is to coagulate the non settle able colloidal solids and to stabilize the organic matter. The various biological processes used for sewage treatment are

- Aerobic
- Anaerobic
- Aerobic & Anaerobic in tandem
- Pond Systems
- Natural treatment systems

2.6.1 AEROBIC PROCESSES

Suspended growth	Attached growth	Both combined
Activated Sludge process	Trickling Filter	Fluidized Aerobic Bioreactor
Sequencing Batch Reactor	Rotating Biological Disc	-
Aerated Lagoons	-	-
Extended Aeration	-	-

2.6.2 ANAEROBIC PROCESSES

Suspended growth	Attached growth
Up flow Anaerobic Sludge Blanket (UASB)	Extended Bed
Anaerobic Baffled Reactor	Fluidized Anaerobic Bed (FAB)

2.6.3 AEROBIC & ANAEROBIC IN TANDEM

Biofilter

2.6.4 POND SYSTEMS

- Waste stabilization Ponds

- Oxidation ponds
- Duck Weed Ponds

2.6.5 NATURAL TREATMENT SYSTEMS

- Slow rate treatment
- Rapid infiltration
- Overland flow
- Constructed Wetlands
- Aquaculture

2.7 TERTIARY OR ADVANCED TREATMENT

The need for tertiary or advanced treatment is based on a consideration of one or more of the following factors.

- The need to remove organic matter and total suspended solids beyond what can be above process to meet more stringent discharge or reuse standards
- The need to remove residual total suspended solids to condition the treated effluent for more effective disinfection.
- The Sneed to remove nutrients beyond what can be accomplished by above processes to limit the eutrophication of sensitive water bodies.
- The need to remove specific inorganic (heavy metals) and organic constituents to meet the reuse standard.

2.7.1 ADVANCED TREATMENT SYSTEMS

- Depth filtration
- Surface filtration
- Membrane filtration
- Carbon adsorption
- Reverse osmosis

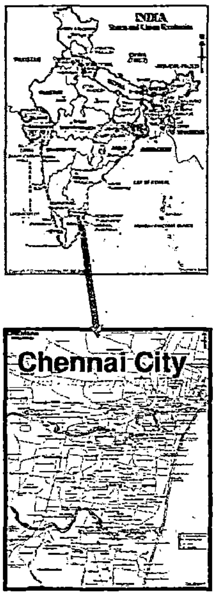
- Chemical precipitation
- Chemical oxidation
- Electro dialysis
- Distillation
- Ultra filtration

2.8 THE CONVENTIONAL WASTEWATER TREATMENT SYSTEM AT CHENNAI IN TAMILNADU

Chennai is the capital of Tamil Nadu and it is fourth largest city in India. It's Geographical area is 175.18 sq.km.and the adjacent urbanized area is 7.88 sq.km. It's latitude is 13°04 minutes North and the longitude 80°15' minutes East. Its population as per 2006 census is 5.32million.Its topography is flat. Adayar and Cooum rivers are its drainage. The climate is tropical. Other details are furnished below.

Salient features of Chennai City

- **The Chennai City is the capital of Tamil Nadu – Fourth largest City in India**
- **The growth of the City started in 17th Century and the initial water supply system was commeced in 1812**



1. Geographical Area	: 175.18 Sq.Km + 7.88 sq.km in AUA
2. Latitude / Longitude	: 13º04' Minutes North / 80º15' Minutes East
3. Population	; 5.32 Million (2006)
4. Topography	: Flat
5. Drainage	: Adayar & Cooum Rivers
6. Average Rain fall	: 1100 mm to 1300 mm per year
7. Temperature	: 30º c to 40º c
8. Climate	; Tropical
9. Humidity	: Vary between 65% and 80%
10. Water Supply Sources	: Surface and Ground water
11. Water Supply (per day) Normal year	: 350 - 450 Mld
12. Supply Rate (Per Day per Head) (Normal year)	: 70 – 100 lpcd
13. Current Water Supply (from 2006)	: 645 Mld
14. Current Supply Rate	: 105 lpcd

Fig 2.7 Salient Features of Chennai City

Due its plain terrain the sewerage system has been formulated in Zonal basis. The entire city is divided into Five zones and is shown in the fig.,below

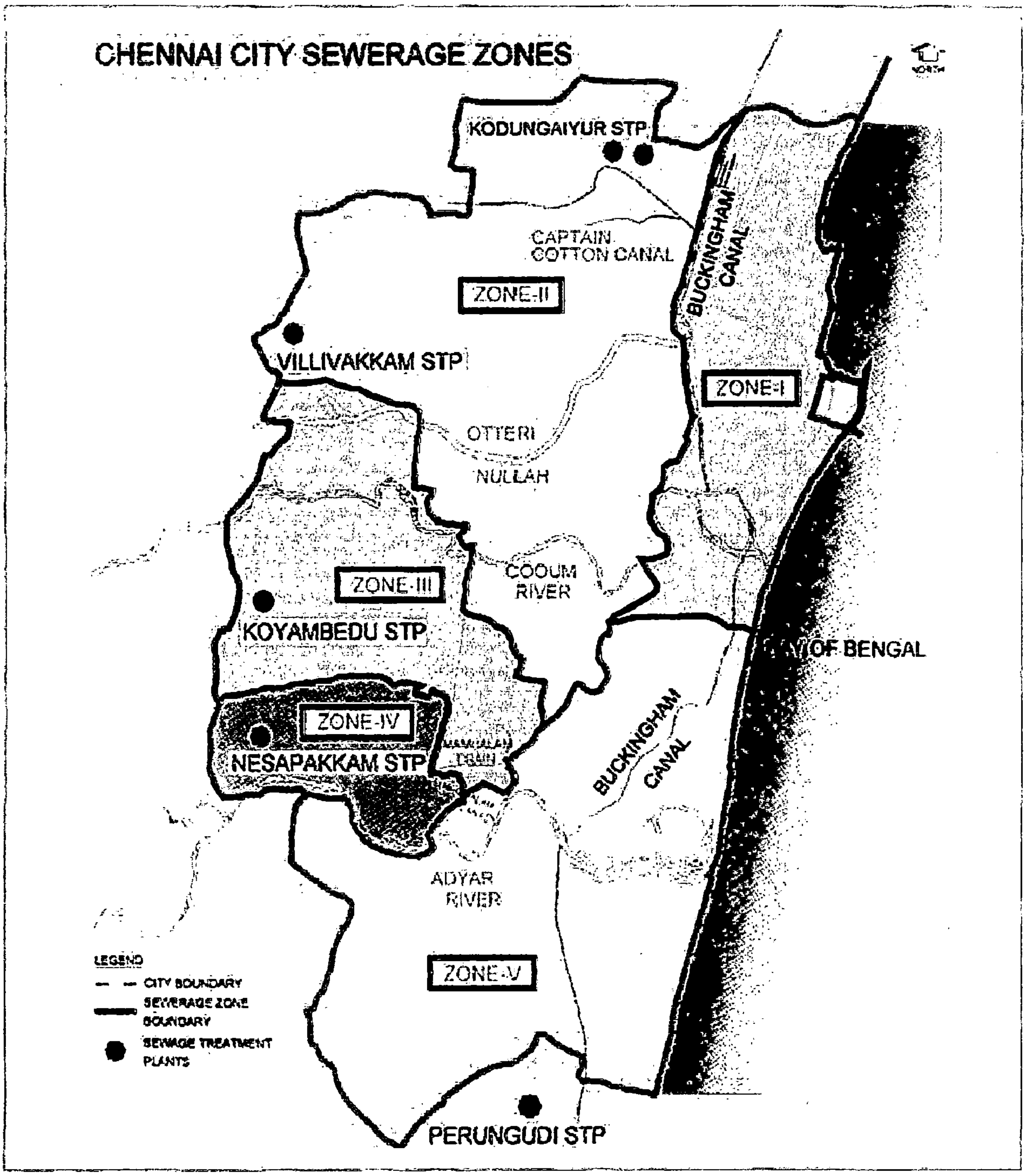


Fig 2.8 Chennai City Sewerage Zones

OF THE FIVE ZONES THE THIRD ZONE NAMELY KOYAMBEDU TREATMENT PLANT IS SHOWN HERE.

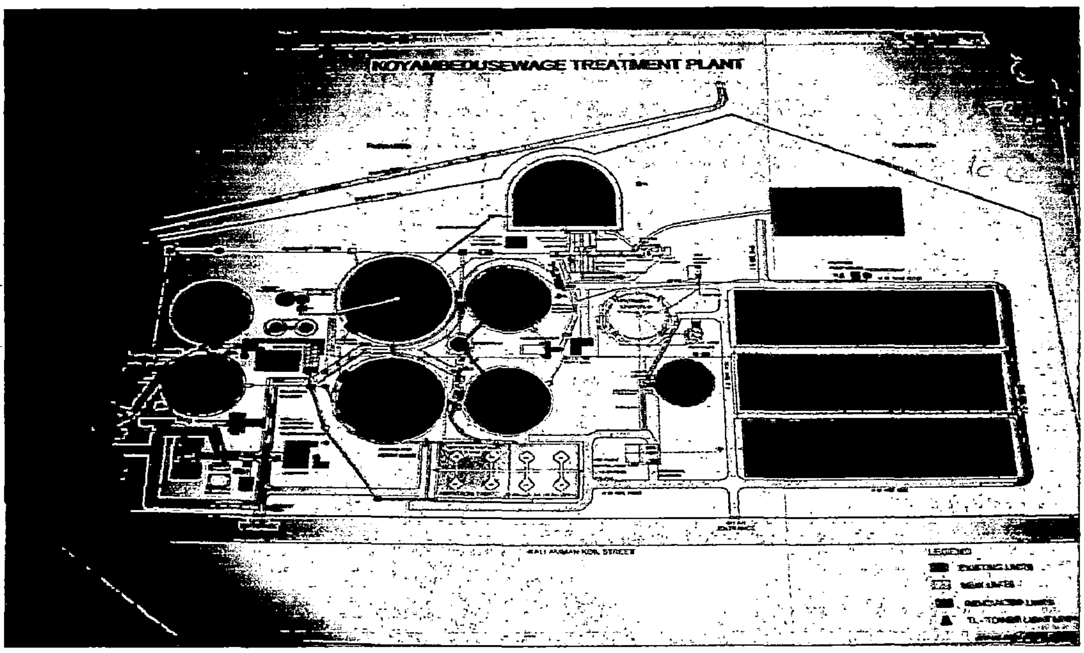
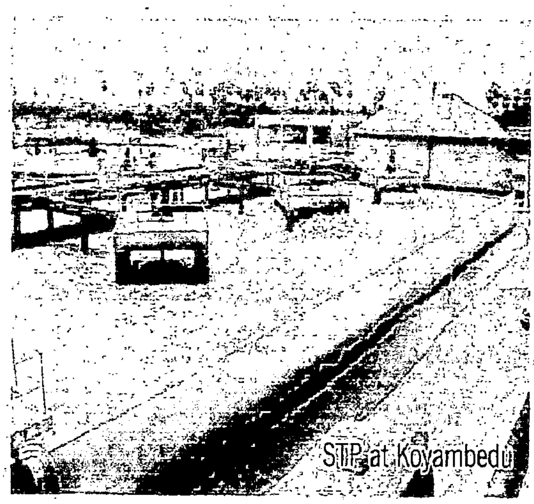
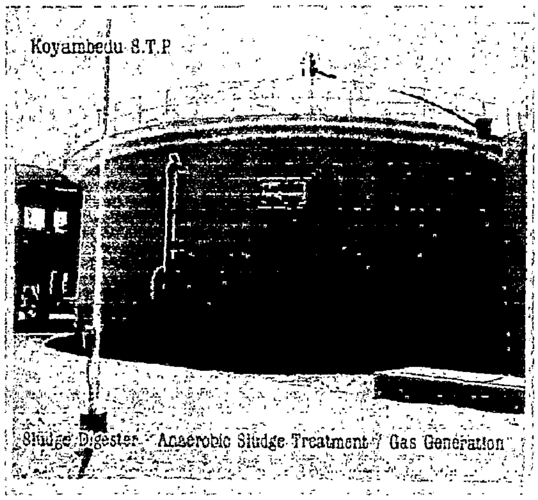


Fig 2.9 Koyambedu Treatment Plant





2.9 SCIENCE AND TECHNOLOGY

Based on today's technology options, using large lots to protect public health and the Environment is not necessarily sound science. An understanding of today's technology, coupled with good planning and a commitment to maintenance and management, is a vital step towards safely developing denser growth areas.

During the last decade, various researchers and institutions, including the World Bank, have started to consider the decentralized wastewater management approach as an alternative to conventional centralized systems, but theses approaches have struggled to gain acceptance. The main arguments against decentralization of wastewater management are based on financial concerns and issues of treatment efficiency. This might be partly true, but it cannot be denied that the decentralized approach has great potential and could serve to complement existing centralized systems.

2.9.1 DECENTRALISED APPROACH

The centralized wastewater management system is nothing else than a transportation system for human excreta and industrial wastes to a central discharge place or a treatment unit. Using valuable drinking water as transport medium, these systems are wasteful not only of water but also of human waste elements that can be easily treated and reused. Centralized wastewater management systems reduce wastewater reuse opportunities and increase the risk to humans and the environment in the event of system failures. Conversely, the decentralized wastewater management concept is better suited to translate Bellagio Principles No 3 (perceiving human excreta and wastes as potential resources) and No 4 (solving sanitation issues as close as possible to the source of waste generation) into practice. Furthermore the decentralized wastewater management concept:

- Broadens the technology options and permits tailoring the solutions to the prevailing conditions;
- Minimizes the freshwater requirements for waste transportation;
- Reduces the risks associated with system failure;

- Increases wastewater reuse opportunities; and
- Permits incremental development and investment in the community wastewater system.

2.9.2 CONVENTIONAL ONSITE WASTEWATER TREATMENT SYSTEM

Onsite system has consisted primarily of a septic tank and a soil absorption field, also known as a subsurface wastewater infiltration system, or SWIS In this manual, such systems is referred to as *conventional systems*. Septic tanks remove most settle able and floatable material and function as an anaerobic bioreactor that promotes partial digestion of retained organic matter. Septic tank effluent, which contains significant concentrations of pathogens and nutrients, has traditionally been discharged to soil, sand, or other media absorption fields (SWISs) for further treatment through biological processes, adsorption, filtration, and infiltration into underlying soils.

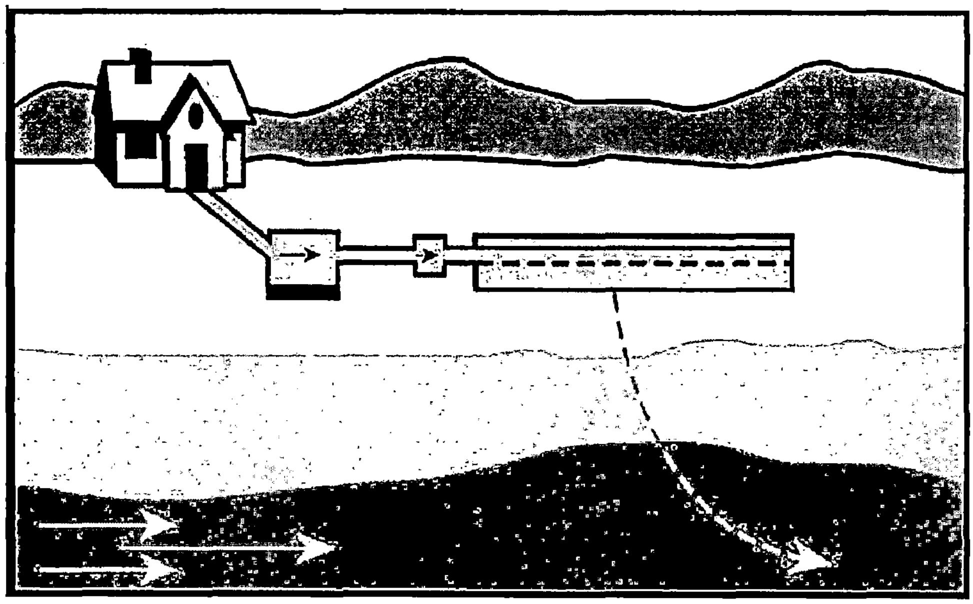


Fig 2.10 CONVENTIONAL ONSITE WASTEWATER TREATMENT SYSTEM

2.9.3 ABOUT DEWATS

DEWATS stands for "Decentralized Wastewater Treatment Systems". DEWATS is rather a technical approach than merely a technology package. DEWATS applications provide treatment for both, domestic and industrial sources. Decentralized wastewater treatment systems have enormous potential in contributing to the development of sustainable environmental sanitation concepts and are in line with the Bellagio Principles. As engineers, we are called upon to provide technologies that are reliable, easy to operate and affordable to use. This task is a difficult one that requires an interdisciplinary approach that takes into account local conditions.

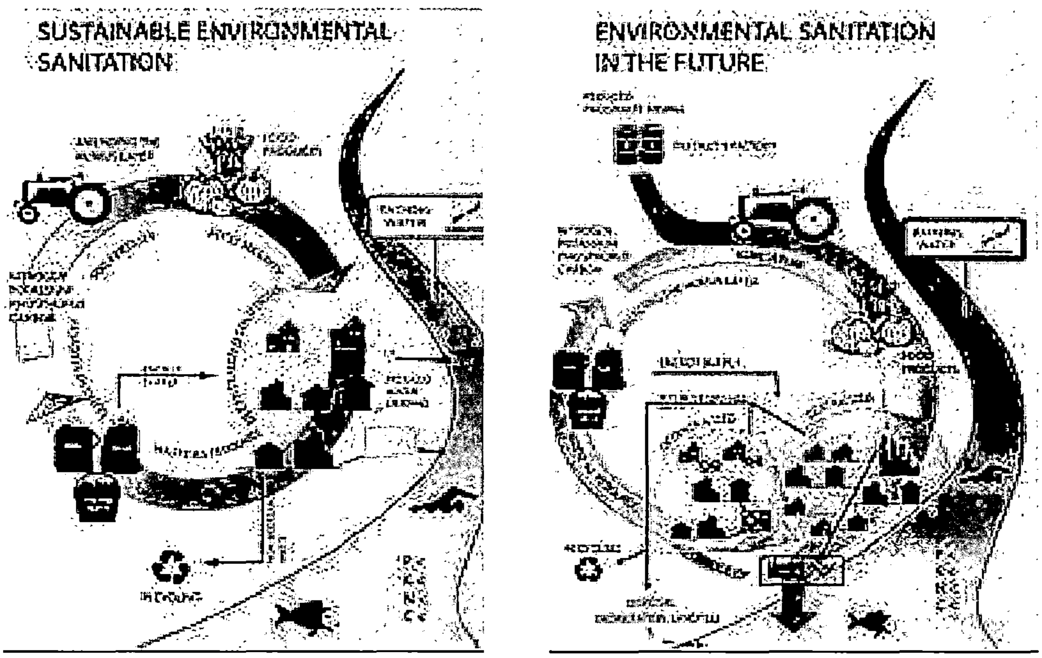


Fig 2.11 Environmental sanitation

DEWATS applications provide treatment for organic wastewater flows from 1-1000 m^3 per day. DEWATS applications are reliable, long lasting and tolerant towards inflow fluctuation. DEWATS applications do not need sophisticated maintenance without considering facilities for necessary chemical pre-treatment of wastewater from industries.

2.9.4 FOUR BASIC TECHNICAL TREATMENT MODULES ACCORDING TO DEMAND FOR DEWATS APPLICATIONS

The four basic technical treatment modules according to demand for DEWATS applications are:

1. Primary treatment: Sedimentation and floatation
2. Secondary anaerobic treatment in fixed-bed reactors: baffled upstream reactors or anaerobic filters.

3. Tertiary aerobic treatment in sub-surface flow filters and
4. Tertiary aerobic treatment in polishing ponds

2.9.5 DEWATS APPLICATIONS

They are designed and dimensioned in such a way that treated water meets requirements stipulated in environmental laws and regulations. DEWATS applications are based on the principle of low-maintenance since most important parts of the system work without technical energy inputs and cannot be switched off intentionally. DEWATS applications provide state of-the-art-technology at affordable prices because all of the materials used for construction are locally available. Hence DEWATS technology is an effective, efficient and affordable wastewater treatment solution for small and medium sized enterprises (SME).

2.9.6 DEMAND OF DEWATS SYSTEM

The demand for reliable, efficient and low-cost wastewater treatment systems is increasing world wide especially in densely populated urban regions where adequate wastewater treatment systems do not exist and uncontrolled discharge of wastewater endangers environmental health and water resources. Many Governments have passed new environmental regulations stipulating that dischargers of wastewater such as small and medium enterprises and housing estates will be held responsible for wastewater pollution and must therefore treat wastewater adequately on-site before it is discharged into the environment.

2.9.7 DEWATS-MODULES FOR PHYSICAL AND BIOLOGICAL WASTEWATER TREATMENT:

1. Settler
2. Anaerobic Baffled Reactor
3. Anaerobic Filter
4. Planted Gravel Filter

2.9.8 ADVANTAGES OF DEWATS TECHNOLOGY:

- Providing treatment for domestic and industrial wastewater
- Low primary investment costs as no imports are needed
- Efficient treatment or daily wastewater flows up to 1000 m^3
- Modular design of all components
- Tolerant towards inflow fluctuations
- Reliable and long-lasting construction design
- Expensive and sophisticated maintenance not required
- Low maintenance costs
- Establishing of multi-stakeholder networks to combat water pollution
- Fulfillment of discharge standards and environmental laws
- Wastewater pollution reduced by up to 90%
- Reliable and long lasting applications
- Materials/ inputs used for construction are locally available
- Minimal maintenance and long de-sludging intervals

2.9.9 DEWATS TECHNOLOY PRINCIPLES

A combination of low- maintenance based technology.

2.9.9.1 BIOGAS DIGESTER

It is Half-ball-shaped fixed dome plant. It is suitable for thick and homogeneous substrate like sludge from aerobic treatment tanks, liquid animal excreta and excrement

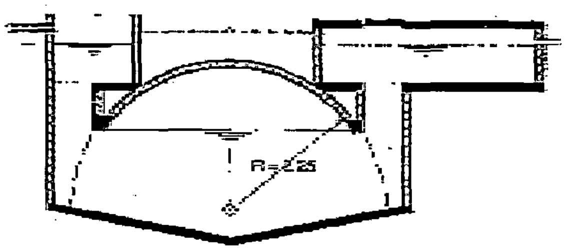
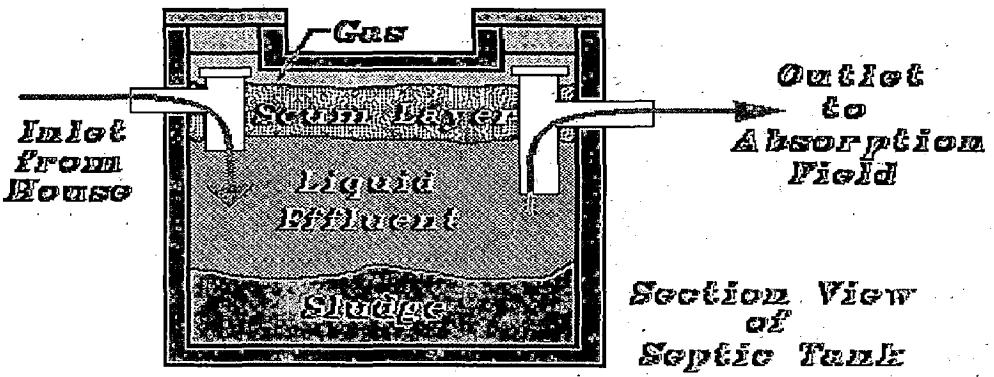


Fig. 2.12 Biogas Digester

2.9.9.2 BASIC SEPTIC TANK



(C) 2005-1985 Daniel Friedman

Fig 2.13 Basic septic tank

In unsewered areas , the liquid waste from individual households is treated in septic tanks. Gas recovery is not done. The sludge disposal is done at long intervals.

Basically principled on sedimentation tank in which settled sludge is stabilized by anaerobic digestion. Here Mechanical treatment by sedimentation. Biological treatment by contact between fresh water and active sludge complete with each other in the septic tank.

Sedimentation biodigesters are optionally constructed and integrated with " Baffle Reactor". They are brick construction, fully waterproof, and air-tight plastering. Biogas produced as renewable energy source.

Retention time of the liquid is in the order of one day, Sludge is digested anaerobically in the septic tank, resulting in a reduced volume of sludge. Septic tank offers primary treatment with 40-50% removal of COD and 65% reduction of suspended solids. It requires very little land and there is no power requirement.

2.9.9.3 BAFFLED UP-FLOW REACTOR

Here treatment is done by forcing incoming wastewater to pass through active bacteria sludge in each compartment. The settler in front prevents larger solids to enter the baffle section.

2.9.9.4 ANAEROBIC FILTER REACTOR

The treatment of non-settle able and dissolved solids is done by bringing them in close contact with a surplus of active bacterial mass.

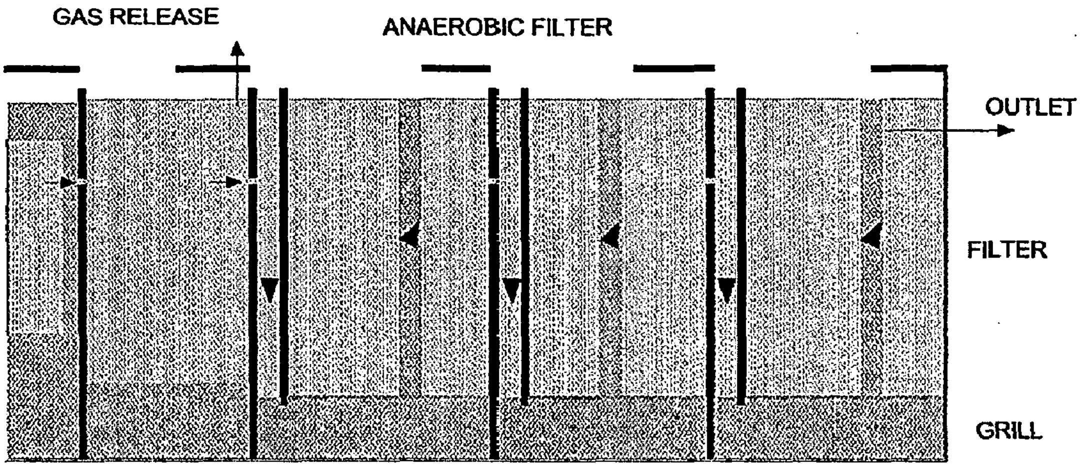


Fig 2.13 Anaerobic Filter

Anaerobic degradation of suspended and dissolved solid is based on up-flow principle. They are simple, durable, and easy to maintain. Underground construction and little permanent space required. They are effective, efficient and low cost maintenance. The BOD reduction is up to 90%.

2.9.9.5 HORIZONTAL SAND FILTER

Here continuous oxygen supply is being provided to the upper layers. Treatment by permanently soaked sand or gravel filter with water and operates partly anoxic and partly anaerobic. This technology uses Aerobic-Facultative- Anaerobic degradation of dissolved and fine suspended solids. Pathogen removal occurring with high treatment efficiency and no nuisance odor. No wastewater above ground.

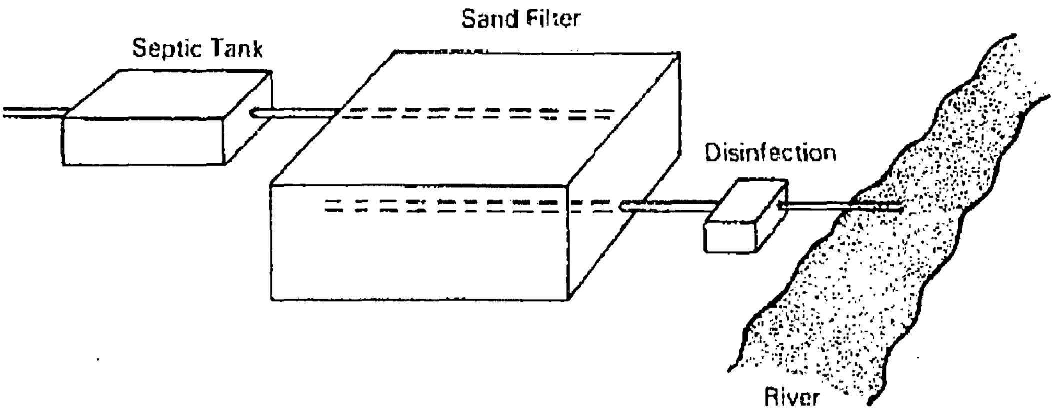


Fig 2.15 Horizontal Sand Filter

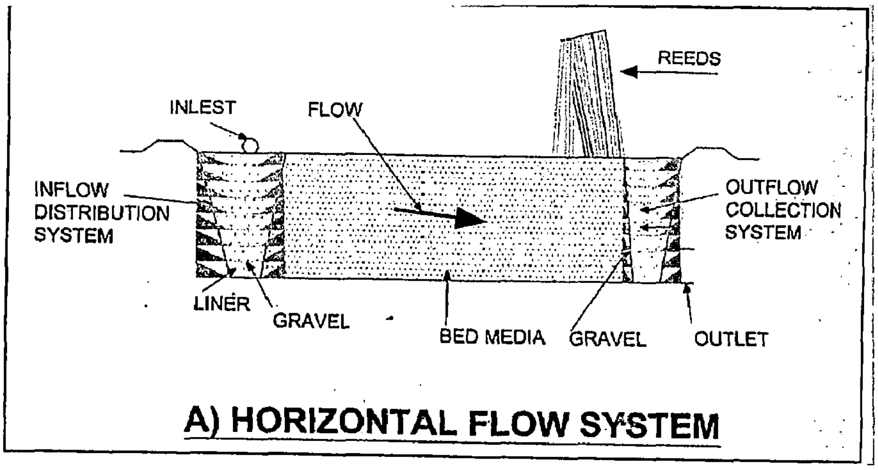


Fig 2.16 Horizontal Flow System

2.9.9.6 IMPROVING TREATMENT THROUGH PERFORMANCE REQUIREMENTS

Most onsite wastewater treatment systems are of the conventional type, consisting of a septic tank and a Subsurface Wastewater Infiltration System (SWIS). Site limitations and more stringent performance requirements have led to significant improvements in the design of wastewater treatment systems .Industry has developed many new treatment technologies that can achieve high performance levels on sites with size, soil, ground water, and landscape limitations that might preclude installing conventional systems.

New technologies and improvements to existing technologies are based on defining the performance requirements of the system, characterizing wastewater flow and pollutant loads, evaluating site conditions, defining performance and design boundaries, and selecting a system design that addresses these factors. Performance requirements can be expressed as numeric criteria (e.g., pollutant concentration or mass loading limits) or narrative criteria (e.g., no odors or visible sheen) and are based on the assimilative capacity of regional ground water or surface waters, water quality objectives, and public health goals.

Wastewater flow and pollutant content help define system design and size and can be estimated by comparing the size and type of facility with measured effluent outputs from similar, existing facilities. Site evaluations integrate detailed analyses of regional hydrology, geology, and water resources with site-specific characterization of soils, slopes, structures, poetry lines, and other site features to further define system design requirements and determine the physical placement of system components.

2.9.9.7 MOST OF THE ALTERNATIVE TREATMENT TECHNOLOGIES APPLIED TODAY TREAT WASTES AFTER THEY EXIT THE SEPTIC TANK.

The tank retains settle able solids, grease, and oils and provides an environment for partial digestion of settled organic wastes. Post-tank treatment can include aerobic (with oxygen) or anaerobic (with no or low oxygen) biological treatment in suspended or fixed-film reactors, physical/chemical treatment, soil infiltration, fixed-media filtration, and/or disinfection. The application and sizing of treatment units based on these technologies are defined by performance requirements, wastewater characteristics, and site conditions.

2.9.9.8 TOWARDS MORE COMPREHENSIVE APPROACH

The principles of the 1980 onsite system design manual have withstood the test of time, but much has changed over the past 20 years. This manual incorporates much of the earlier guide but includes new information on treatment technologies, site evaluation, design boundary characterization, and especially management program functions. The manual is organized by functional topics and is intended to be a comprehensive reference. Although this manual focuses on individual and small, clustered onsite systems, state and tribal governments and other management entities can use the information in it to construct a framework for managing new and existing large-capacity decentralized systems .

2.9.9.9 ONSITE WASTEWATER TREATMENT SYSTEMS (OWTS)

They have evolved from the pit privies used widely throughout history to installations capable of producing a disinfected effluent that is fit for human consumption. Although achieving such a level of effluent quality is seldom necessary, the ability of onsite systems to remove settle able solids, floatable grease and scum, nutrients, and pathogens from wastewater discharges defines their importance in protecting human health and environmental resources. In the modern era, the typical onsite system has consisted primarily of a septic tank and a soil absorption field, also known as a subsurface wastewater infiltration system, or SWIS .Such systems are referred to as *conventional systems*.

Septic tanks remove most settle able and floatable material and function as an anaerobic bioreactor that promotes partial digestion of retained organic matter. Septic tank effluent, which contains significant concentrations of pathogens and nutrients, has traditionally been discharged to soil, sand, or other media absorption fields (SWISs) for further treatment through biological processes, adsorption, filtration, and infiltration into underlying soils. Conventional systems work well if they are installed in areas with appropriate soils and hydraulic capacities; designed to treat the incoming waste load to meet public health, ground water, and surface water performance standards; installed properly; and maintained to ensure long-term performance.

2.10 ONSITE WASTEWATER TREATMENT SYSTEMS TECHNOLOGY BY CONTINUOUS-FLOW, SUSPENDED-GROWTH AEROBIC SYSTEMS (CFSGAS)

DESCRIPTION

The activated sludge process is an aerobic suspended-growth process that maintains a relatively high population of microorganisms (biomass) by recycling settled biomass back to the treatment process. The biomass converts soluble and colloidal biodegradable organic matter and some inorganic compounds into cell mass and metabolic end products. The biomass is separated from the wastewater through settling in a clarifier for recycling or wasting to sludge handling processes. Preliminary treatment to remove settle able solids and floatable materials is usually provided by a septic tank or other primary treatment device. Most onsite designs are capable of providing significant ammonia oxidation and effective removal of organic matter.

The basic system consists of a number of interrelated components

- An aeration tank or basin.

• An oxygen source and equipment to disperse atmospheric or pressurized air or oxygen into the aeration tank at a rate sufficient to always maintain positive dissolved oxygen.

• A means to appropriately mix the aeration basin and ensure suspension of the biomass (usually accomplished by the aeration system).

• A clarifier to separate the biomass from the treated effluent and collect settled biomass for recycling to the aeration basin.

Several modifications of this basic process are commercially available. These include different aeration devices; different means of sludge collection and recycling to the aerator; the use of coarse membrane filters in lieu of, or in addition to, the clarifier; and process enhancement through the addition of an inert media area on which biofilms can grow. The addition of surfaces where biota can become attached and grow increases the capacity of the system (increased organic loading possible). This last modification is the most significant enhancement and is described below. The combined fixed-film/suspended growth process is sometimes referred to as a class of treatment processes called coupled contact aeration, enhanced, or high biomass systems. To enhance performance and increase the capacity of the aeration tank, an inert support medium is added to the aeration tank. This allows a fixed film of biomass to attach and grow on the medium to augment the suspended microbial population, providing more biomass to feed on wastewater constituents. Synthetic trickling filter media, loops of fiber bundles, and a variety of different plastic surface configurations can be suspended in the aeration tank. Advantages include increased active microbial mass per unit volume, enhanced potential for nitrification, reduced suspended solids loading to the clarifier, improved solids separation characteristics, reduced sludge production, and resilience under variable influent conditions.

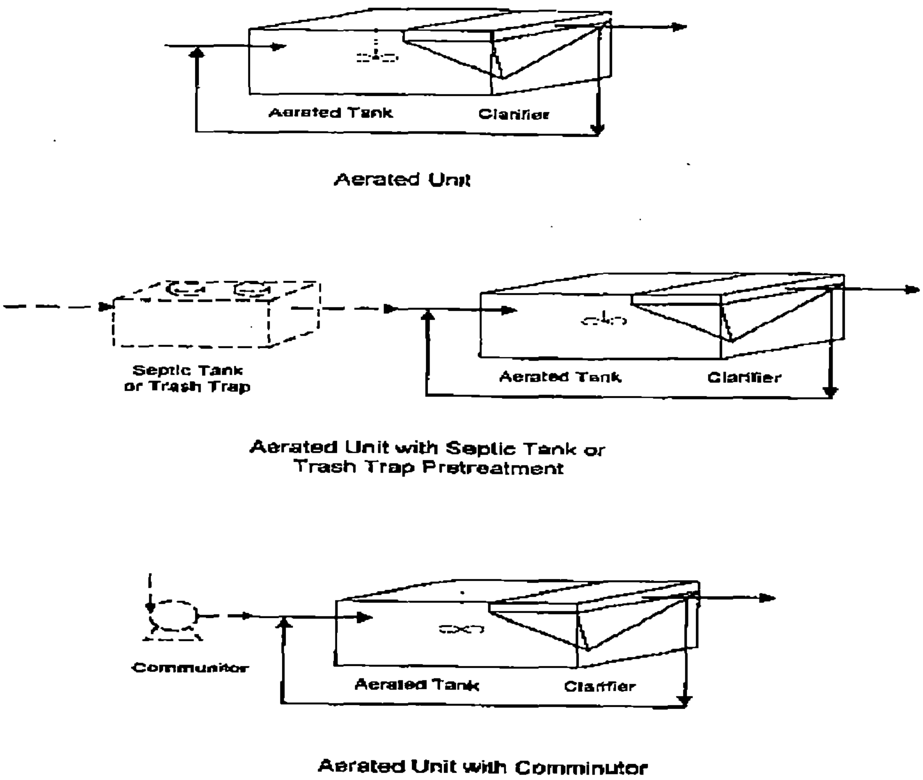


Fig 2.17 Aerated Units

2.10.1 COSTS

The installed costs of package plants are highly variable but are usually less than $10,000. Operation and maintenance (O/ M) costs are primarily dependent on local power and labor costs, varying from $400 to $600 per year in most cases.

2.11 ONSITE WASTEWATER TREATMENT SYSTEMS TECHNOLOGY BY FIXED-FILM PROCESSES

2.11.1 DESCRIPTION

Fixed-film systems (FFS) are biological treatment processes that employ a medium such as rock, plastic, wood, or other natural or synthetic solid material that will support biomass on its surface and within its porous structure.

At least two types of fixed-film systems may be considered.

- those in which the medium is held in place and is stationary relative to fluid flow (**trickling filter**) and
- Those in which the medium is in motion relative to the wastewater (e.g., **rotating biological disk**). A third classification includes dual-process systems that encompass both fixed and suspended biomass together or ins series.

2.11.2 TRICKLING FILTER (T.F)

Systems are typically constructed as beds of media through which wastewater flows. Oxygen is normally provided by natural or forced ventilation. Flow distributors or sprayers distribute the wastewater evenly onto the surface of the medium. As the wastewater moves by gravity through the medium, soluble and colloidal organic matter is metabolized by the biofilm that forms on the medium. Excess biomass sloughs from the medium and is carried with the treated wastewater to the clarifier, where the solids settle and separate from the treated effluent. At this point the treated wastewater may be discharged or recycled back to the filter medium for further treatment.

2.11.3 ROTATING BIOLOGICAL CONTACTOR (RBC)

Fixed-film biological treatment process that employs rotating disks that move within the wastewater is referred to as Rotating Biological Contactor (RBC). Developed in the late 1960s, the RBC employs a plastic medium configured as disks and mounted on a horizontal shaft. The shafts are rotated slowly (1 to 2 rpm) by mechanical or compressed air drive. For a typical aerobic RBC, approximately 40 percent of the medium is immersed in the wastewater. Anoxic or anaerobic RBCs (far less common) are fully immersed in the wastewater. Wastewater flows through the medium by simple displacement and gravity.

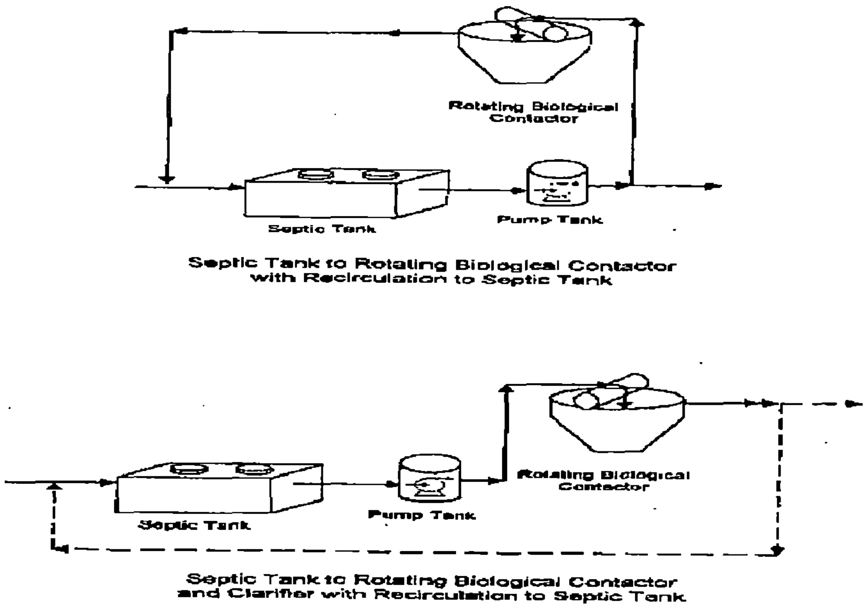


Fig 2.18 Septic tank to RBC with Recirculation

Biomass continuously sloughs from the disks, and some suspended biomass develops within the wastewater channels through which the disks rotate, making the addition of a secondary clarifier necessary. The rotation of the disks exposes the attached biomass to atmospheric air and wastewater. Oxygen is supplied by natural surface transfer to the biomass. Some oxygenation of the wastewater is also created by turbulence at the disk-water interface.

2.11.4 COSTS

Observed costs are highly variable depending on climate, location, onsite aesthetic requirements, and many other factors. The cost of power should be in the range of $100 per year for RBC units and $35 per year for trickling filters. Capital(installed) costs of $9,000 to $14,000 are typical. A management contract estimated at about $100 to $200 per year recommended.

2.12 ONSITE WASTEWATER TREATMENT SYSTEMS TECHNOLOGY BY TRICKLING FILTER PROCESSES

The first Trickling Filter(TF) was installed in England in1893.This bed was filled with sewage from the top and the sewage is allowed to remain in contact the media for a short a time. The bed was then drained and allowed to rest before the cycle was repeated. The resting period was about 6 hrs while a complete cycle took 12 hrs .In view of low loading rate ,long resting period heavy clogging ,these filters have given place to TF.

Here sewage is sprayed over the bed becomes wet and sewage trickles through the filter bed. The surface of the media that comes into contact with sewage develops a Zoogleal film rich in bacteria ,fungi and protozoa. This film first transfers the suspended, colloidal and dissolved solids from sewage from simple absorption and adsorption, decomposes them and then throws back into sewage their end products .This result in a considerable removal of BOD. The suspended solids get sloughed off and the converted SS are removed in a secondary settling tank.

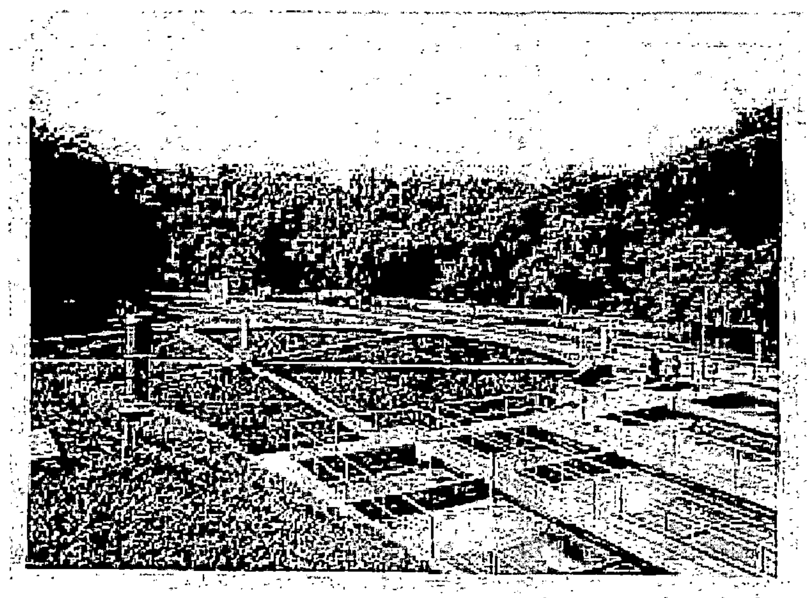


Fig 2.19 Trickling Filter

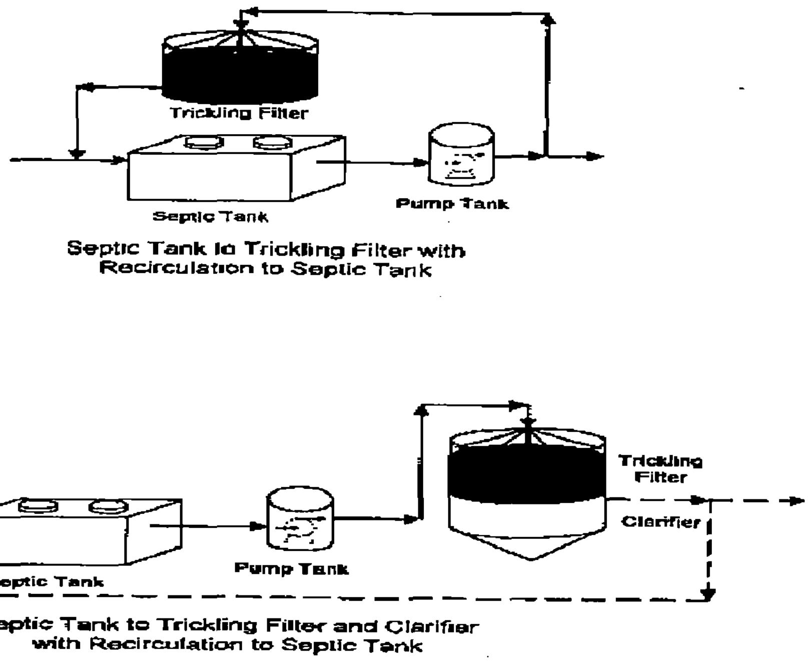


Fig 2.20 Septic Tank to Trickling Filter with Recirculation

2.13 ONSITE WASTEWATER TREATMENT SYSTEMS TECHNOLOGY WITH SEQUENCING BATCH REACTOR SYSTEMS

2.13.1 DESCRIPTION

The Sequencing Batch Reactor (SBR) process is a sequential suspended growth (activated sludge) process in which all major steps occur in the same tank in sequential order . There are two major classifications of SBRs: the intermittent flow (IF) or "true batch reactor," which employs all the steps in figure 1, and the continuous flow (CF) system, which does not follow these steps. Both

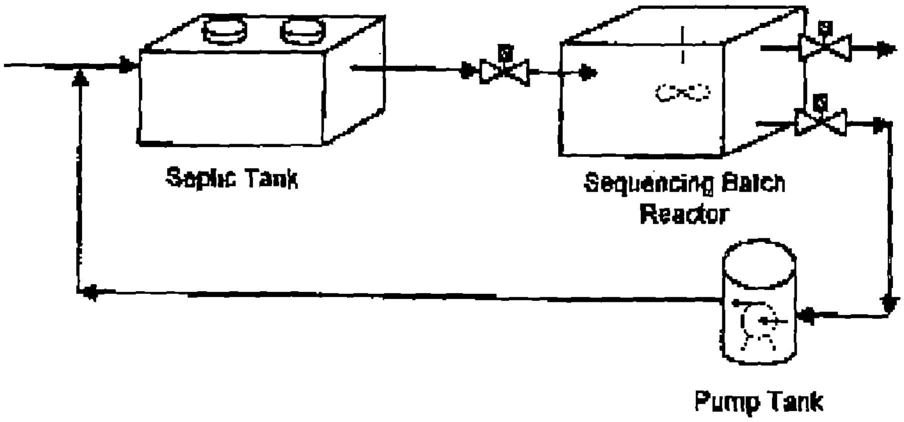


Fig 2.21 Septic Tank to SBR with Recirculation

Have been used successfully at a variety of U.S. and worldwide installations. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, in addition to removing TSS and BOD. The intermittent flow SBR accepts influent only at specified intervals and, in general, follows the five-step sequence. There are usually two IF units in parallel. Because this system is closed to influent flow during the treatment cycle, two units may be operated in parallel, with one unit open for intake while the other runs through the remainder of the cycles. In the continuous inflow SBR, influent flows continuously during all phases of the treatment cycle. To reduce short-circuiting partition is normally added to the tank to separate the turbulent aeration zone from the quiescent area.

2.13.2 PERFORMANCE

With appropriate design and operation, SBR plants have been reported to produce high quality BOD and TSS effluents. Typical ranges of CBOD5 (carbonaceous 5-day BOD) are from 5 to 15 mg/L. TSS ranges from 10 to 30 mg/L in wall operated systems. FC removal of 1 to 2 logs can be expected. Normally, nitrification can be attained most of the time unless cold temperatures persist. The SBR systems produce a more reliable effluent quality than CFSGAS or FFS owing to the random nature of the wastewater generated from an individual home.

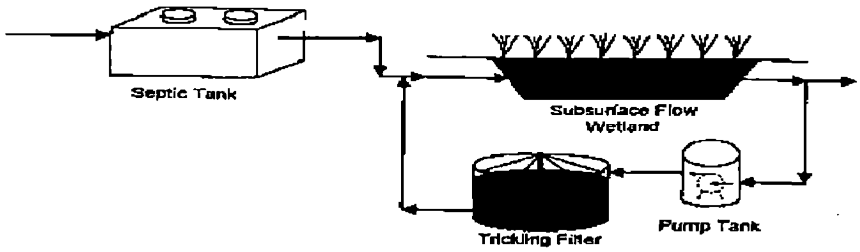
2.13.3 COSTS

For residential applications, typical system equipment costs are $7,000 to $9,000. Installation costs vary depending on site conditions; installation costs between $1,500 and $3,000 are typical for uncomplicated sites with good access. It should be noted that additional system components (e.g., subsurface infiltration system) will result in additional costs. Annual operation and maintenance costs include electricity use (<$300/year), sludge removal (>$100/year), and equipment servicing. (Some companies are providing annual service contracts for these units for $250 to $400.) Actual costs will vary depending on the location of the unit and local conditions.

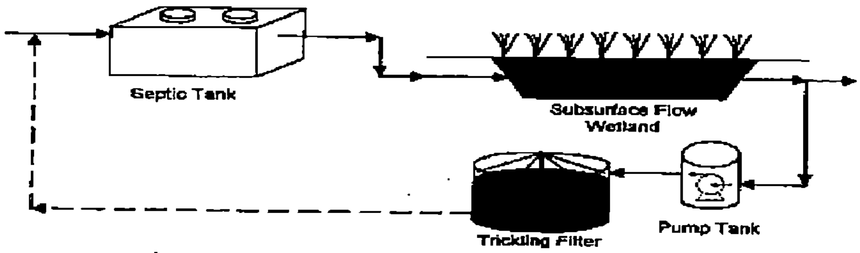
2.14 ONSITE WASTEWATER TREATMENT SYSTEMS TECHNOLOGY WITH STABILIZATION PONDS, FWS CONSTRUCTED WETLANDS, AND OTHERAQUATIC SYSTEMS

2.14.1 DESCRIPTION

Aquatic systems are large basins filled with wastewater undergoing some combination of physical, chemical, and/or biological treatment processes that render the wastewater more acceptable for discharge to the environment .They are not widely used because they tend to be large in area, require some form of fencing to minimize human health risk, often require supplemental treatment before discharge or reuse, and are approved in only a few states. Stabilization ponds (lagoons) have many forms, but the facultative lagoon is the most widely used. Aerated lagoons are often preferred because of their smaller size requirements. Anaerobic lagoons and maturation ponds are not used in the United States for onsite application by design. In some areas, lagoons must be lined according to codes, which further limit their application. Facultative lagoons are large in size, perform best when segmented into at least three cells, obtain necessary oxygen for treatment by surface reaeration from the atmosphere, combine sedimentation of particulates with biological degradation, and produce large quantities of algae, which limits the utility of their effluent without further treatment.



Septic Tank to Subsurface Flow Wetland To Trickling Filter with Recirculation to Subsurface Wetland



Septic Tank to Subsurface Flow Wetland To Trickling Filter with Recirculation to Septic Tank

Fig 2.22 Septic Tank to Trickling Filter with Recirculation

2.15 ONSITE WASTEWATER TREATMENT SYSTEMSTECHNOLOGY WITH INTERMITTENT SAND/MEDIA FILTERS

2.15.1 DESCRIPTION

The term intermittent sand filter (ISF) is used to describe a variety of packed-bed filters of sand or other granular materials available on the market. Sand filters provide advanced secondary treatment of settled wastewater or septic tank effluent. They consist of a lined (e.g., impervious PVC liner on sand bedding) excavation or structure filled with uniform washed sand that is placed over an under drain system. The wastewater is dosed onto the surface of the sand through a distribution network and allowed to percolate through the sand to the under drain system. The under drain system collects the filter effluent for further processing or discharge. Sand filters are aerobic, fixed-film bioreactors. Other treatment mechanisms that occur in sand filters include physical processes, such as straining and sedimentation, that remove suspended solids within the pores of the media.

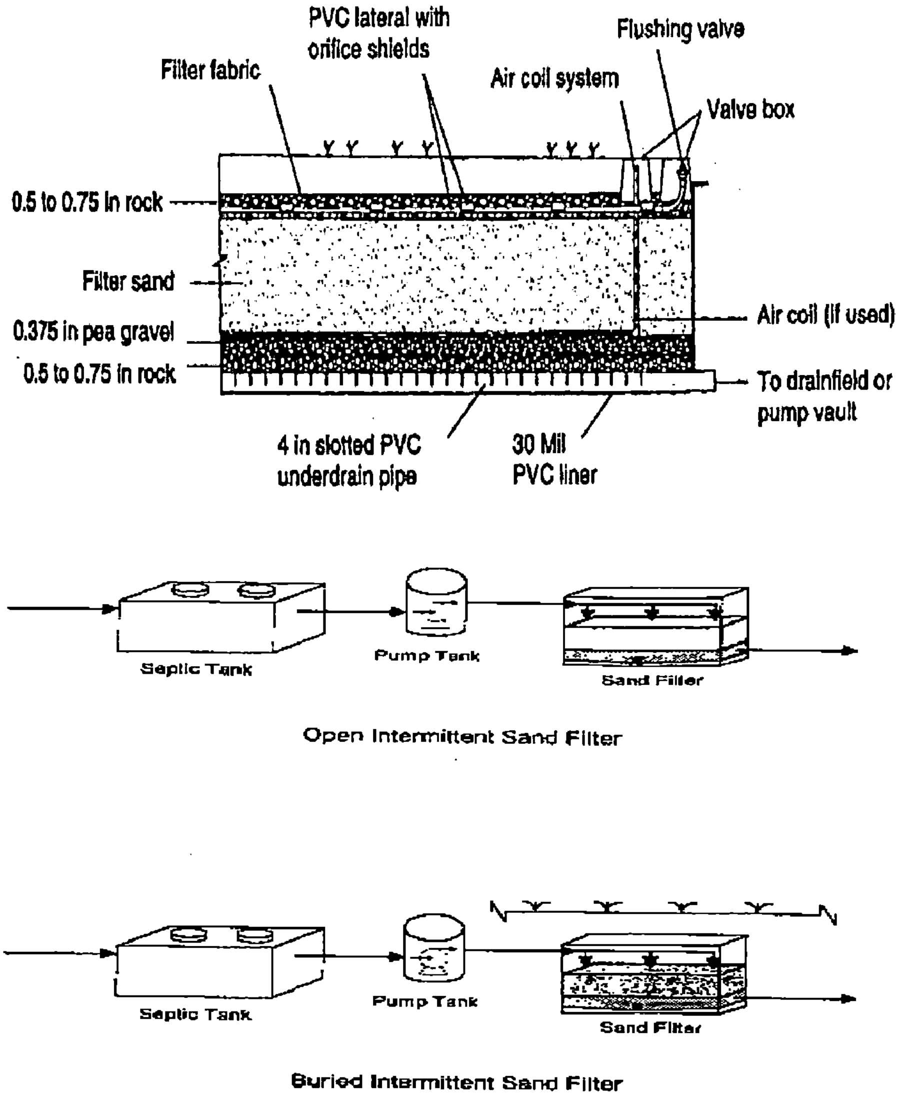


Fig 2.23 Sand Filter

Also, chemical adsorption of pollutants onto media surfaces plays a finite role in the removal of some chemical constituents (e.g., phosphorus).Bio slimes from the growth of microorganisms develops as films on the sand particle surfaces. The microorganisms in the slimes absorb soluble and colloidal waste materials in the wastewater as it percolates over the sand surfaces. The adsorbed materials are incorporated into a new cell mass or degraded under aerobic conditions to carbon dioxide and water. Most biochemical treatment occurs within approximately 6 inches of the filter surface. As the wastewater percolates through this layer, suspended solids and carbonaceous biochemical oxygen demand (BOD) are removed.

2.15.2 APPLICATIONS

Sand filters can be used for a broad range of applications, including single-family residences, large commercial establishments, and small communities. Sand filters are frequently used to pretreat septic tank effluent prior to subsurface infiltration onsite where the soil has insufficient unsaturated depth above ground water or bedrock to achieve adequate treatment. They are also used to meet water quality requirements (with the possible exception of fecal coli form removal) before direct discharge to surface water. Sand filters are used primarily to treat domestic wastewater,

2.15.3 COSTS

Costs of the feasible alternatives should be arrayed based on the *total cost* of each alternative. Total costs include both the capital costs incurred in planning, designing, and constructing the system and the long-term costs associated with maintaining the system over its design life (20 to 30 years in most cases); This method of cost analysis is an equitable method of comparing alternatives with higher capital costs but lower annual operating costs to other alternatives with lower capital costs but higher annual operating costs. Often, owners are deceived by systems with lower capital costs. These systems might have much higher annual operating costs, a shorter design life, and possibly higher replacement costs, resulting in much higher total costs. Systems with higher capital costs might have lower total costs because the recurring operation and maintenance costs are less. Choosing between alternatives with varying total cost options is a financing decision. In some cases, capital budgets are tighter than operating budgets. Therefore, this is a decision the prospective owner must make based on available financing options.

2.15.4 RELIABILITY

The reliability of the proposed system and the risk so the owner, the public, and the environment if malfunctions or failures occur must be considered. Potential risks include public health and environmental risks, property image, personal injury, medical expenses, fines, and penalties. Where these or other potential risks are significant, contingency plans should be developed to manage the risks. Contingencies include storage, pump and haul (holding tank), redundant components, reserve capacity, and designation of areas for repair or replacement components (e.g., replacement leach field). These come at additional cost, so their benefit must be weighed against the potential risks.

2.16 WITH WASTE STABILIZATION PONDS

Waste Stabilization Ponds(WSP) are shallow man-made ponds into which sewage flows and from which after a retention time of several days a well-treated effluent is discharged. The oxygen requirement for the bacteria is obtained through the mutualistic relation between the pond algae and the pond bacteria. During the presence of sum light during the photosynthetic process the algae provide oxygen to the bacteria and bacteria provide the carbon dioxide required by the algae.WSP can be neither single pond or a series of ponds-anaerobic, facultative and maturation.70-95% of BOD is removed in the pond system.

2.17 WITH ACTIVATED SLUDGE PROCESS

The activated sludge process was developed around 1913-1914 by Ardern and Lockett. The activated sludge process was so named because it involved the production of an activated mass of microorganisms (bacteria, fungi, protozoa, rotifers and nematodes.) capable of stabilizing a wastewater under aerobic conditions. Bacteria actually degrade the organic waste in the influent. In the aeration tank, contact time is provided for mixing and aerating the influent wastewater with the microbial suspension, generally referred to as the mixed liquor suspended solids (MLSS) or mixed liquor volatile suspended solids (MLVSS). It is a measure of the active biological mass in the aeration tank. The term **mixed liquor** implies a mixture of activated sludge and wastewater. The fraction of the suspended matter that volatilizes at 55°c is taken to be a measure of active biomass. The MLVSS commonly is taken to be 75to 80 percent of total mixed liquor suspended solids (MLSS).

Mechanical equipment is used to provide the mixing and transfer of oxygen into the process. The mixed liquor then flows to a clarifier where the microbial suspension is settled and thickened. The settled biomass, described as Activated sludge because of the presence of active microorganisms, is returned to the aeration tank to continue biodegradation of the influent organic material. A portion of the thickened solids is removed daily or periodically as the process produces excess biomass that would accumulate along with the non biodegradable solids contained in the influent wastewater. If the accumulated solids are not removed, they will eventually find their way t the system effluent.

An important feature of the activated sludge process is the formation of floc particles, ranging in size from 50 to 200 micrometer, which can be removed by gravity settling, leaving relatively clear liquor as the treated effluent.

2.18 WITH UPFLOW ANAEROBIC SLUDGE BLANKET

The Up flow Anaerobic Sludge Blanket Reactor(UASB), maintains a high concentration of biomass through formation of highly settle able microbial aggregates. The wastewater flows upwards through a layer of sludge. At the top of the reactor phase separation between gas-solid-liquid takes place. Any biomass leaving the reaction zone is directly recirculated from the settling zone. The process is suitable for both soluble wastes and those containing particulate matter. The process has been used for treatment of municipal wastewater at few locations and hence limited performance data and experience is available presently.

2.19 WITH SEQUENCING BATCH REACTOR

The Sequencing Batch Reactor(SBR) process utilizes a fill-and –draw reactor with complete mixing during the batch reaction step(after filling) and where the subsequent steps of aeration and clarification occur in the same tank. All SBR systems have five steps in common, which are carried out in sequence as follows;

- Fill
- React(aeration)
- Settle(sedimentation/clarification)
- Draw(decant)
- Idle

During the fill and react phase , the waste is aerated in the same fashion as an activated sludge unit. After the react phase , the Mixed Liquor Suspended Solids(MLSS) are allowed to settle. The treated supernatant is discharged during the draw phase. The idle stage, the time between the draw and fill, may be zero or may be a few days depending on wastewater flow demand.

PERFORMANCE CHARACTERISTICS OF THE TECHNOLOGIES

Item	WSP	UASB	ASP	SBR
BOD removal%	75-85	75-85	85-92	98
Nutrient Removal, %N	40-50	-	30-40	-
Nutrient Removal, %P	20-60	-	30-45	-
Coliform Removal, %	60-99.9	99.99	99.99 after chlorination	9.99 after chlorination
Land requirement, (ha per MLD)	1.00	0.225	0.11	0.033
Power requirement,(HP per MLD)	2.5	3.25	11	9
Sludge handling	Manual desilting once in 5-10 years	Directly dry on sludge drying beds or mechanical devices	First digest then dry on sludge drying beds or mechanical devices	Mechanical devices
Equipment requirement(except screening and grit removal which are require for all cases)	Nil	Nil(except gas collection and flaring; gas conversion to electricity is optional	Aerators, Recycle pumps, capers, Thickeners, Digestors,driers, Gas equipment	Aerators,PLC, Decanters, sludge pumps
Operational characteristics	Simplest	Simpler than ASP	Skilled operation is required	More skilled Personnel required

TECHNOLOGY / PROCESS COMPARISON

Description	WSP	UASB	ASP	SBR
Type of process	Aerobic suspended growth	Anaerobic suspended growth process	Aerobic suspended growth process	Aerobic suspended growth process
Principle of operation	Organic matter converted to new cell mass by natural process with the aid of sunlight algal growth photosynthesis	Organic matter is reduced by anaerobic bacteria present in the sludge	The organic matter is brought in contact with bacteria in suspension	Filling ,aeration, Settling and decanting carried out in a single or more tank in batches
Mode of oxygen supply	No external supply of oxygen is required	No oxygen supply is required	Oxygen is supplied by surface aerators	Oxygen is supplied by blowers through diffusers
Sludge recirculation in the reactor	Nor required	Not required	Sludge recirculation is necessary to maintain MLSS in aeration tank	Optional
Process variables	No monitoring natural process depends on temperature wind	Volatile fatty acids, sludge blanket levels,alkalinity,pH must be checked on daily basis	MLSS,SVI,F/M Ratio must be monitored sludge recycle and wastage should be controlled regularly	Oxygen requirement

Description	WSP	UASB	ASP	SBR
Cost for installation	Less, easy construction	Medium	Higher than UASB	High
Annual maintenance	Less, easy to maintain, skilled personnel not required	Slightly higher than WSP requires skilled personnel	High, requires technical and skilled personnel	Very high, high technical & skilled personnel required
Area requirement	Large area is required	Moderately large area required	Medium area	Small area
Power requirement	No power	Almost negligible power	Large power required	Large power requirement for aeration. Also power optimization
Total coliform content in treated sewage	10^4-10^5 MPN/100ml	10^4-10^5 MPN/100ml	10^4-10^5 MPN/100ml	10^3-10^4 MPN/100ml
Effluent quality	Meets the standard	Meets the standard	Very good quality	Best quality
Sludge production	Less	Medium	More	Medium
Methane production	Methane recovery is possible but no reference in India	Yes	Yes	No methane recovery

2.20 TREATMENT SYSTEM SELECTION

Failures occur for a reason. The reason for failure should be determined before corrective actions are implemented; if not, failures can recur. The diagnostic procedure should be comprehensive, but based on deductive reasoning to avoid excessive testing and data gathering . Another example of a failure diagnosis, *Failure Analysis Chart for Troubleshooting Septic Systems* (FACTS). In addition to specific design boundary failures, failures can be caused by system age. Tanks and pipes buried in the ground begin to deteriorate after 20 or more years of use and may require repair or replacement. In addition, the treatment capabilities of soils below infiltration fields that have been in use for several decades might not be adequate for continued use. Years of treatment use can cause the interstitial spaces between soil particles to become filled with contaminants (e.g., TSS, precipitates, and biomass). Soil structure can also be affected after many years of use. Finally, changes in design and construction practices in the past 25 years have led to marked improvements in system performance and treatment capacity. These issues make consideration of system age a vital component of the overall failure investigation.

2.21 SUSTAINABILITY OF ANY PROJECT.

Special attention has to be given to the selection of appropriate technology either participatory approach. Appropriate technology must be:

- Cost-effective technology that provides adequate treatment
- Affordable in capital cost and operation and maintenance.
- Operable at a reasonable cost and with locally available labour.
- Reliable enough to consistently meet effluent quality requirements.

All the stake holders should be actively involved from the project formulation stage and technology selection process. Such a selection should be based on knowledge of capital investment, land requirement, energy consumption, treatment efficiency and reliability and operation and maintenance cost of different technological options used for treatment of wastewater.

2.22 CHOICE OF A TREATMENT SYSTEM

The choice of a treatment system depends on various other factors which can be grouped under three key words;

- Affordability
- Acceptability
- manageability

2.22.1 AFFORDABILITY

Affordability depends on the financial ability of the community to be served and the requirement of the process in terms of power and land requirements.

2.22.2 ACCEPTABILITY

Acceptability mainly depends on performance of the system. The acceptability generally depends on two groups of individuals:

1. The pollution control authorities who have to approve the treatment method proposal
2. The riparian public who have to live near the treatment facility.

2.22.3 MANAGEABILITY

This refers to both routine operations of the plant and its maintenance and repairs when needed.

2.23 FACTORS IN SELECTION AND DESIGN OF SEWAGE TREATMENT SYSTEM

The most important factors that should be borne in the mind before the selection and design of any sewage/wastewater treatment system are:(Sulabh Envis Newsletter,2007)

2.23.1 ENGINEERING FACTORS

- Design period, stage wise population to be served and expected sewage flow and fluctuations.
- Topography of the area to be served, its slope and terrain; tentative sites available for treatment plant, pumping stations and disposal works.
- Available hydraulic head in the system up to high flood level in case of disposal into a river or high tide level in case of coastal discharges.
- Groundwater depth and its seasonal fluctuations affecting construction, sewer infiltration.
- Soil bearing capacity and type of strata to be met in constructions
- On site disposal facilities, including the possibilities of segregating sullage and sewage
- And reuse or recycling of sullage water within the households.

2.23.2 ENVIRONMENTAL FACTORS

- Surface water, ground water and costal water quality where wastewater have to be disposed after treatment
- Odour and mosquito nuisance which affects land valves, public health and well being.
- Public health considerations by meeting the requirements laid down by the regularity agencies for effluent discharge standards, permissible levels of microbial and helminthic quality requirements and control of nutrients, toxic and accumulative substances in food chain.

2.23.3 PROCESS CONSIDERATIONS:

- Waste water flow and characteristics.
- Degree of treatment required.
- Performance characteristics.
- Availability of land, power requirements, equipments and skilled staff for handling and maintenance.

2.23.4 COST CONSIDERATIONS

- Capital costs for land, construction, equipments etc.
- Operating costs including staff, chemicals, fuels and electricity, transport, maintenance and repairs etc.

"Appropriate technology" can be defined as the technology that is affordable and operable by the user and that reliably provides the requirement treatment. Other criteria are that the technology be financially sustainable by the local community and use a holistic approach. "Sustainability and Waste water treatment" looks at wastewater treatment with a focus on environmental and cost appropriateness.

Choosing technologies for domestic waste disposal is a complex process involving many factors. To arrive at an appropriate technology for given community the cost-effective technology that provides adequate treatment and that the local community has the finances and skilled labour force to operate and maintain. Selecting the most appropriate technology for a given community requires an analysis for each community based on local factors and needs. The main factors in choosing a domestic wastewater treatment technology are water availability, presence of a collection system, housing or population density, availability of skilled management and operating personnel, land availability, availability and cost of power, receiving water requirements, hydrologic conditions and climate, and availability of opportunities for effluent reuse.

2.24 ECONOMICS OF TREATMENT TECHNOLOGIES/ METHODOLOGY FOR SELECTION

The following financial management tools are used for comparing the costs of various Sewage Treatment Technologies using net present value (NPV), internal rate of return(IRR), and benefit-cost ratio(BCR) calculations.

2.24.1 Annual Cash Flow Projections

Cash flows are the expenditures made and revenues received during the lifetime of a technology,\. By computing annual expenditures and revenues, a year-by-year cash flow projection is established.

2.24.2 Net Present Value or Present worth Method

This method uses compound interest factors to compound or discount all cash flows. Sewage Treatment technologies are then ranked by comparing the equivalent values at time zero of each alternative using the same interest rate and equipment lifetime. Net present value (NPV) is calculated as the difference between benefits and the discounted costs. The technology with the highest present worth is the best technology from an economic standpoint.

2.24.3 Capitalist Cost or Life Cycle Cost Method

In this method, the present worth of a technology assuming an infinite life is compound, i.e., the capitalized cost is the initial cost plus the present value of an infinitely lived technology. The technology with the lowest capitalized cost is the best technology from an economic standpoint.

2.24.4 Internal rate of return

The internal rate of return(IRR) is the discount rate which equalizes the present values of costs/expenditures and revenues, i.e., the value at which the NPV=0

2.24.5 Return on Investment Method

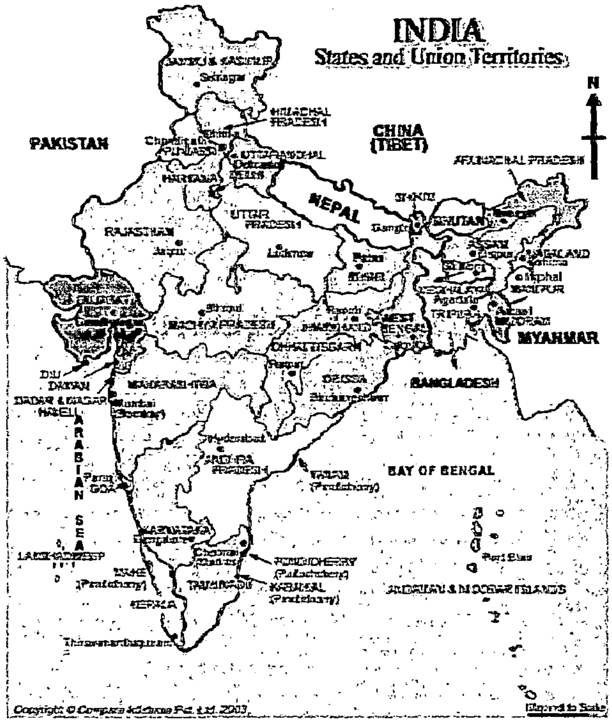
The return on investment (ROI) is the ratio of annual profits to original investment. This may be used to compare the savings from Sewage Treatment technologies in relation to unknown costs. This method does not account for the time value of money and other factors. The technology with the highest ROI is the best technology from an economic standpoint

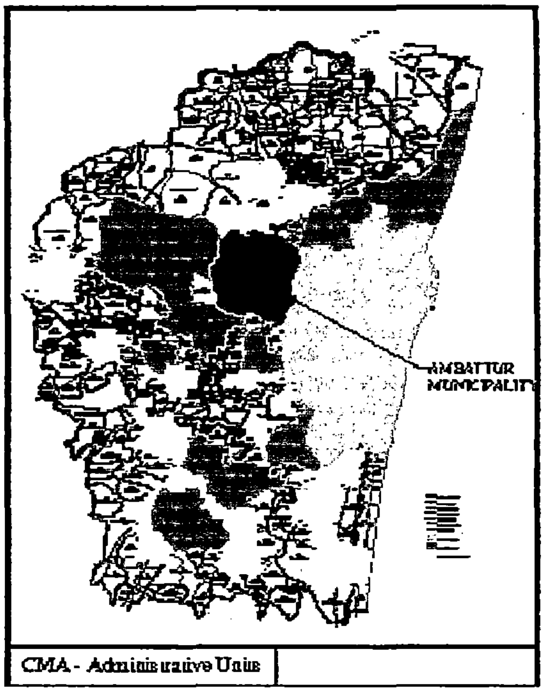
2.24.6 Benefit cost ratio

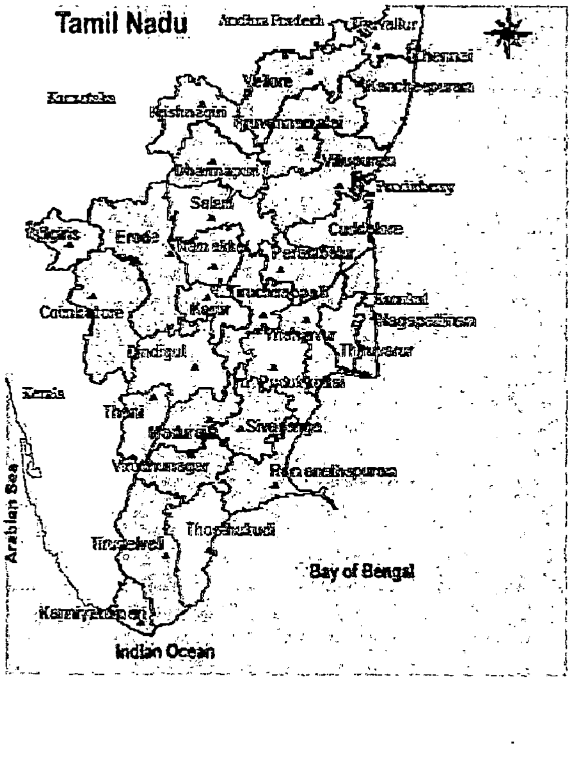
It is the ratio of the total present value of benefits to the total present value of expenditures of any project. It should be greater than one. The benefit cost ratio (BCR) is calculated as:

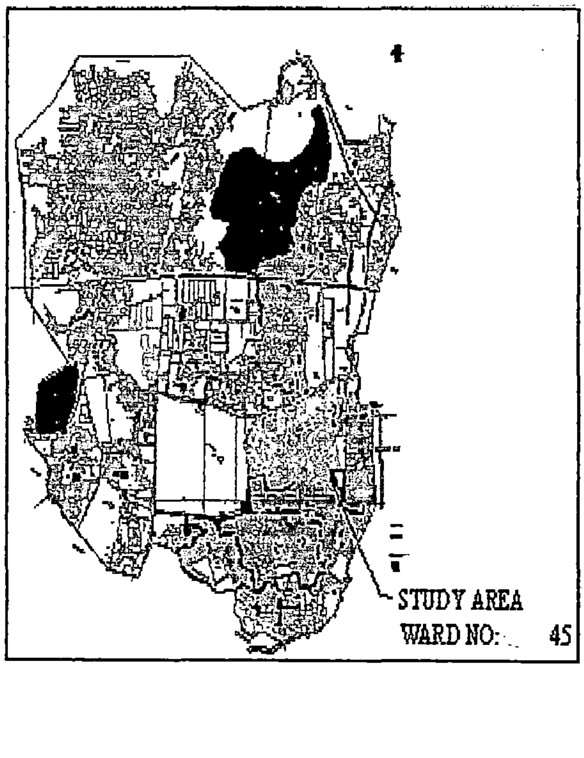
$$BCR = \frac{\text{Present value of benefits}}{\text{Present value of expenditures}}$$

The technology with higher the Benefit cost ratio is the best technology from an economic standpoint.


INDIA
States and Union Territories
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
MYANMAR
BANGLADESH
BAY OF BENGAL
ARABIAN SEA


AMBATTUR MUNICPALITY
CMA - Administrative Units


Tamil Nadu
Andhra Pradesh
Karnataka
Kerala
Vellore
Salem
Erode
Coimbatore
Dindigul
Theni
Cuddalore
Arabian Sea
Bay of Bengal
Indian Ocean


STUDY AREA
WARD NO: 45

COST CALCULATIONS

Land Area required;

Land required for SBR	= (55×25) – (7×5)	= 1340 m^2
Land required for ISF	= 60 × 50	= 3000 m^2
Land required for WSP	= (80 × 86.5) – (22 × 38)	= 6084 m^2
Land required for MASP	= 50 × 40	= 2000 m^2

Land cost;

Cost of land (1m^2)	= Rs.15000	
Land cost for SBR	= 1340 × 15000	= 201.00 lakhs
Land cost for ISF	= 3000 × 15000	= 450.00 lakhs
Land cost for WSP	= 6084 × 15000	= 912.60 lakhs
Land cost for MASP	= 2000 × 15000	= 300.00 lakhs

Energy cost for SBR;

Energy required for 3 HP pump (1No)	= 3 × 0.746 × 12	= 26.86 kW
Energy required for Blower	= 15 × 4 × 2	= 120.00kW
Energy required for effluent pump	= 10 × 0.746 × 2	= 14.92 kW
Energy required for sludge disposal	= 1 ×0.746 × 2	= 1.49 kW
Energy required for lighting	= 0.240× 12	= 2.88 kW
Total Energy required for SBR (1 day)		= 166.15kW
Current Energy cost for 1 kW		= Rs.3.5
Energy cost for 1 year	= 166.15×365×3.5	= Rs.2.12 lakhs

Energy cost for ISF;

Energy required for 3 HP pumps(2 Nos)	= 2×3×0.746×24	= 107.42 kW
Energy required for lighting		= 2.88 kW
Total Energy required for ISF (1 day)		= 110.3 kW
Current Energy cost for 1 kW		= Rs.3.5
Energy cost for 1 year	= 110.3×365×3.5	= Rs 1.409 lakhs

Energy cost for WSP;

Energy required for 1 HP pump(2 Nos)	= 2×1×0.746 ×24	= 35.81kW
Energy required for lighting		= 2.88 kW
Total Energy required for WSP (1 day)		= 38.69 kW
Current Energy cost for 1 kW		= Rs.3.5
Energy cost for 1 year	= 38.69×365×3.5	= Rs.0.494 lakhs

Energy cost for MASP;

Energy required for 25HP pump	= 25×0.746×24	= 447.6 kW
Energy required for 5HP pump	= 5×0.746×20	= 74.6 kW
Energy required for 15 HP pump	= 15×0.746×4	= 44.76kW
Lighting etc.,	=16x60x12/1000	=11.52 kW
Total Energy required for MASP (1 day)		= 578.48kW
Energy cost for 1 year	= 578.48×365×3.5	= Rs.2.11 lakhs

BACKGROUND OF THE STUDY AREA

3.1 STUDY AREA

The study area here selected is ward number 45 of "Ambattur" Municipality which is one among the 16 municipalities in Chennai Metropolitan Area (CMA) located in Thiruvellore District. Ambattur is designated as special grade Municipality and lies north of Chennai with an extent of 40.36 sq.km, bearing 52 numbers of wards and 2526 number of streets to the total length of 554.64 KM housing 70212 numbers of buildings of which 63991 residential building 1610 industrial building 4570 commercial and 41 institutions. This municipality itself possessing 75 own buildings. Ambattur is famous for its Industrial area.

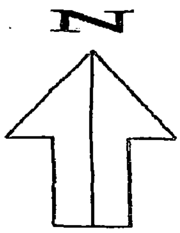
3.1.1 LOCATION

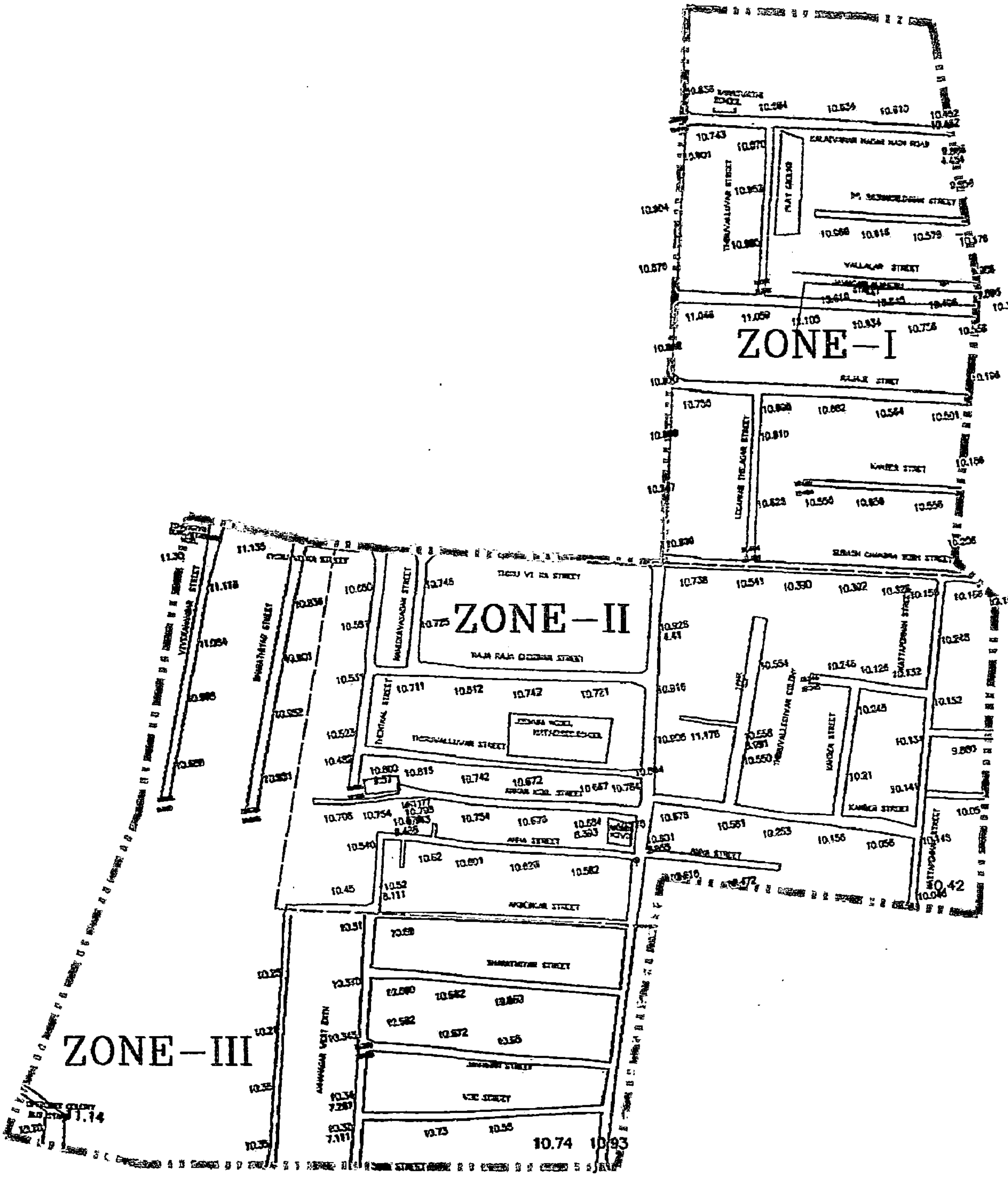
The terrain of the Municipality has a gentle slope west to east ranging from +5.82m to +18m (MSL). On the North, the Municipality is bounded by Madavaram Municipality, on the East Chennai City and in the South by Nolambur and Nerkundram Village Panchayat and in the west by Thiruverkadu Municipality and Avadi Municipality. There are two lakes namely Korattur Eri and Ambattur Lake within the Municipality. RedHills lake also forms part of this Local Body.

3.1.2 DETAILS OF STUDY AREA

Of the 52 wards, 13 wards are falls under unsewered area. From the unsewered 13 wards, ward number 45 has been selected as study area since this area is very adjacent to Chennai City, apart from that, Chennai Metropolitan Water Supply and Sewerage Board(which is responsible to promote or secure the planned development, efficient operation, maintenance and effective regulation of water supply and sewerage systems in the Chennai Metropolitan

MAP SHOWING THE WARD–45
OF AMBATTUR MUNICIPALITY AREA





Area.) maintain this area for water supply. The area is low lying area and almost well developed, the provision of sewer system is must inorder to upkeep the environment safe and sustainability.

The area is a mixture of residential, markets and industrial sector having 39 streets to the total length Of 8273 meters with population of 5047 as per 2001 census.Of the 5047 population 2571 are male & 2476 female and the projected population is worked out to 10700. It does not possess sewerage system.

3.1.3 SOIL

Generally it is observed that the top soil upto 1.5 m is browny silty sand further clay mixed with sand and clay upto 3m. From 3m to 6m it is found to be fine to medium sand and in some locations black soft clay / loose silty clay.

3.1.4 ECONOMIC BASE

Ambattur is famous for Its Industrial area. Apart from Big and medium size Industrials like T.I Group, LOCAS- TVS Group Industries, BRITANIA food Industries, SIDCO Industries also there. People living in this area are Working and Business oriented. Production, Products Selling, Exporting are good revenue to this Ambattur Municipality.

3.1.5 WATER SUPPLY

The ward water supply is being maintained by Chennai Metropolitan Water Supply and Sewerage Board (which is responsible to promote or secure the planned development, efficient operation, maintenance and effective regulation of water supply and sewerage systems in the Chennai Metropolitan Area.), Water is being supplied to this Ward at the rate of 110 lpcd.

3.2 NEED OF SEWERAGE SYSTEM

The area has not been provided with sewerage system.People are very eager in Sewerage system and willing to contribute the amount, for providing Sewerage facilities to their areas. Since the area has been developed to its capacity and the area is low lying and is not ease with economic cost to include the area into the Chennai City Sewerage net work. Hence the only solution to go for DEWAT system for upkeeping the area for hygienic at economic cost with sustainability.

3.3 POPULATION FORCAST AND SEWAGE GENERATION FOR WARD 45

From the town planning it has been obtained that the population decade growth is 30%.
As per 2001 Census records this ward population is 5047.
Base population that is present population (2008) is $5047+[0.7 \times (30/100) \times 5047] = 6107$
Projected Population at 2038 is $[3.7\times(30/100) \times 5047] + 5047 = 10649 \approx 10650$
Sewage generation is 80% of water supplied.
Water supply is 110 lpcd.
Accordingly **Sewage Generation** is **$0.9 \times 100 \times 10650 = 958500$ say 1mld.**

3.4 ZONING OF SEWERAGE SYSTEM

According to the nature of topography and the level, the Ward has been divided into three (3) Zones. The details of the Zones are given below.

3.4.1 DETAILS OF ZONE I

Zone I represents the Northern part of ward 45.This Zone contains 11streets to a total length of 3280m and 388 houses with a population of 1900.The full details of Zone I of ward 45 are shown in the table

All the houses in this Zone already have septic tank without dispersion trenches.Hence frequent removal of waste water is being carried out by mobile sewage lorries. There is also frequent occurring of water pollution and local wells are also polluted. Hence for safe and hygienic with sustainable environment, this Zone must be provided sewerage system. At present this ward could not be connected to the Chennai city sewerage network system provision of DEWAT system is finalized.

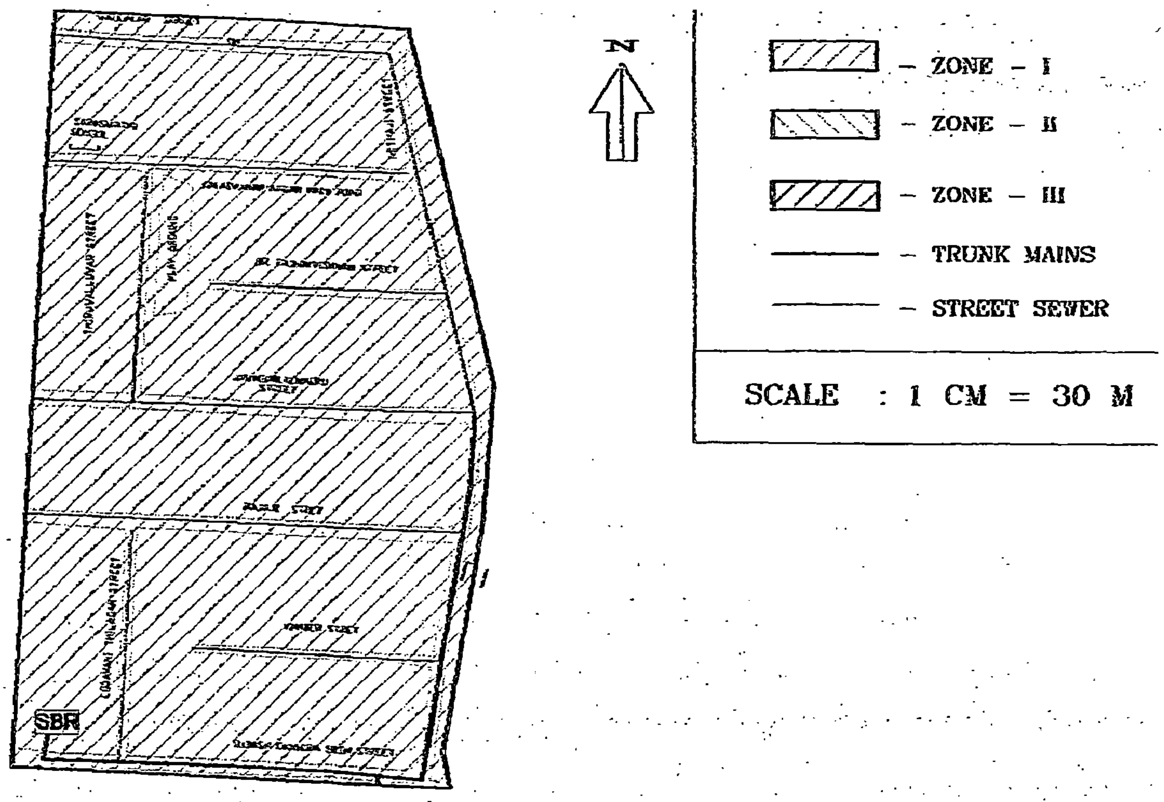
Among the DEWAT system, Septic Tank (ST) with Sequencing Batch Reactor (SBR) has been selected for treatment of waste water for this Zone. The details of sewage generation are worked out below.

3.4.1.1 Sewage Generation For Zone I

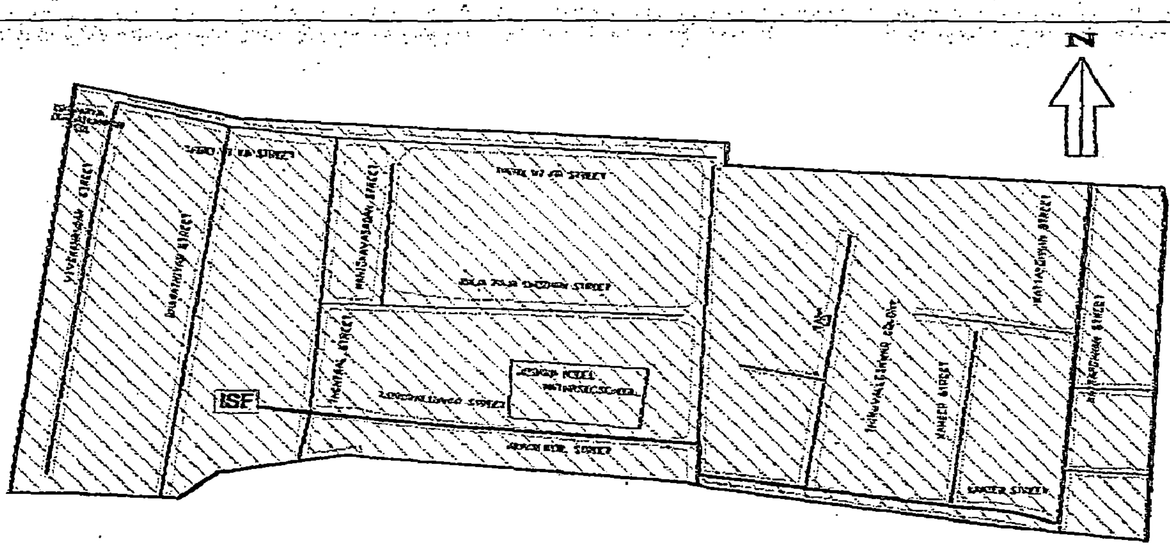
Population in the year 2001for Zone I	= 1900.	
Base population (2008)	= $(0.7\times0.3\times 1900)+1900$	= 2299
Projected population (2038)	$=(3.7\times0.3\times1900)+1900$	= 4009
Sewage Generation	$= 0.9\times100\times4009$	= 360810 ≈3.61 lakh litres
		Say 4 lakh litres

Now designed for 4 lakh litres for easy of comparison of Techno Economic of DEWAT system.

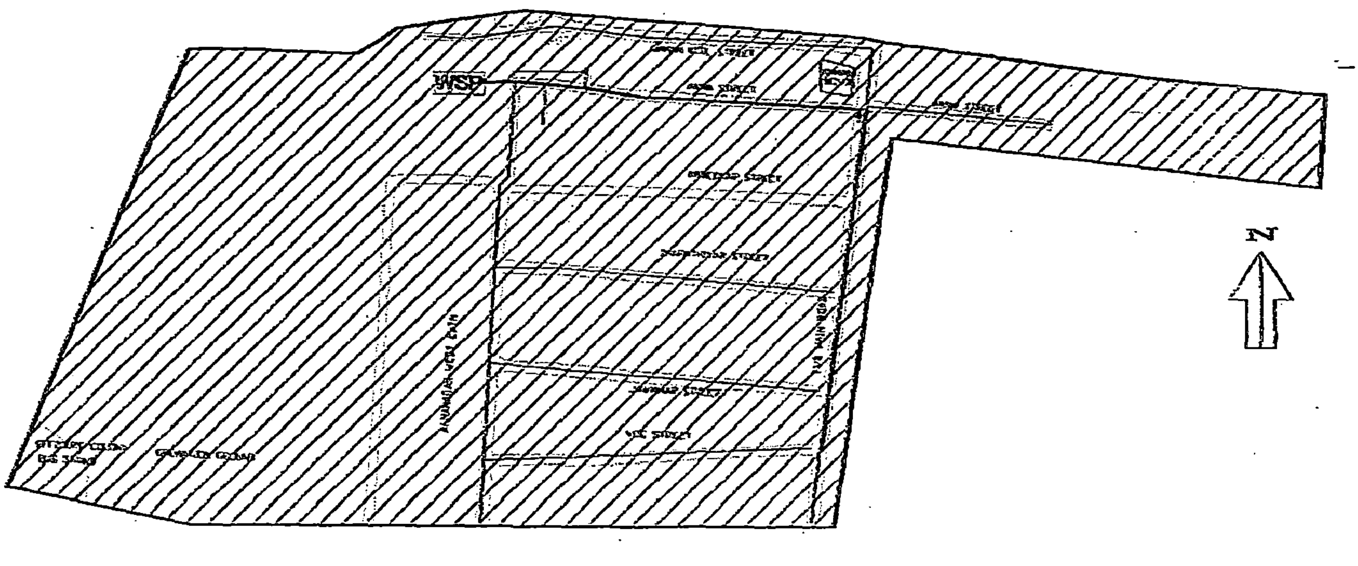
The collection and treatment unit location for this Zone is shown in the fig below:



ZONE-I



ZONE-II



ZONE-III

TITLE:

PROVIDING DEWAT SYSTEM TO

WARD No : 45 OF AMBATTUR MUNICIPALITY

Table 3.1 The collection and treatment unit location for Zone I

S.No	Name of the street	Nature of Road	Road		No of Houses	Population
			Length (m)	Width (m)		
1	Magathma Gandhi Main Road	BT	850	6	140	700
2	V.O.C Street	BT	250	5	18	90
3	Sardar Patel Street	BT	155	5	20	100
4	Thiruvalluvar street	BT	160	4	15	75
5	Dr.Radhakrishnan Street	BT	190	4	14	70
6	Jawaharlal Nehru Street	BT	210	5	32	160
7	Rajaji Street	BT	230	5	31	115
8	Thilagar Street	BT	195	4	17	85
9	Kamber Street	BT	350	4	16	80
10	Nethaji Street	BT	280	5	31	155
11	Kamarajar Street	BT	410	5	54	270
		Total	**3280**		**388**	**1900**

3.4.2 DETAILS OF ZONE II

Zone II represents the central part of ward 45.This Zone contains 17streets to a total length of 3240m and 355 houses with a population of 2068.The full details of Zone II of ward 45 are shown in the table

As in the Zone I, all the houses in this Zone II too have septic tank without dispersion trenches.Hence frequent removal of waste water is being carried out by mobile sewage lorries. There is also frequent occurring of water pollution and local wells are also polluted. Hence for safe and hygienic with sustainable environment, this Zone must be provided sewerage system. At present this ward could not be connected to the Chennai city sewerage network system provision of DEWAT system is finalized.

Among the DEWAT system ,Septic Tank(ST) with Intermittent Sand Filter (ISF) has been selected for treatment of waste water for this Zone. The details of sewage generation is worked out below.

3.4.2.1 Sewage Generation For Zone II

Population in the year 2001for Zone II = 2068

Base population (2008) $= (0.7\times0.3\times2068) + 2068 = 2502$

Projected population (2038) $= (3.7\times0.3\times2068) + 2068 = 4364$

Sewage generation $= 0.9\times100\times4364 = 392760 \approx 4$ lakh litres

The collection and treatment unit location for this Zone is shown in the fig below

The Flow Chart for the Zone II treatment is shown below

Table 3.2 The collection and treatment unit location for Zone II

S.No	Name of the Street	Nature of Road	Road		No of Houses	Population
			Length (m)	Width (m)		
1	Kattabomman Street	BT	260	4	16	80
2	Tr-Vi-Ka Street	BT	190	5	24	120
3	Rajendra Prasad Street	BT	220	5	22	110
4	Manickavasagar Street	BT	260	5	20	100
5	Rajarajacholan Street	BT	250	5	24	120
6	Vivekanandhar Street	BT	180	3	16	80
7	Thiruvalluvar Street	BT	220	4	22	110
8	Bharathiyar Street	WBM	190	4	21	120
9	Vasantham Street	WBM	185	5	16	120
10	Thendral Street	WBM	260	5	43	315
11	Kurinji Street	WBM	195	5	20	125
12	Pillayar Koil Street	WBM	160	5	23	115
13	1 Cross Street	WBM	200	5	9	120
14	2nd Cross Street	WBM	90	5	6	96

15	3rd Cross Street	WBM	100	5	12	75
16	Mullai Street	WBM	180	5	25	142
17	Mullai 1st Street	WBM	100	5	16	120
		Total	**3240**		**335**	**2068**

3.4.3 DETAILS OF ZONE III

Zone III represents the Southern part of ward 45.This Zone contains 11streets to a total length of 1753m and 232 houses with a population of 1079.The full details of Zone III of ward 45 are shown in the table

Here also all the houses in this Zone already have septic tank without dispersion trenches. Hence frequent removal of waste water is being carried out by mobile sewage lorries. There is also frequent occurring of water pollution and local wells are also polluted. Hence for safe and hygienic with sustainable environment, this Zone must be provided sewerage system. At present this ward could not be connected to the Chennai city sewerage network system provision of DEWAT system is finalized.

Among the DEWAT system ,Septic Tank(ST) with Waste Stabilization Pond (WSP) has been selected for treatment of waste water for this Zone. The details of sewage generation is worked out below.

3.4.3.1 Sewage Generation For Zone III

Population in the year 2001for Zone III = 1079

Base population (2008) $= (0.7\times0.3\times1079) + 1079 = 1305$

Projected population (2038) $= (3.7\times0.3\times1079) + 1079 = 2277$

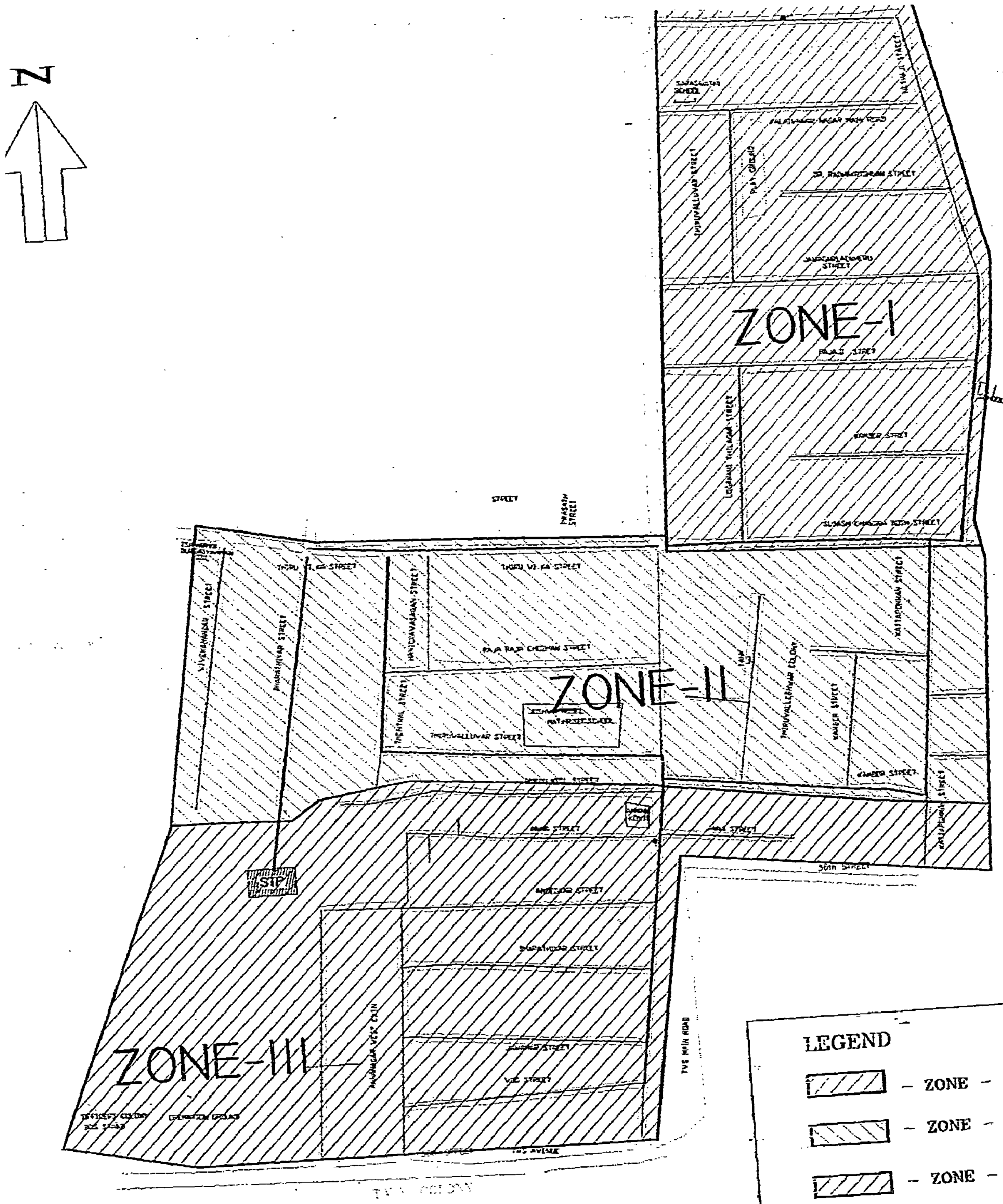
Sewage generation $= 0.9\times100\times2277 = 204930 \approx 2.0$ lakh litres

The collection and treatment unit location for this Zone is shown in the fig below

The Flow Chart for the Zone III treatment is shown below:

Table 3.3 The collection and treatment unit location for Zone III

S.No	Name of the Street	Nature of Road	Road		No of Houses	Population
			Length (m)	Width (m)		
1	Amman Koil Street	BT	190	5	22	105
2	Anna 1st Street	BT	133	4	12	60
3	Anna 2nd Street	BT	120	4	10	50
4	Ambedkar Street	BT	135	4	22	150
5	Jawahar Street	BT	230	4	24	104
6	V.O.C Street	BT	130	4	24	110
7	Gandhi Street	BT	180	4	14	70
8	Kumaran Nagar 1st Street	WBM	175	6	24	100
9	Kumaran Nagar 2nd Street	WBM	160	6	31	95
10	Kumaran Nagar 3rd Street	WBM	120	6	24	110
11	Kumaran Nagar 4th Street	WBM	180	6	25	125
		Total	**1753**		**232**	**1079**



LEGEND

- ZONE - I
- ZONE - II
- ZONE - III
- TRUNK MAINS
- MAIN SEWER
- STREET SEWER

SCALE : 1 CM = 30

TITLE:

PROVIDING DEWAT SYSTEM TO
WARD No : 45 OF AMBATTUR MUNICIPALITY

RESULT AND DISCUSSION

4.1 DATA COLLECTION AND ANALYSIS

Data collection is an important function for any work, based on which one can do further analysis from which good decision can be drawn.Hence intensive care has been taken in collecting the data from various authentic authorities.

4.1.1 DESIGN CRITERIA

For the selection and design criteria for any STPs, the following data's are very important and as such they have been collected from Ambattur Municipalities.

- Population
- Quantity of water supply and wastewater generation.
- Wastewater characteristics such as BOD, COD, TSS, TDS, Heavy water, Faecal coliform, Nitrate, Sulphate, etc.
- Quality of land
- Level of Treatment
- Effluent disposal to land or water bodies
- Drainage pattern and slope
- Wind direction
- Temperature
- Rainfall details
- Type of soil and geology
- Ground water Table level
- Climatic conditions
- Location details
- Industries

Most of the data are secondary in nature and obtained from the Municipality and other Government departments.

4.2 TECHNOLOGY FOR ANALYSIS

The following DEWATs have been considered and analyses were made among them along with Centralised treatment system also.

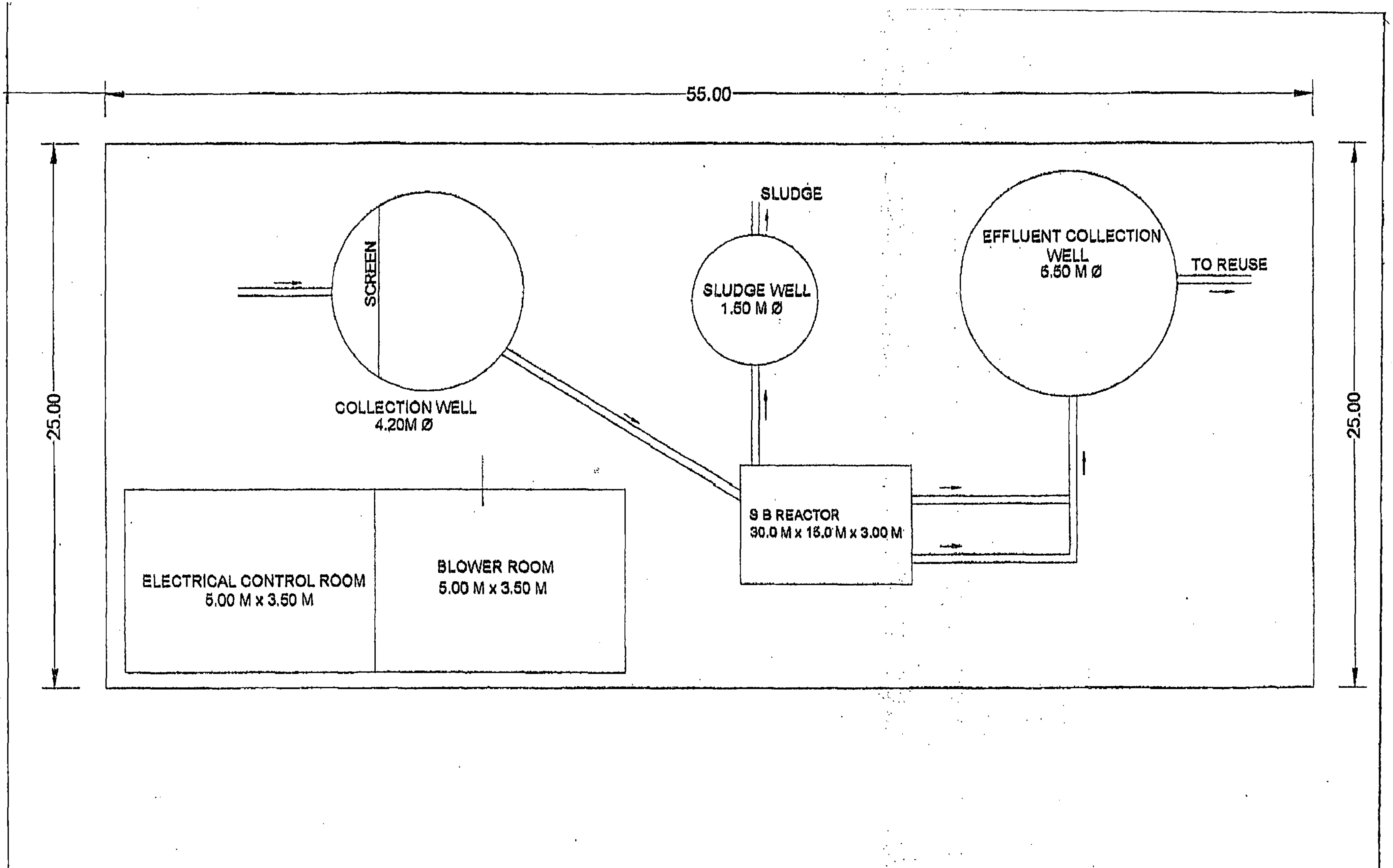
DEWATs considered

- For Zone I – SBR
- For Zone II – ISF
- For Zone III- WSP

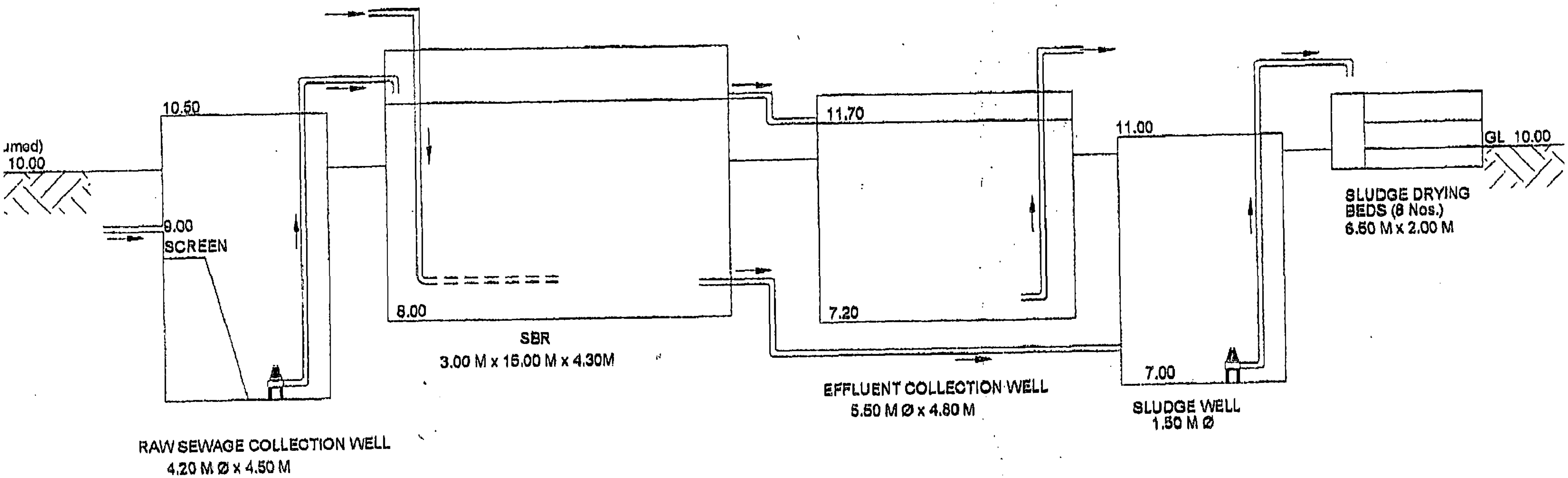
For centralized treatment system, Modified Activated Sludge Process (MASP) has been adopted.

Table 4.1 Performance Characteristics of the Technologies

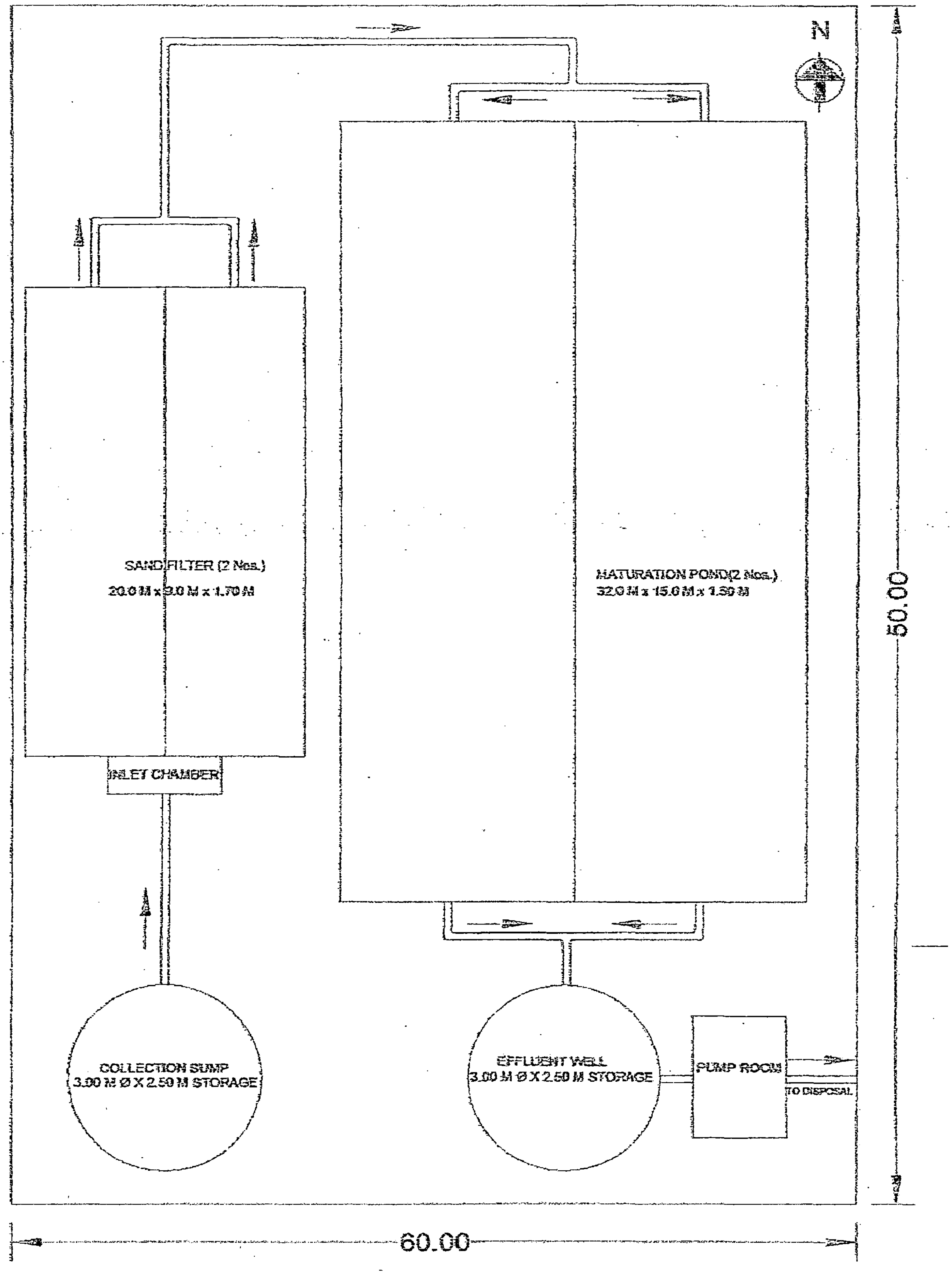
SI No	Description	SBR	ISF	WSP	MASP
1	BOD Removal %	96	93	92	92
2	Land Requirement, (hectare / 0.4mld)	0.134	0.300	0.880	0.200/mld
3	Power Requirement, (kW per 0.4 mld)	166.15	110.30	2.5	567.0
4	Operational Characteristics	More skilled personal required	Simple	Simplest	Skilled operation required



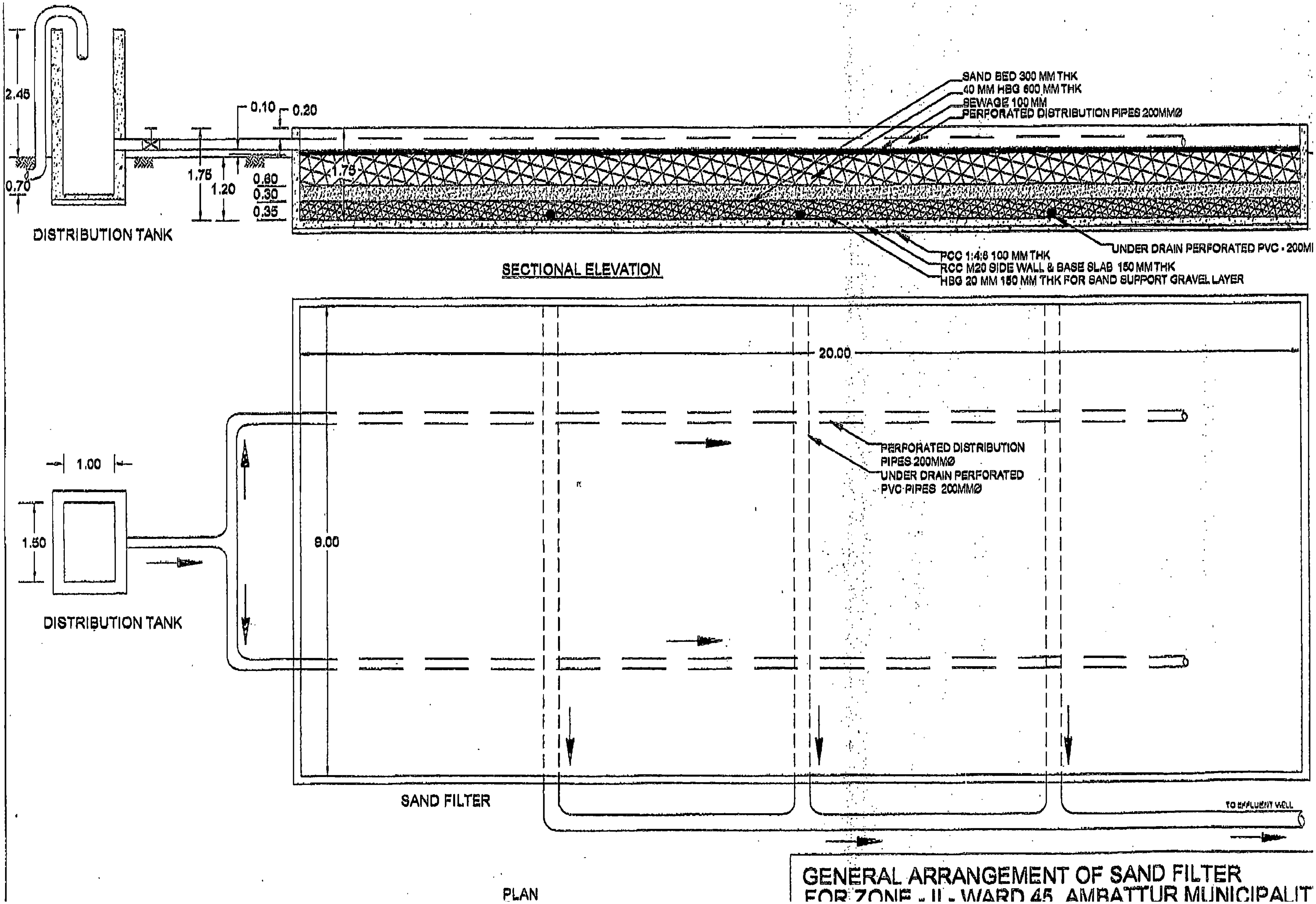
GENERAL ARRANGEMENT OF STP (SB REACTOR)
FOR ZONE - I - WARD 45, AMBATTUR MUNICIPALITY



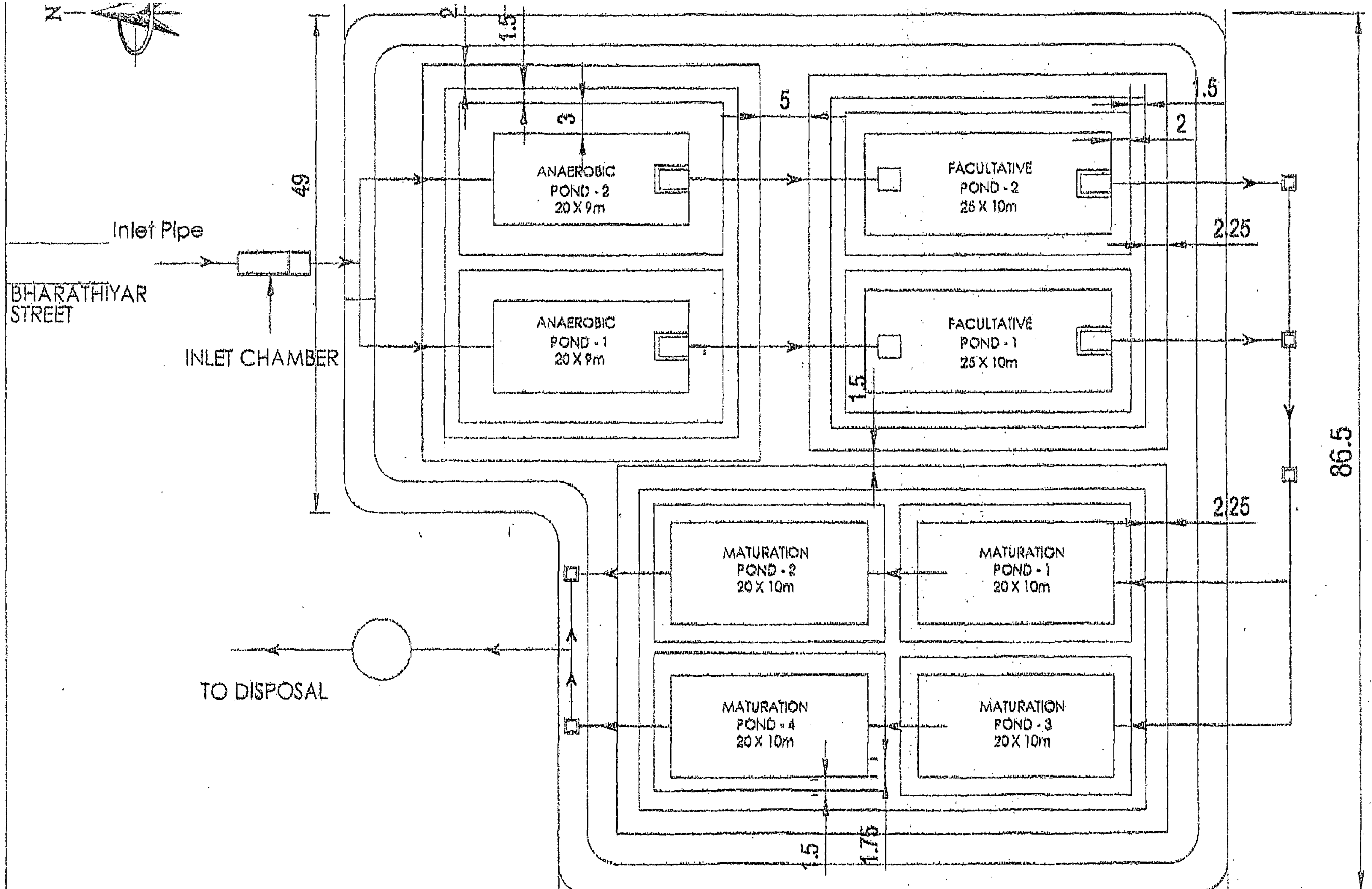
FLOW DIAGRAM OF SBR TREATMENT PLANT
FOR ZONE - I - WARD 45, AMBATTUR MUNICIPALITY



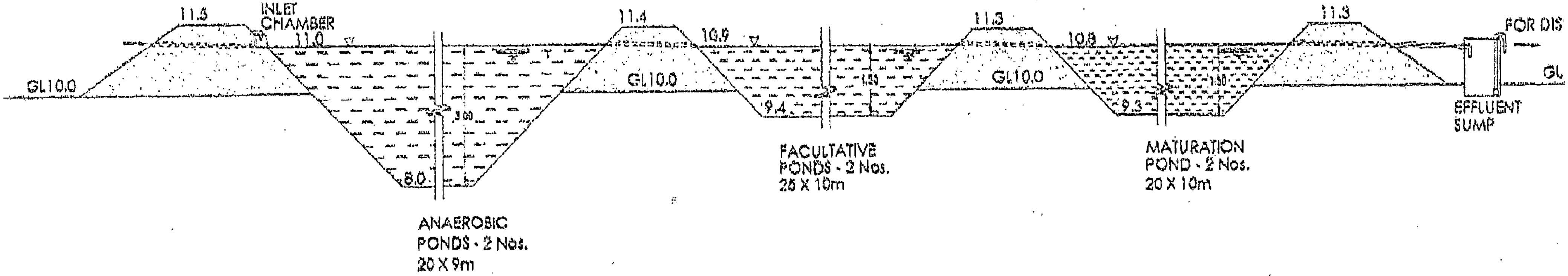
SCHEMATIC DIAGRAM OF SAND FILTER TREATMENT PLANT
FOR ZONE - II - WARD 45, AMBATTUR MUNICIPALITY.



GENERAL ARRANGEMENT OF SAND FILTER
FOR ZONE - II - WARD 45 AMBATTUR MUNICIPALIT



LAYOUT OF 0.2 Mld WASTE STABILISTAION POND
TREATMENT PLANT FOR WARD NO:45



FLOW DIAGRAM OF 0.2 Mld WASTE STABILISATION PON
FOR ZONE III , WARD NO:45
AMBATTUR MUNICIPALITY

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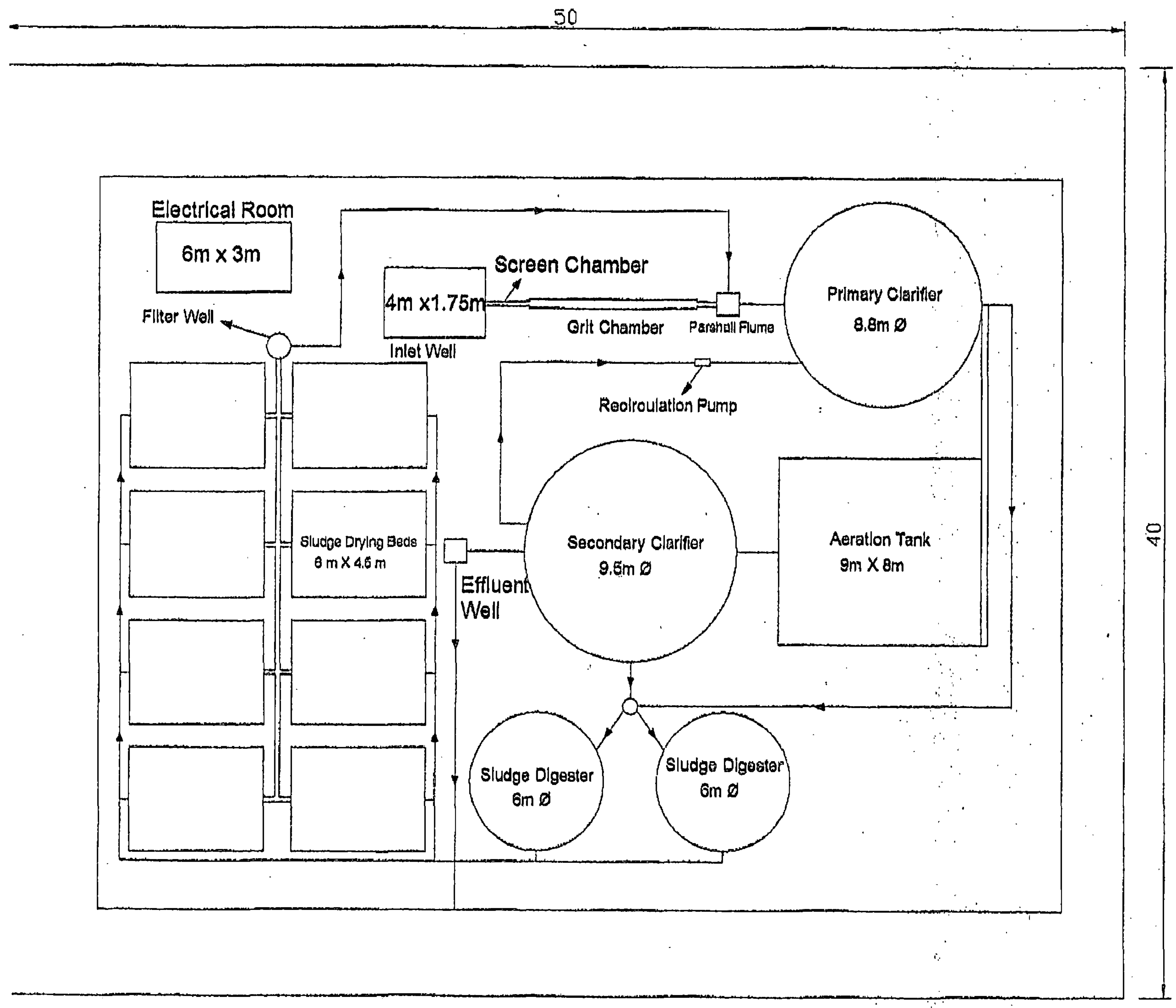
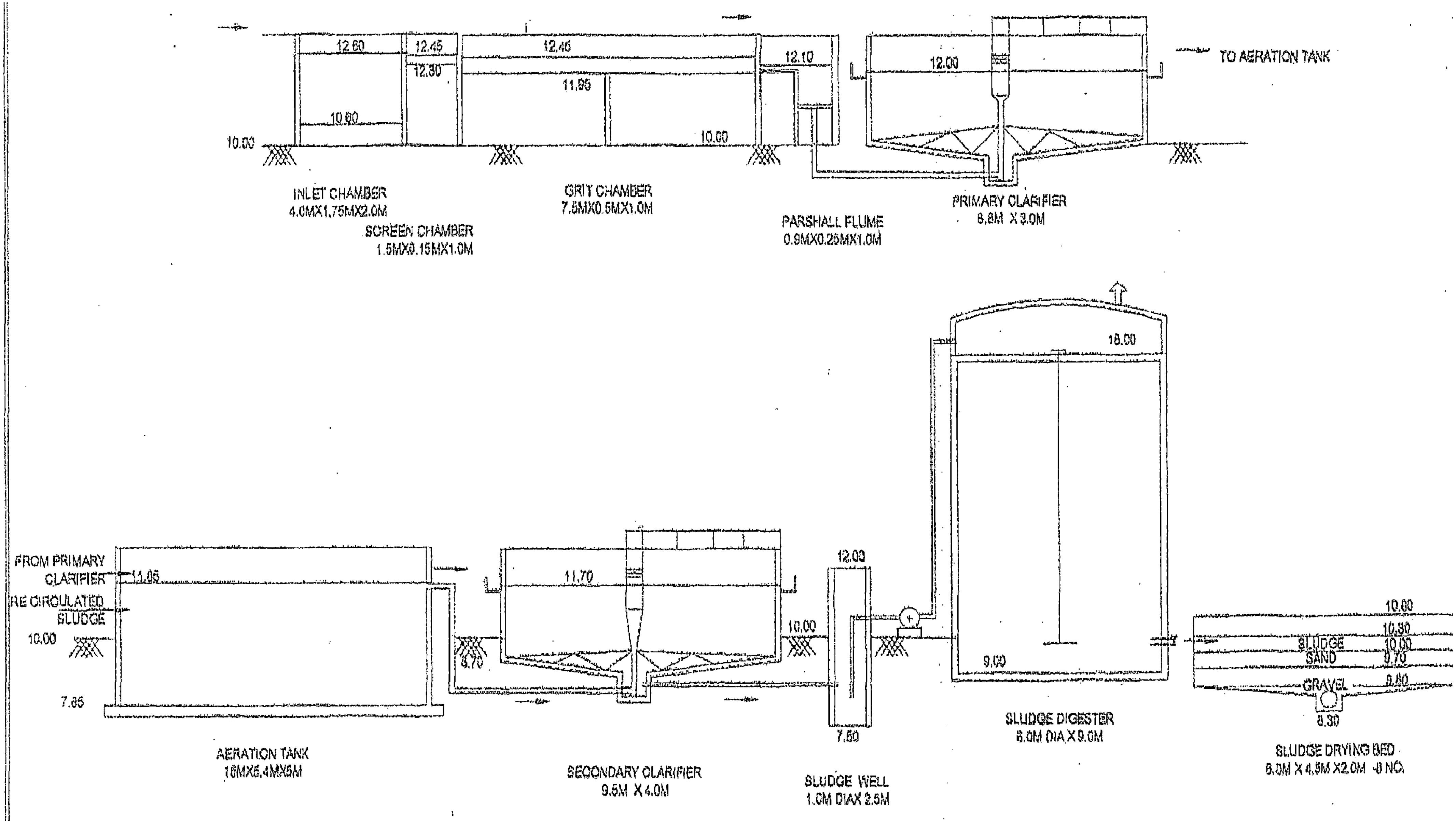


LAYOUT OF 1 Mld CAPACITY
MODIFIED ACTIVATED SLUDGE
TREATMENT PLANT FOR WARD NO:45
AMBATTUR MUNICIPALITY



FLOW DIAGRAM OF 1 MLD CAPACITY
MODIFIED ACTIVATED SLUDGE
TREATMENT PLANT FOR WARD NO:45
AMBATTUR MUNICIPALITY

Table 4.2 Technology Process Comparison

SI No	Description	SBR	ISF	WSP	MASP
1	Types of process	Aerobic suspended growth	Aerobic attached growth	Aerobic suspended growth process	Aerobic suspended growth
2	Peaceful of operation	Filling, aeration decanting and settling carried out in a single or more tank in batches	Organic matter is reduced by the fixed film biological Filter	Organic matter converted to new cell mass by natural process with the and of sunlight algal growth photo	The organic matter is brought in contact with bacteria in suspension
3	Mode of O_2 supply	O_2 is supplied by blowers through diffusers	No external supply of O_2 is required	No external supply of O_2 is required	O_2 is Supplied by surface aerator
4	Cost for installation	High	Slightly higher than WSP	Less,Easy construction	High
5	Annual Maintenance	Very high,High technical& skilled personnel required	Higher than the WSP, More skilled personnel not required	Less, easy to maintain,Skilled personnel not Required	High, Requires technical and skilled personnel required
6	Area Required	Small area required	Area required higher than the SBR,but lesser than WSP	Large area is required	Medium area
7	Power Requirement	Larger power Requirement for aeration. Also, power optimization	Less power	Less power	Large Power required

		is conducted by PLC			
8	Total Coliform content in treated sewage	-	-	99%	-
9	Effluent Quality	Very good quality	Good	Best	Very good quality
10	Expandability	Easy	Limited	Higher loads possible by producing aeration	Limited
11	Moving Parts	High	Nil	Nil	High
12	-	-	-	Less	Moderately sensible

4.3 LIFE CYCLE COST ANALYSIS

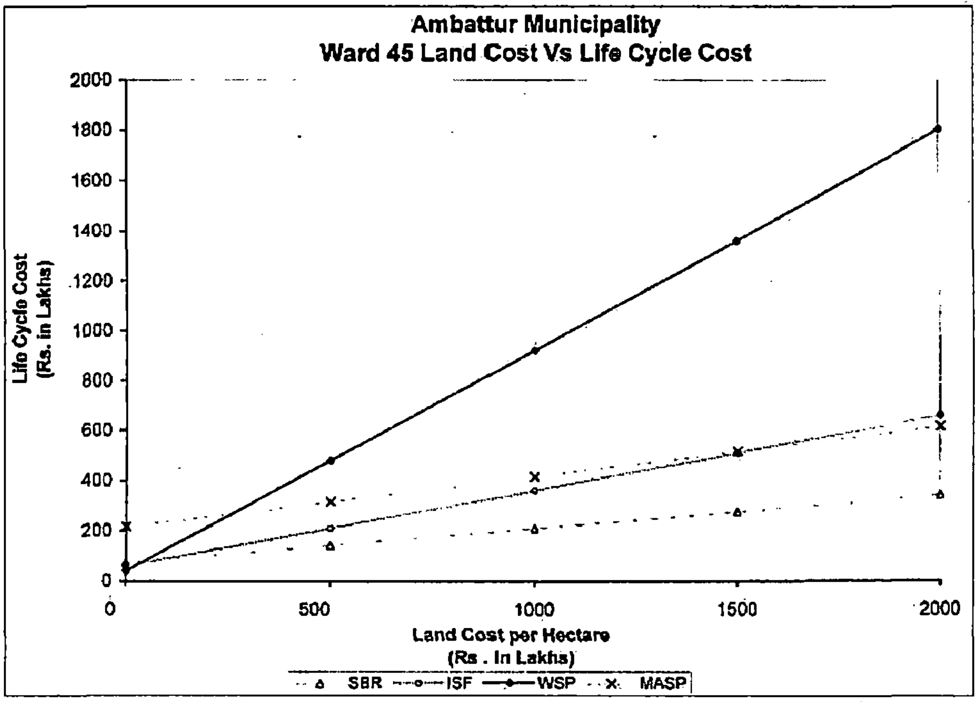
The design of DEWATs for each Zone as said above has been made. The estimate for each system has been prepared with current schedule of rate year 2008-09 of Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB), Tamilnadu water supply and Drainage Board (TWAD Board).The cost of construction for Zone I that is 0.4 mld capacity of SBR,for Zone II that is 0.4 mld capacity of ISF and for Zone III that is 2.0 mld capacity of WSP has been tabulated. For comparison purpose, separate construction cost for 0.4 mld WSP has been prepared. Since the proportional rate techniques could not be adopted due to non proportional varying size of unit and materials etc.

The annual operation and Maintenance charge were calculated based on the Energy cost, Manpower cost, Repair & Maintenance cost. Careful (accurate attention is needed in the calculation of Annual Maintenance cost as it is highly sensitive in technology selection in the Life Cycle Cost analysis. The Life Cycle Cost for both DEWATs & Centralized technology has been calculated by the following method.

Life Cycle Cost for 30 years = Capital cost including land cost + Present worth of Annual maintenance cost for 30 years at the rate of 10%

For calculating the present worth Annual maintenance cost for 30 years @ 10% the annuity factor has been calculated as 0.10607.By dividing the annual maintenance cost by the annuity factor, the capitalized cost of O & M is obtained. With this amount the capital cost is added, the total cost will be arrived; with this total cost land cost is added for getting Life cycle Cost.

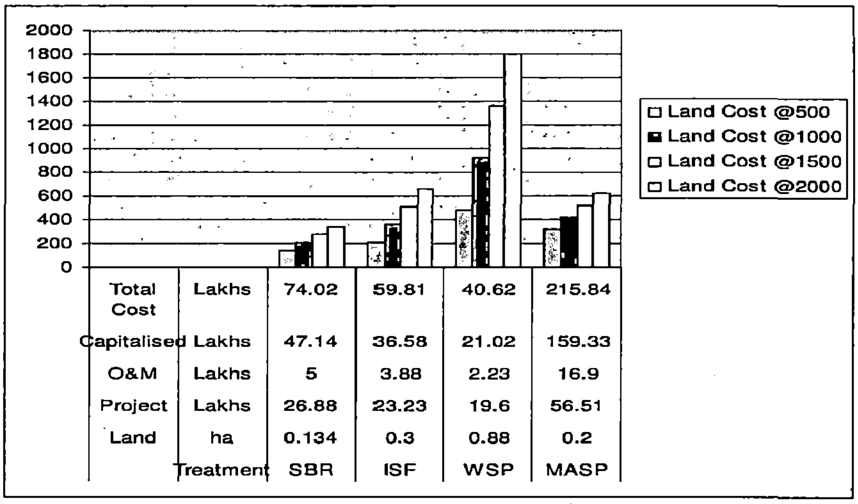
The Life Cycle Cost for each technology for various land cost has been worked out and tabulated in the Table No-----,With the tabulated values the Life Cycle Cost Vs Land cost has been plotted and the graph has been drawn. From the Graph, it is noted that, with out land cost, the WSP found out opt technology for DEWAT. Next lowest is ISF and the high cost technology is SBR. When land cost is considered SBR is opt technology and high cost is WSP, and the intermittent is ISF.



The O&M cost for each technology has been worked out and the component cost has been shown in the bar chart.

Table: 4.3 Ambattur Municipality Ward 45 Land Cost & O &M Details

Sl.No.	Treatment System	Land Required	Project Cost	O&M Cost	Capitalised Cost of O&M	Total Cost	Land Cost @500	Land Cost @1000	Land Cost @1500	Land Cost @2000
		ha	Lakhs	Lakhs	Lakhs	Lakhs	Lakhs	Lakhs	Lakhs	Lakhs
1	SBR	0.134	26.88	5.00	47.14	74.02	141.02	208.02	275.02	342.02
2	ISF	0.300	23.23	3.88	36.58	59.81	209.80	359.80	509.80	659.80
3	WSP	0.880	19.6	2.23	21.02	40.62	480.62	920.62	1360.62	1800.62
4	MASP	0.200	56.51	16.90	159.33	215.84	315.84	415.84	515.84	615.84



4.4 Comparison of DEWAT & Centralized Collection System

Considering DEWAT collection system for all the three Zones, small bore pipes that are capable of carrying the sewage has been used and cost has been worked out as 21.90 lakhs.Whereas Centralized conventional cost is 141 lakhs i.e 6.5 times higher than the DEWATs system which clearly indicate the DEWATs system adopt less pipe cost where as in Centralized collection system, pipe cost is almost 60% of the total cost of the project. Actually the pipe never treat the wastewater.

4.5 Comparison of DEWAT & Centralized System with out Land Cost

For comparison purpose, all the three Zone DEWAT system has been considered as one that is 0.4 mld+0.4 mld+0.2mld totaling to 1mld and this is compared with the Centralized MASP 1mld capacity.As such it is noted that without land cost, DEWAT systems capital and collection system is worked as 87.01 lakhs [capital cost(26.88+23.23+15.00) + collection cost(21.90)] where as for Centralized 1mld MASP is worked out 197.51 [capital cos(56.51)+ collection cost(141.0)], which is 2.3 times higher than the DEWAT system.

CONCLUSIONS

In providing sewerage facility for ward 45 of Ambattur Municipality which is adjacent to Chennai Mega City area, 3 (Three) DEWATS Technology namely Sequential Batch Reactor (SBR), Intermittent Sand Filter (ISF) and Waste Stabilization Pond (WSP) have been analysed. From the analysis the following conclusion arrived.

1. In view of adjacent area of Chennai Mega City, the land cost also going very high. Hence the compact technology, occupying less space of Sequential Batch Reactor. Also level of treatment in the SBR also high, the effluent can be directly sold out to adjacent industries where the demand is high, since Ambattur is famous for Industrial area.
2. Even though the traditional DEWATS system namely, Waste Stabilisation Pond (WSP) treatment performance is better, but in view of high land cost the technology is not recommended for adjacent Chennai City area. If the land is available with the municipality or at subsidized rate then this technology WSp can be considered for the adjacent Chennai area.
3. Intermittent Sand Filter (ISF), technology requires cost wise lies midway is between the two technologies namely WSP and SBR. Due to not compact size and treatment level also not to that of SBR this technology also not recommended to the adjacent Chennai City area.
4. The benefits of smaller dia pipes and not land in-depth getting also reaping the benefit of 3 R's (Reduce, Reuse and Recycle) and thereby attaining the goal of "Sustainable sanitation for all", the DEWATS system is opt. Hence, for the ward 45 of Ambattur Municipality the technology SBR is strongly recommended.
5. From the, 'Life Cycle Cost analysis verses Land Cost Curve', it is concluded that at one point the technologies namely ISF and MASP is coinciding. Hence Careful analysis of land cost has to make. Since it bears a high sensitive factor is deciding the best technology that is opt for adjacent area of Chennai City.

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[Annexures]

SEWAGE TREATMENT PLANT
forZone I- WARD 45 -AMBATTUR MUNICIPALITY

Design of Sequential Batch Reactor (SBR) - 0.4 MLD CAPACITY

Input data

Population

Ward 45 has been divided in to 3 zones based in topography
Zine I comprise of 11 streets , with a present population of 2299
Arithmetic increase method of population projection is adopted.
A decadal growth rate of 30% is proposed to be adopted.
Population as per 2001 census 1900

Present Population (year 2008) population
Assume Base year 2008
Ultimate Design year 2038 4009

Sewage generation			
Per capita water supply		110	lpcd
Sewage generation (ignoring infiltration) =80% of WS.=88 lpcd		88	
			Say 90 lpcd
Total ultimate sewage generated in the zone=0.3608 mld		0.4	mld
Wastewater characteristics			
BOD	=	250	mg/L (g/m^3)
COD	=	450	mg/L (g/m^3)
TSS	=	300	mg/L (g/m^3)
VSS	=	220	mg/L (g/m^3)
bCOD/BOD ratio	=	1.60	
Effluent BOD desired	<	10	mg/L
Final disposal will be through reuse for watering of lawns and gardens and industrial floor eashing			
Design Criteria			
Parmeter	=	value	
BOD loading rate, F/M (kg BOD/kg MLVSS)	=	0.04 - 0.10	
Oxygen requirement at 20°C (kg/ kg of BOD applied)	=	2.0 - 3.0	
MLSS (mg/L)	=	2000 - 5000	
Detention time	=	15 - 40	h
Volumetric loading, kg BOD/d/m3	=	0.1 - 0.30	
Ultimate flow		400	m^3/ day

DESIGN

2 **Design assumptions**

Total liquid depth when full	=	4	m
Decant depth = 30% of tank depth	=	1.2	m
SVI	=	150	mL/g
bCOD = 1.6* BOD	=	400	mg/L (g/m^3)
inert TSS = TSS - VSS	=	80	mg/L (g/m^3)

3 **Design of Sequencing Batch Reactor**

SBR operating cycle

Assumption based on ult av flow			
Aeration time, ta	=	2	h
settling time, ts	=	0.5	h
decant time, td	=	0.5	h
idle time, ti	=	0	h
Filling time tf = ta + ts + td	=	3	h
Total cycle time, Tc = tf+ ta+ ts + td + ti	=	6	h
	=		
Total number of cycles /day	=	4	
Fill volume, Vf = Flow/8	=	100	m^3/fill
Mass of volume at full volume = Mass of settled solids			
Vt* X = Vs* Xs			
MLSS conc in settled volume, Xs =10^6/SVI	=	6666.7	mg/L (g/m^3)
MLSS conc at full volume, X (assumed)	=	3500	mg/L (g/m^3)
settled fraction of solids = X / Xs	=	0.525	
Provide 20% liquid above the sludge blanket	=		
Vs/Vt = 1.2 (X/Xs)	=	0.63	
(Vf/Vt) + (Vs/Vt) =1			
Vf/Vt = 1 -- (Vs/Vt)	=	0.37	

Selected Vs/Vt of 0.37 is acceptable , nearer to 0.3

	Overall Hydraulic detention time			
	Decant depth	=	1.2	m
	Volume of tank, Vt = Vf/0.3	=	333.33	m^3
	Overall detention time	=	20	h
	Aeration time	=	2	h
	Decant volume = fill volume	=	100	m^3
	Decant time	=	30	min
	Rate of decant	=	3.333	m^3/min
	Adopt 110 OD PVC pipes, velocity = 1.07 m/s	=		
4	**Blower design**			
	BOD load = (BOD*flow)/1000	=	100	kg/d
	Oxygen required = 2.5kg/kg ofBOD	=	250	kg/d
	Aeration time = aeration time* number of cycle	=	8	h
	Average oxygen transfer rate	=	12.500	kg/h
	Oxygen demand will be higher initially; Transfer rate should be multiplied by 1.5. Actual oxygen rate (AOR)	=	18.750	kg/h
	Assume depth of tank	=	4	m
	Actual Oxygen transfer rate (AOR) / Standard Oxygen transfer rate (SOR) with fine bubble aeration	=	0.33	
	Standard Oxygen transfer rate (SOR)	=	56.818	kg/h
		=	0.947	kg/min
	Efficiency of fine bubble oxygen transfer/ 30 cm	=	2	%
	Position of diffuser above the tank floor	=	0.3	m
	Depth of submergence = depth of tank - 0.3	=	3.7	m
	Oxygen transfer efficiency (OTE)	=	24.667	%
	O_2 contents of air pr m3	=	0.277	kg/min
	Oxygen transfer	=	0.068	kg O_2/min
	Air required = SOR/ Oxygen transfer	=	0.231	m^3/sec
	Power requirement of blower = Pw=(wRTi)/(29.7ne)[(p2/p1)$^{0.283}$ - 1]			
	Where			
	w = weight of flow of air, kg/s		0.2987	kg/m^3
	R = engineering gas constant for air = 8.314 kJ/k mol K		8.314	
	Ti = absolute inlet temperature, K		295.000	
	p1 = absolute inlet pressure, atm		15	m
	p2 = absolute outlet pressure, atm		10	m
	n = 0.283		0.283	
	e = efficiency, (0.7 to 0.90)		0.7	
	Power requirement of blower = Pw	=	15.138	kW
			16.000	kW
	Provide two blowers, each of 100 kW power rating			
5	**Dimensions of the SBR**			
	Volume of each of aeration tank V	=	333.33	
	Assume depth of tank	=	4	m
	Surface area of each tank =V/depth	=	83.333	m^2
	Assume L:B ratio of 2:1			
	Breath of tank = Sq. root[Area/2]	=	6.45	m
			6.50	m
	Length of the tank = 2* breath	=	13.00	m
	Provide Aeration tanks of overall dimensions 13.0m x 6.50m x 4.3m			
6	**Collection Well for Raw Sewage**			
	Depth of incoming sewer at collection well	=	2	m
	Ultimate flow	=	400	m^3/d
	Detention time	=	30	min
	Volume of storage	=	8.333	m^3
	Adopt a depth of storage	=	2	m
	Cross section al area of well	=	4.167	m2
	Diameter of the collection well	=	2.30	m
			2.00	m
	Provide extra for pump and bottom clearance for the submersible pump	=	1	m
	Total depth of well from GL	=	6	m
	Provide a collection well of 2m internal dia and 6m total depth			

7 **Collection Well for Treated Effluent**

Quantity of effluent		400	m^3/d
Total decant time/cycle	=	0.5	h
Total Decant time	=	2	h
Volume required for 15 minutes storage	=	50.0	m^3
Adopt a depth of storage	=	3.5	m
Cross section al area of well	=	14.286	m2
		15.890	
Diameter of the collection well	=	4.26	m
Provide extra for pump and bottom clearance for the submersible pump	=	1	m
Total depth of well from GL	=		m

Provide a collection well of 4.50m internal dia and 5.00m total depth

8 **Design of Pumps**

0.5

a. **Sewage Pumps (for pumping to aeration tank)**

Ultimate peak flow to be handled	=	400	m^3/d
Number cycles of operation	=	4	
Volume of sewage to be pumped per cycle	=	100	m^3
Duration of pumping for fill	=	3	h
Rate of pumping	=	0.00926	m3/s
Total head for pumping H = 3.5 + 1.5+ 2 =7.m	=	7	m
Power requirement for pumps, HP = wQH/(0.735*e)			
Assume efficiency, e		60	%
Power required	=	1.442	HP
Provide	=	1.500	HP

Provide 1.5HP non-clog submersible pumps- 2 NOs(one stand by)

b. **Effluent Pumps (for pumping effluent for disposal)**

Volume of effluent to be pumped per day	=	400	m^3
Duration of pumping	=	2	h
Rate of pumping	=	0.05556	m3/s
Total head for pumping H = 3.5 + 1.8 + 1.7 = 7.0m	=	7	m
Power requirement for pumps, HP = wQH/(0.735*e)			
Assume efficiency, e		60	%
Power required	=	8.520	HP
Provide	=	10.00	HP

Provide 10 HP non-clog submersible pumps- 2 NOs(one stand by)

c. **Sludge withdrawl pumps**

Volume of sludge to be withdrawn = 1% of flow against normal 2%	=	4	m^3
Duration of pumping	=	30	min
Rate of pumping	=	0.00222	m3/s
Total head for pumping	=	5	m
Power requirement for pumps, HP = 1.2*wQH/(0.735*e)			
Assume efficiency, e		60	%
Power required	=	0.252	HP
Provide	=	1.0	HP

Provide 1HP non-clog submersible sludge pumps- 2 NOs(one stand by)

9 **Sludge Drying Beds**

Sludge wasted per day	=	4	m^3/day
Sludge drying period	=	7	days
Sludge application	=	0.2	m
Surface area of sludge drying beds	=	20	m2

Size of SDBs = 4m x 2.0m

Provide 4Nos of drying beds each of size 4m x 2.0m

<u>Summary of Design</u>

Sl.No.	Name of unit	Dimension	No. of Units
1	Raw Sewage Collection Well	2.6m dia x 3.0m depth - 1No	
2	Effluent Collection Well	3.0m dia x 2.80m depth - 1No.	
3	Sequencing Batch Reactors	4m x 2m x 4.3m - 2 Nos	
4	Blowers	9 kW	2Nos
5	Pumps		
	a) Raw sewage pumps	0.5 HP	2 Nos
	b) Effluent pumps	0.75 HP	2 Nos
	c) Sludge pumps	0.5 HP	2 Nos
6	Sludge Drying Beds	6.5m x2.0m	8 Nos
7	Blower cum Electrical room& Store room	7m x 5m	1 No.

ESTIMATE FOR STP FOR ZONE - II , WARD 45, AMBATTUR MUNICIPALITY 0.4 MLD CAPACITY SEQUENTIAL BATCH REACTOR (SBR)									
Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
1	Earth work excavation & depositing on bank with an initial lead of 10 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standard specification and as directed by Departmental Engineer. **(Civil works)**								
i	Raw sewage Collection Well	1	4.10	4.10	4.40	73.96			
ii	Aeration Tank	1	74.00	7.50	2.40	1332.00			
iii	Sludge well	1	120.79	1.90	3.40	780.27			
iv	Sludge drying beds	4	4.90	8.90	2.40	418.66			
v	Sludge drying Beds channel (central portion)	4	4.90	0.50	0.50	4.90			
vi	Effluent well	1	3.141*6.1^2/4		3.20	93.50			
						2703.29	**cum**	**28.75**	**77719.66**
2	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications								
i	Raw sewage Collection Well	1	4.10	4.10	0.10	1.68			
ii	Aeration Tank	1	74.00	7.50	0.10	55.50			
iii	Sludge well	1	120.79	1.90	0.10	22.95			
iv	Sludge drying beds	4	4.90	8.90	0.10	17.44			
v	Sludge drying Beds channel (central portion)	4	4.90	0.50	0.10	0.98			
vi	Effluent well	1	3.90			3.90			
						102.45	**cum**	**2110.00**	**216169.58**
3	Supplying & laying Reinforced Cement Concrete of M25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforcement which shall be measured & paid under seperate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.								
	Raw Sewage Collection Well								
	side walls all around	1	8.79	0.30	4.50	11.87			
	base slab	1	3.14	0.30	4.50	4.24			
	beam for base slab	1	0.79	2.60	0.15	0.31			
	aeration tank								
	side walls allround	1	40.60	0.40	4.30	69.83			
	base slab	1	13.40	6.80	0.30	27.34			
	beam for fixing aerators	2	6.40	0.45	0.45	2.59			
	Sludge well								
	side wall	1	5.34	0.20	4.80	5.13			
	base slab	1	1.49	1.90	0.30	0.85			
	Drying bed								
	side wall	8	16.60	0.15	2.00	39.84			

Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
	base	8	6.80	2.30	0.15	18.77			
	Effluent well								
	side wall	1	15.56	0.45	4.80	33.61			
	base slab	1	2.44	3.10	0.30	2.27			
						216.64	**cum**	**3539.00**	**766673.41**
4	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.	1	75		216.64	16,248	Kg	**51.00**	**828631.19**
5	Supplying & erecting centering for sides & walls including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm centre to centre etc. complete complying with standard specifications. Centering for RCC works below GL (wall).								
	Raw Sewage Collection Well								
	side walls all around	2	8.79	4.50		79.15			
	base slab	1	8.17	0.30		2.45			
	aeration tank								
	side walls allround	2	40.60		4.10	332.92			
	base slab	1	42.20	0.30		12.66			
	beam for fixing aerators	2	6.50	1.25		16.25			
	Sludge well								
	side wall	2	5.34		4.00	42.72			
	Drying bed								
	side wall	16	16.00		2.00	512.00			
	base	8	7.30	2.80	0.15	24.53			
	Effluent well								
	side wall	2	15.56		4.30	133.82			
						1156.50	**sqm**	**428.00**	**494980.79**
6	Supplying and installation of following machineries including all electrical works and labour charges etc complete as per standard specifications and as directed by Engineer-incharge								
	Machinery								
	Bar screen	1				1	no.	**5000.00**	**5000.00**
	Blower 100 KW	2				2	nos.	**25000.00**	**50000.00**

Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
	Raw sewage Pump 1.5 HP	2				2	no.	10000.00	20000.00
	sludge well pump 1.0 HP	2				2	no.	8000.00	16000.00
	effluent pump (10 HP)	2				2	no.	60000.00	120000.00
7	Earth work excavation & depositing on bank with an initial lead of 10 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely soil as directed by the Departmental Engineer. (Pipeline works)								
	Collection Well to Aeration tank	1	10	0.80	1.00	8			
	Areation tank to effluent well	1	10	0.80	1.00	8			
	Aeration to Sludge well	1	15	0.80	1.00	12			
	Sludge well to sludge drying beds	1	35	0.80	1.00	28			
	Effluent well to surplus course	1	25	0.90	2.00	45			
						101	cum	28.75	2903.75
8	Supply of 200 mm diameter of RCC pipes NP 3 class with sulphate resistance cement with inner lining of high alumina cement as per IS:783 with epoxy coating outside of the spigot portion and poly solution coating inside the socket portion including lowering into trenches, laying to proper grade and alignment, cutting the pipes true to axis & jointing the pipes & specials with rubber rings including cost of lubricant, testing the pipe to the required pressure including barricading, provision of danger lights, arranging for watch & ward etc., complete as per specifications.								
	Collection Well to Aeration tank	1	12			12			
	Areation tank to effluent well	1	18			18			
	Aeration to Sludge well	1	20			20			
	Sludge well to sludge drying beds	1	35			35			
	Effluent well to surplus course	1	25			25			
	Net quantity					110	m	304.00	33440.00
9	Supply and installation of following size of CI Double Flanged Sluice Valves (PN 1.0) with cap and confirming to IS:14846, to site, including flanged tail pieces and other specials as required, loading, unloading, transportation charges & stacking at site etc all complete as per standard specifications and as directed by the Engineer-in-charge								
	sluice valves 200 mm	4				4	nos.	10128.00	40512.00
	Sluice valve at Sludge drying beds 100mm	4				4	nos.	4100.00	16400.00
	Total								2688430.37
								Say	26.88 Lakhs

		DESIGN OF DECENTALISED WASTE WATER TREATMENT FOR					
			Zone II-Ward 45- Ambattur municipality				
			INTERMITTANT SAND FILTER (ISF)				
1	**Population**						
	Ward 45 has been divided in to 3 zones based in topography						
	Zine II comprise of 17 streets , with a present population of						
	2052						
	Arithmetic increase method of population projection is adopted.						
	A decadal growth rate of 30% is proposed to be adopted.						
	Population as per 2001 census			2068			
					Projected population		
	Present Population (year 2008)						
	Assume Base year		2008		2502		
	Ultimate Design year		2038		4364		
2	**Sewage generation**						
	Per capita water supply			110 lpcd			
	Sewage generation (ignoring infiltration) =80% of WS.=88 lpcd						
					Say 90 lpcd		
	Total ultimate sewage generated in the zone=0.3927 mld					0.4	mld
3	**Total sewage to be treated**					400	m3
	sewage is passing through septic tanks (interceptors)						
	and only solid free effluent is collected for treastment.						
	Since septic tanks provide 24 hours detention ,peak						
	flow will be twice the average flow.						
4	**Collection sump**						
	Average flow					278	lpm
	Capacity of collection sump assuming 60 min. storage					17	m3
	Provide 2 sumps to meet the peak						
	Assuming a depth.of 3 m			area of well		5.56	m2
	Dia. of well					2.68	m
					Say	3.00	m
	Total depth=0.5+2+3=5.5m						
5	**Intermittant sand filter**						
	No. of dose per day					4	nos.
	Sewage is dosed in two beds alternatively once in 4 hours						
	Rate of feed per dose					67	m3
	Surface loading per sq.m per dose					0.2	m3
	Surface area of sand filter required					333	m2
	Adpot 2 Nos filter		20x9m ,	Area provided		360	m2
	Free board=0.15m						
	Distribution pipe 0.20m						
	Depth of water=0.10m						
	Gravel (40 mm size)media=0.60						
	Sand media=0.30m						
	Gravel(20mm size) support=0.15m						
	Under drains =0.20m						
	Overall Depth of filter=1.7m, Provide 0.7m above ground.						
5	**Treated effluent sump**						
	Assuming 60 min. storage , provide 3m dia and 2.5m depth						
	depth of effluent pipe =1.0m						
	Overall depth of sump =3.0+1.0+0.5=4.50m below ground						
6	**Polishing pond-Maturation pond**						
	BOD of sand filter effluent					50	mg/l

	Retention time (Assumed)	t		3.5	days
	Depth of Pond			1.5	m
	Area of Pond = Q x t / D				
	Where Q = Flow in m^3				
	t = Retention period in days				
	D = Depth in metres.				
	Area of Pond			933	m2
	Provide 2 ponds of size 32 x 15x 1.5m			960	m2
	Check for Bacterial Quality				
	Mean Temperature			30	°C
	BOD of Effluent, $L_e = L_i / (1+(0.3x(1.05)^{T-20}*t)$			18.45	
				< 20	mg/l
			Hence OK		

Estimate for STP for Zone-I, Ward - 45, Ambattur Municipality
0.4 MLD CAPACITY - INTERMITTANT SAND FILTER (ISF)

Sl.No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs)	Amount (Rs)
	COLLECTION WELL - 3.0 m dia								-
1	Eart work excavation above water level in sandy or clayey soil for wells including levelling the site with initial lead of 10 m								
	First depth of 2m	2 x π/4	3.30	3.3	2.00	17.11	cum	28.75	491.80
2	Sinking of well below water level including all incidental charges using special tools and plants such as air compressor, helmet etc, complete and including baling out water								
	For 3.0 m dia well								
	First depth 2m	2x1				2.00	m	1,030.00	2,060.00
	second depth 2 m	2x1				1.80	m	2,041.00	3,673.80
3	Supplying & laying Reinforced Cement Concrete of M20 grade using machine crushed hard broken granite stone jelly 20 mm for RCC Kerbs of all shapes (Excluding cost of providing centering & fabrication of reinforcement which shall be measured & paid under seperate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.								
	RCC Kerb	2 x π	3.30	0.3	0.30	0.23	cum	3,539.00	825.55
4	Supplying & laying Reinforced Cement Concrete of M20 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in Well Sinking of all shapes (Excluding cost of providing centering & fabrication of reinforcement which shall be measured & paid under seperate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.								
	RCC Well sinking	2 x π	3.30	3.3	5.50	47.04	cum	3,539.00	166,479.60
5	Supplying & erecting centering for sides & walls including supports with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm centre to centre etc. complete complying with standard specifications. Centering for RCC works.								
		2x2 xπ	3.30		5.50	28.51	sqm	513.60	14,642.75

Sl.No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs)	Amount (Rs)
6	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.								
	steel at 75 Kg/cum of Concrete					3545.60	KG	51.00	180,825.70
7	Providing Pumping Machinaries and electrical items including installation								
	3 Hp Pumpset	2 x 1				2.00		14,721.00	29,442.00
	Sub total A								**398,441.20**
	SAND FILTER - 3.0 m dia								
1	Earth work excavation and depositing on bank with initial lead of 10 m and initial lift of 2 m in hard stiff clay, stiff black cotton, hard red earth, shales murram, gravel, stony earth and earth mixed with small size of boulders as directed by the Engineer.- 1 cu.m								
	For filter area	2	20.90	9.90	1.25	517.28	cum		
	For Distribution Chamber	1	2.4	1.9	1	4.56	cum		
						521.84	**cum**	28.75	15,002.80
2	Providing & laying PCC 1:4:8 with 40 mm HBG as levelling course including curing etc all complete as per standard specification as directed by the Engineer.								
	For filter area	2	20.90	9.90	0.10	41.38	cum		
	For Distribution Chamber	1	2.4	1.9	0.1	0.46	cum		
						41.84	**cum**	1,872.00	78,320.75
3	Supplying & laying Reinforced Cement Concrete of M20 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works of all shapes (Excluding cost of providing centering & fabrication of reinforcement which shall be measured & paid under seperate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.								
	Filter								
	For side wall	2	58.60	0.15	1.700	29.89	cum		
	For Base slab	2	20.30	9.30	0.150	56.64	cum		
	Distribution Chamber								
	For Base slab	1	1.9	1.3	0.15	0.37	cum		
	For side wall	1	5.60	0.15	2.45	2.06	cum		
						88.95	**cum**	3,539.00	314,799.40
4	Refilling with suitable excavated earth available in layers of 150 mm thick, watering, ramming & consolidation as directed by the Engineer.								
	Filter	2	60.4	0.3	1.15	41.68	cum		
	Distribution Chamber	1	7.4	0.3	0.9	2.00	cum		
						43.67	**cum**	10.10	441.15

Sl.No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs)	Amount (Rs)
5	Supplying & erecting centering for sides & walls including supports with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm centre to centre etc. complete complying with standard specifications. Centering for RCC works.								
	Filter								
	Side walls	2 x 2	58.8		1.7	399.84	sqm		
	Base slab	2	59.2		0.15	17.76	sqm		
	Distribution chamber								
	Side walls	1	5.6		2.45	27.44	sqm		
	Base Slab	1	6.4		0.15	1.92	sqm		
						446.96	**sqm**	428.00	191,298.90
6	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.								
	Steel at 75 Kg/cum of Concrete					6671.36	Kg	51.00	340,239.50
7	Suppling Filter Media and laying								
	HBG 40 mm	2	20	9	0.6	216	cum	560.00	120,960.00
	HBG 20 mm	2	20	9	0.6	216	cum	780.00	168,480.00
	Sand	2	20	9	0.15	54	cum	348.00	18,792.00
8	Providing Under Drains								
	200 mm perforated PVC Pipe	2 x 3	12			72	m	310.00	22,320.00
	200 mm Plain PVC Pipe	2 x 3	1			6	m	281.50	1,689.00
	Effluent pipe PVC Plan 300 mm	2 x 1	40			80	m	708.00	56,640.00
9	Providing Distribution pipes								
	200 mm perforated	2 x 2	21			84	m	281.50	23,646.00
10	Providing CI Sluice for filter	1 x 2				2	Nos	8,340.00	16,680.00
	Sub Total B								**1,369,309.50**
	EFFLUENT WELL - 3.0 m dia								
1	Eart work excavation above water level in sandy or clayey soil for wells including levelling the site with initial lead of 10 m								
	First depth of 2m	2 x π/4	3.30	3.3	2.00	17.11	cum	28.00	479.00
2	Sinking of well below water level including all incidental charges using special tools and plants such as air compressor, helmet etc, complete and including baling out water								
	For 3.0 m doa well								
	First depth 2m	2x1				2.00	cum	1,030.00	2,060.00

Sl.No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs)	Amount (Rs)
3	Supplying & laying Reinforced Cement Concrete of M20 grade using machine crushed hard broken granite stone jelly 20 mm for RCC Kerbs of all shapes (Excluding cost of providing centering & fabrication of reinforcement which shall be measured & paid under seperate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.								
	RCC Kerb	2 x π	3.30	0.3	0.30	0.23	cum	2,756.00	642.90
4	Supplying & laying Reinforced Cement Concrete of M20 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in Well Sinking of all shapes (Excluding cost of providing centering & fabrication of reinforcement which shall be measured & paid under seperate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.								
	RCC Well sinking	2 x π	3.30	3.3	4.50	38.49	cum	2,756.00	106,074.15
5	Supplying & erecting centering for sides & walls including supports with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm centre to centre etc. complete complying with standard specifications. Centering for RCC works.								
		2x2 xπ	3.30		4.50	23.33	sqm	428.00	9,983.70
6	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.								
	steel at 75 Kg/cum of Concrete					2904.13	KG	51.00	148,110.55
7	Providing Pumping Machinaries and electrical items including installation								
	3 Hp Pumpset	2 x 1				2.00	No.	14,721.00	29,442.00
	Sub Total C								**296,792.30**
	MATURATION POND								
1	Eart work excavation above water level in sandy or clayey soil for wells including levelling the site with initial lead of 10 m	2	33.05	16.05	1.05	1113.95	Cum	28.75	32026.10
2	Forming of Bund	2	33.75	16.75	2.38	2690.89	Cum		-
3	Gravel 150 mm thick	2	101	2.48	0.15	75.14	Cum	97.00	7,289.00

Sl.No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit	Rate (Rs)	Amount (Rs)
4	Supplying and fixing Precast cement Slab	2	101	2.48	0.075	37.57	Cum	2,059.20	77,368.30
5	Supplying and seeding of grass @ 50 mm c	2	109	2.37		516.66	sqm	10.10	5,218.30
6	Inlet Arrangement LS								136,555.30
	Sub Total D								**258,457.00**
	Grand Total (Sub Totals - A+B+C+D)								**2,323,000.00**
								Say	**23.23 Lakhs**

Design of Decentalised Waste Water Treatment System (Stabilisation Pond) - 0.2 mld capacity for Treating Septic Tank Effluent from Zone III-Ward 45 Ambattur Municipality			
Population			
Ward 45 has been divided in to 3 zones based in topography			
Zine III comprise of 11 streets , with a present population of			
1305			
Arithmetic increase method of population projection is adopted.			
A decadal growth rate of 30% is proposed to be adopted.			
Population as per 2001 census 1079			
Present Population (year 2008)			
Assume Base year -2008 proj.population 1305			
Ultimate Design year -2038 Proj.population - 2277			
Sewage generation			
Per capita water supply		110	lpcd
Sewage generation (ignoring infiltration) =80% of WS.=88 lpcd		90	lpcd
Total ultimate sewage generated in the zone		0.20493	mld
say		0.20 mld	
The effluent from Septic Tank is directly fed in to Facultative Pond			
BOD of incoming sewagw		250	mg/l
Mean temperature		30	°C
Fecal coliform		80x10^5	MPN/100 ml
Design of Anaerobic pond			
Area of Pond = Q x t / D			
Where Q = Flow in m^3	=	200.00	cum
t = Retention period in days		5	days
D = Depth in metres.		3	m
Area of Pond	=	333.333	sqm
Provide 2 ponds of size 20 x9 x 3m - area			sqm
Area of Pond	=	360	sqm
Actual retention time	=	5.40	days
BOD reduction in anaerobic pond	=	56.00	%
BOD of effluent	=	110	mg/l
Quantity of effluent = Q-0.001Ae	=	196.40	cum
Where Q = Flow in m^3			
A = Area of Pond in Sq.m			
e = Evaporation in mm (10mm)			
2. Design of Facultative Pond			
Retention time (Assumed)	=	5	days
Influent BOD	=	110	mg/l
Area of Pond = Q x (L_i -L_e) / 18 x D x$(1.05)^{T-20}$			
Where Q = Flow in m^3	=	196	cum
T = Mean temperature	=	30	^{0}C
L_i = BOD of Influent	=	110	mg/l

L_e = BOD of effluent (% reduction Assumed)	=	60	mg/l
Depth of Pond, D in metres	=	1.5	m
Area of Pond	=	223.28	sqm
Organic Loading = 10Q L_i / A	=	967.56	kg/ha.day
Permissible Organic loading = 20T-120	=	480	kg/ha.day
As the organic loading rate is greater than the permissible organic loading rate the area of the pond has to be increased			
Provide 2 ponds of size 25 x 10 x 1.5m			
Area provided	=	500	sq.m
Now the organic loading rate = 10Q Li / A	=	432.08	kg/ha.day
	<	480	kg/ha.day
Hence OK			
Actual Retention time, V/Q	=	3.82	days
BOD of Effluent, Le = Li / 1+(0.3x(1.05)$^{T-20}$*t	=	38.38	mg/l
Quantity of effluent = Q-0.001Ae	=	191.40	cum
Where Q = Flow in m^3			
A = Area of Pond in Sq.m			
e = Evaporation in mm (10mm)			
3. Design of Maturation Pond			
Retention time (Assumed)	=	3	days
Depth of Pond	=	1.5	m
Area of Pond = Q x t / D	=	382.8	
Where Q = Flow in m^3	=	191.40	cum
t = Retention period in days			
D = Depth in metres.			
Area of Pond	=	382.80	sqm
Provide 2 ponds of size 20 x 10x 1.5m	=		
Area of Pond	=	400	sqm
Actual retention time	=	3.13	days
Check for Bacterial Quality			
Fecal Coliform in raw sewerage (Assumed), N_i	=	80 x 10^5	MPN/100ml
Rate Constant, $K_{b(T)} = 2.6 \times (1.19)^{T-20}$	=	14.81	
Fecal Coliform in treated sewerage, N_e			
$= N_i / (1+K_b \times t_{an}) (1 + K_b \times t_{fac}) (1+K_b \times t_{m})$	=	**36.22**	MPN/100ml
	<	100	MPN/100ml
Hence OK			
Actual Retention time, V/Q	=	3.13	days
BOD of Effluent, $L_e = L_i / (1+(0.3x(1.05)^{T-20}*t)$	=	**15.16**	mg/l
	<	20.00	mg/l
Hence OK			

Abstract Estimate for 0.2 Mld Waste Stabilisation PondTreatment Plant at Ward No.45 Ambattur Municipality

Sl. No.	Description of item	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
1	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	2,116	cum	28.75	60,835.00
	(As per Data Bank - Lead Charges)				
2	Spreading the available earth in layers of 25cm thick including watering upto Optimum moisture content, consolidation by power roller (Forming bund above GL from suitable excavated earth & laid in layers, watering, ramming & consolidation by rollers as per standard specifications as directed by the Departmental Engineer.	2,276	cum	30.60	69,645.60
	(As per Data Bank - Lead Charges)				
3	Supplying & laying of gravel 150 mm thick below precast slab, levelling the layer, watering and consolidation etc all complete as per standard specification and as directed by the Departmental Engineer.	429	cum	185.40	79,536.60
	(As per Data Bank - Lead Charges)				
4	Supplying and seeding of grass at 50 mm c/c including preparation of earth with sweet earth, 150 mm thick, watering and maintaining the lawn upto 6 months etc all complete as directed by the Engineer.	2,791	sqm	48.05	134,107.55
	(As per Data Bank - Lead Charges)				
5	Supplying and fixing in position RCC precast slabs of 450 x 450 x 50 mm over the bed of gravel to proper level etc all complete as directed by Engineer	1,854	sqm	151.58	281,029.35
	(As per Data Bank - Lead Charges)				
6	Construction of toe wall etc all complete as per standard specification or as directed by the Engineer.				
a)	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	68.29	cum	28.75	1,963.00
b)	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications	20.70	cum	2,110.00	43,666.55
c)	Construction of brick masonry with class II bricks in CM 1:6 in foundation including curing etc all complete as per standard specifications.	25.46	cum	2,371.00	60,368.00
d)	Plastering with C.M 1:4, 12 mm thick including necessary scaffolding, watering the surface etc all complete as per standard specification.	332.08	sqm	64.00	21,255.00
	(As per Data Bank - Lead Charges)				

Sl. No.	Description of item	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
7	Supplying & laying reinforced cement concrete of M 25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforcements which shall be measured & paid under separate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.	53.73	cum	3,258.00	175,053.00
	(As per Data Bank - Lead Charges)				
8	Supplying & erecting centering for sides & walls of outlet chamber including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm c/c etc. complete complying with standard specifications. Centering for RCC works below GL (wall).	160.07	sqm	428.00	68,510.00
9	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.	2,160.44	kg	51.00	110,182.00
10	Supply of NP 3 class RCC pipes as per IS:783, lowering into trenches, laying to proper grade and alignment, cutting the pipes true to axis & jointing the pipes & specials with cement mortar joints including cost of jointing material, testing the pipe to the required pressure as directed by the Departmental Engineer including barricading, provision of danger lights, arranging for watch & ward etc., complete as per specifications at different depths.				
	350 mm diameter	600	m	616.50	369,900.00
15	Supplying, delivery, spreading & fixing of LDPE sheet in all the Anaerobic, Facultative & Maturation ponds for avoiding the seepage / infiltration including transportation and labour charges etc complete as per standard specification and as directed by Engineer-in-charge.	1,660	sqm	100.00	166,000.00
16	Effluent Pump		LS		4,900

	Total Cost				**1,646,952**

Say Rs.16.50 Lakhs

Detailed Estimate for 0.2 Mld Waste Stabilisation Pond Treatment Plant at Ward NO.45 Ambattur Municipality

Sl. No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit
1	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	1				2,116	cum
2	***Spreading the available earth*** *in layers of 25cm* thick including watering upto Optimum moisture content, consolidation by power roller **(Forming bund** above GL from suitable excavated earth & laid in layers, watering, ramming & consolidation by rollers as per standard specifications as directed by the Departmental Engineer.	1				2,276	cum
3	**Supplying & laying of gravel 150 mm thick** below precast slab, levelling the layer, watering and consolidation etc all complete as per standard specification and as directed by the Departmental Engineer.						
	Anaerobic ponds						
	Sides	2	64.00	4.95	0.15	95.04	
	Top of bund	2	84.00	1.50	0.15	37.80	
	Facultative ponds						
	Sides	2	86.00	2.83	0.15	73.01	
	Top of bund	2	92.00	1.50	0.15	41.40	
	Maturation ponds						
	Sides	4	74.00	2.48	0.15	110.11	
	Top of bund	4	80.00	1.50	0.15	72.00	
	Net quantity					**429.00**	cum
4	**Supplying and seeding of grass** at 50 mm c/c including preparation of earth with sweet earth, 150 mm thick, watering and maintaining the lawn upto 6 months etc all complete as directed by the Engineer.						
	Anaerobic ponds						
	sides	2	79.00	3.53		557.74	
	bottom	2	92.00	1.00		184.00	
	Facultative ponds						
	sides	2	100.10	3.29		658.66	
	bottom	2	112.20	1.00		224.40	
	Maturation ponds						
	sides	4	84.20	2.37		798.22	
	bottom	4	92.20	1.00		368.80	
	Net quantity					**2,791.00**	**Sqm**
5	Supplying and fixing in position RCC precast slabs of 450 x 450 x 50 mm over the bed of gravel to proper level etc all complete as directed by Engineer						
	Anaerobic ponds	2	64.00	4.95		633.60	
	Facultative ponds	2	86.00	2.83		486.76	
	Maturation ponds	4	74.00	2.48		734.08	
	Net quantity					**1,854.00**	**Sqm**

Sl. No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit
6	**Construction of toe wall** etc all complete as per standard specification or as directed by the Engineer.						
	Anaerobic ponds	2	56.16			112.32	
	Facultative ponds	2	68.16			136.32	
	Maturation ponds	4	58.16			232.64	
	Net quantity					**481.28**	**Rmt**
a)	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	1	481.28	0.43	0.33	68.29	cum
b)	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications	1	481.28	0.43	0.10	20.70	cum
c)	Construction of brick masonry with class II bricks in CM 1:6 in foundation including curing etc all complete as per standard specifications.	1	481.28	0.23	0.23	25.46	cum
d)	Plastering with C.M 1:4, 12 mm thick including necessary scaffolding, watering the surface etc all complete as per standard specification.	1	481.28	0.69		332.08	sqm
7	Supplying & laying reinforced cement concrete of M 25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforcements which shall be measured & paid under separate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.						
a	**RCC for inlet chamber**						
	Columns	12	0.23	0.23	2.00	1.27	
	Base slab	2	7.45	2.30	0.20	6.85	
	Vertical walls	2	18.90	1.10	0.15	6.24	
	Partition wall	2	2.00	1.10	0.15	0.66	
	Foundation	12	1.20	1.20	0.50	8.64	

Sl. No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit
b	Refer Enclosure					30.07	
	Total					**53.73**	**24cum**
8	Supplying & erecting centering for sides & walls of outlet chamber including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm c/c etc. complete complying with standard specifications. Centering for RCC works below GL (wall).						
	Columns	12	0.69	2.00		16.56	
	Base slab	2	7.45	2.30		34.27	
	Vertical walls	4	18.90	1.10		83.16	
	Partition wall	4	2.00	1.10		8.80	
	Foundation	12	1.20	1.20		17.28	
	Total					**160.07**	sqm
9	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.						
	Walls	16.81	100.00			1,680.66	
	Floors	6.85	70.00			479.78	
	Total					**2,160.44**	Kg
10	Supply of NP 3 class RCC pipes as per IS:783, lowering into trenches, laying to proper grade and alignment, cutting the pipes true to axis & jointing the pipes & specials with cement mortar joints including cost of jointing material, testing the pipe to the required pressure as directed by the Departmental Engineer including barricading, provision of danger lights, arranging for watch & ward etc., complete as per specifications at different depths.						
	350 mm diameter	1	600			600	Rmt
11	Supplying, delivery, spreading & fixing of LDPE sheet in all the Anaerobic, Facultative & Maturation ponds for avoiding the seepage / infiltration including transportation and labour charges etc complete as per standard specification and as directed by Engineer-in-charge.						
	Anaerobic Pond	2	20	9		360	
	Facultative Pond	2	25	10		500	
	Maturation Pond	4	20	10		800	
	Net quantity					**1,660**	sqm

RCC Estimation for STP

Descrption of Item	CL	W	H	Volume
Anerobic Pond				
Wall A	1.80	0.15	2.00	0.540
Wall B	1.50	0.15	1.00	0.225
Wall C	1.50	0.08	0.30	0.036
				0.801
Wing Walls				
abb'c'a'	0.50	0.15	1.72	0.129
bb'c	0.22	0.15	0.22	0.004
b'c'dd'f'c	1.50	0.15	1.50	0.338
ded'	1.50	0.15	1.50	0.169
f'd'ef	2.20	0.15	2.20	0.363
				1.002
For 2 Wing Walls				**2.004**
Flooring (Slab)				
a'c'f'	1.80	1.80	0.15	0.486
f'f	3.11	1.80	0.15	0.840
fg	0.15	1.80	0.30	0.081
				1.407
Grand Total				**4.211**
Maturation Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	0.15	2.00	0.540
Wall B	1.50	0.15	0.85	0.191
Wall C	1.50	0.15	0.50	0.113
				0.844
Wing Walls				
abkij	0.50	0.15	1.75	0.131
bck	0.50	0.15	0.50	0.019
kcdhgi	1.58	0.15	1.25	0.296
deh	0.75	0.15	0.75	0.042
efgh	0.75	0.15	0.50	0.056
				0.545
For 2 Wing Walls				1.089
Flooring (Slab)				
Flooring	1.90	1.80	0.15	0.513
Projection	0.15	1.80	0.15	0.041
				0.554
Grand Total				**2.487**
Facultative Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	0.15	2.50	0.675
Wall B	1.50	0.15	1.00	0.225
Wall C	1.50	0.08	0.80	0.096
				0.996
Wing Walls				
abjik	0.50	0.15	2.15	0.161
bcj	0.70	0.15	0.70	0.037
dgij	1.55	0.15	1.45	0.337
deh	0.95	0.15	0.95	0.068
efgh	0.95	0.15	0.50	0.071
				0.674
For 2 Wing Walls				1.348
Flooring (Slab)				
Flooring	2.15	1.80	0.15	0.581

Descrption of Item	CL	W	H	Volume
Grand Total				**2.925**
Reinforcement				
slabs @ 70 kg/cum	7.3494	70		514.458
Wall @ 100 kg/cum	22.7185	100		2271.852
	30.0679			**2786.31**
Centring				
Wall A	1.80	-	2.00	3.600
Wall B	1.50	-	1.00	1.500
Wall C	1.50	-	0.30	0.450
				5.550
Wing Walls				
abb'c'a'	0.50	-	1.72	0.860
bb'c	0.22	-	0.22	0.048
b'c'dd'f'c	1.50	-	1.50	2.250
ded'	1.50	-	1.50	2.250
f'd'ef	2.20	-	2.20	4.840
				10.248
For 2 Wing Walls				20.497
Flooring (Slab)				
a'c'f'	1.80	1.80	-	3.240
f'f	3.11	1.80	-	5.598
fg	-	1.80	0.30	0.540
				9.378
Grand Total				**35.425**
Maturation Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	-	2.00	3.600
Wall B	1.50	-	0.85	1.275
Wall C	1.50	-	0.50	0.750
				5.625
Wing Walls				
abkij	0.50	-	1.75	0.875
bck	0.50	-	0.50	0.250
kcdhgi	1.58	-	1.25	1.975
deh	0.75	-	0.75	0.563
efgh	0.75	-	0.50	0.375
				4.038
For 2 Wing Walls				8.075
Flooring (Slab)				
Flooring	1.90	1.80	-	3.420
Projection	0.15	1.80	-	0.270
				3.690
Grand Total				**17.390**
Facultative Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	-	2.50	4.500
Wall B	1.50	-	1.00	1.500
Wall C	1.50	-	0.80	1.200
				7.200
Wing Walls				
abjik	0.50	-	2.15	1.075
bcj	0.70	-	0.70	0.490
dgij	1.55	-	1.45	2.248
deh	0.95	-	0.95	0.903
efgh	0.95	-	0.50	0.475
				5.190

Descrption of Item	CL	W	H	Volume
For 2 Wing Walls				10.380
Flooring (Slab)				
Flooring	2.15	1.80	-	3.870
Total				**21.450**

226.2096

Summary

Component	East Zone	West Zone	Total	RCC (cum)	Total RCC (cum)
Anerobic Pond	1	1	2	4.211	8.423
Maturation Pond	2	2	4	2.487	9.947
Facultative Pond	2	2	4	2.925	11.699
		TOTAL RCC QUANTITY			**30.07**

Earthwork & Refilling Quantity for new STP

Sl. No.	Description	Height (m)	Bottom Width (m)	Top Width (m)	Area (sqm)	Length (m)	Volume	Total
	Bunds							
1	Point A	1.49	5.21	1.50	5.00			
2	Point B	1.41	5.03	1.50	4.60			
3	Point C	0.78	3.45	1.50	1.93			
					3.84	114	438.26	
4	Point D	1.90	6.25	1.50	7.36			
5	Point E	1.05	4.11	1.50	2.95			
6	Point F	1.19	4.46	1.50	3.55			
					3.94	297	1,170.18	
7	Point G	1.40	5.00	1.50	4.55			
					4.05	93	376.47	
8	Point H	1.43	5.06	1.50	4.69			
9	Point I	1.97	6.41	1.50	7.79			
					5.50	298	1,639.00	
10	Point J	1.06	4.15	1.50	2.99			
11	Point K	0.79	3.48	1.50	1.97			
					3.31	297	983.07	
12	Point L	1.59	5.48	1.50	5.55			
13	Point M	1.34	4.84	1.50	4.25			
					5.85	300	1,755.00	
14	Point N	0.89	3.71	1.50	2.32			
					3.27	252	824.04	
15	Point O	1.26	4.64	1.50	3.87			
					3.57	252	899.64	
A	Total Earth from Existing Bunds						8,085.66	**8086 cum**
16	Silt in Inlet Zone						12,316.50	
17	Silt in West Zone						16,417.50	
18	Silt in East Zone						8,250.00	
B	Total Silt						36,984.00	**36984 cum**
	For New Treatment Plant							
	WEST ZONE							
a	Anerobic Pond	1.90	6.25	1.50	7.36	253.00	1,862.08	
	Bottom Filling						367.78	
b	Facultative Pond	1.75	5.88	1.50	6.45	727.50	4,692.38	
c	FP-Central Bund	2.00	6.50	1.50	8.00	199.25	1,594.00	
	Bottom Filling						7,435.16	
d	Maturation Pond	1.15	4.38	1.50	3.38	574.00	1,940.12	
e	MP-Central Bund	1.75	5.88	1.50	6.45	169.00	1,090.05	
C	Bottom Cutting						2,656.80	**2657 cum**
	Total Earth for Bunds and Filling						18,983.92	18984 cum
	EAST ZONE							
f	**Anerobic Pond**	1.75	5.88	1.50	6.45	214.00	1,380.30	
	Bottom Filling						194.59	
g	**Facultative Pond**	1.65	5.63	1.50	5.88	601.50	3,536.82	
h	FP-Central Bund	2.00	6.50	1.50	8.00	164.25	1,314.00	
	Bottom Filling						1,494.23	
D	Cutting New Area						1,276.35	
E	Cutting Triangle Area						9.56	
I	**Maturation Pond**	1	4	1.5	2.75	474	1,303.50	
j	MP-Central Bund	1.75	5.875	1.5	6.453	139	896.98	
F	Bottom Cutting						2,653.20	
G	Cutting New Area						2,690.81	
H	Cutting Triangle Area						43.02	
	Total Earth for Bunds and Filling						9,925.38	9929 cum
	Earth from Cutting						6,867.52	6868 cum

Sl. No.	Description	Height (m)	Bottom Width (m)	Top Width (m)	Area (sqm)	Length (m)	Volume	Total
	Filling Area in Inlet						17,365.14	
	Filling Area in between Facultative Ponds						2,653.74	
	Filling behind M Pond						1,902.05	
	Total Filling in Existing STP						21,920.93	21921 cum
	Summary							
	Total Earthwork in cutting							
	(A + B + C + D + E + F + G + H)							
	Total bund making							
	(a + b + c + d + e + f + g + h + i + j)							

Design of Sewage Treatment Plant (Waste Stabilisation Pond) - for Ward 45 Ambattur Municipality - 0.4 Mld			
Total Flow, Q	=	400000	litres
	=	400	cum
BOD of incoming sewage	=	**250**	mg/l
Mean Temperature	=	30	C
Fecal Coliform	=	80×10^5	MPN/ 100ml
1. Design of Anaerobic Pond			
Retention time (Assumed)	=	5	days
Depth of Pond	=	3	m
Area of Pond = Q x t / D			
Where Q = Flow in m^3	=	400.00	cum
t = Retention period in days			
D = Depth in metres.			
Area of Pond	=	666.667	sqm
Provide 2 ponds of size 26 x 13 x 3m			
Area of Pond	=	676	sqm
Actual retention time	=	5.07	days
BOD reduction in anaerobic pond	=	56.00	%
BOD of effluent	=	110	mg/l
Quantity of effluent = Q-0.001Ae	=	393.24	cum
Where Q = Flow in m^3			
A = Area of Pond in Sq.m			
e = Evaporation in mm (10mm)			
2. Design of Facultative Pond			
Retention time (Assumed)	=	5	days
Influent BOD	=	110	mg/l
Area of Pond = $Q \times (L_i - L_e) / 18 \times D \times (1.05)^{T-20}$			
Where Q = Flow in m^3	=	393.24	cum
T = Mean temperature	=	30	^{0}C
L_i = BOD of Influent	=	110	mg/l
L_e = BOD of effluent (Assumed)	=	60	mg/l
Depth of Pond, D in metres	=	1.5	m
Area of Pond	=	447.07	sqm
Organic Loading = $10Q\ L_i / A$	=	967.56	kg/ha.day
Permissible Organic loading = 20T-120	=	480	kg/ha.day
As the organic loading rate is greater than the permissible organic loading rate the area of the pond as to be increased			
Provide 2 ponds of size 30 x 15 x 1.5m			
Area provided	=	900	sq.m
Now the organic loading rate = 10Q Li / A	=	480.63	kg/ha.day
	<	480	kg/ha.day
Hence OK			

Actual Retention time, V/Q	=	3.43 days
BOD of Effluent, Le = Li / 1+(0.3x(1.05)$^{T-20}$*t	=	41.08 mg/l
Quantity of effluent = Q-0.001Ae	=	384.24 cum
Where Q = Flow in m^3		
A = Area of Pond in Sq.m		
e = Evaporation in mm (10mm)		
3. Design of Maturation Pond		
Retention time (Assumed)	=	3.5 days
Depth of Pond	=	1.5 m
Area of Pond = Q x t / D	=	896.56
Where Q = Flow in m^3	=	384.24 cum
t = Retention period in days		
D = Depth in metres.		
Area of Pond	=	896.56 sqm
Provide 2 x 2 ponds of size 30 x 15x 1.5m	=	
Area of Pond	=	900 sqm
Actual retention time	=	3.51 days
Check for Bacterial Quality		
Fecal Coliform in raw sewerage (Assumed), N_i	=	80 x 10^5 MPN/100ml
Rate Constant, $K_{b(T)} = 2.6 \times (1.19)^{T-20}$	=	14.81
Fecal Coliform in treated sewerage, N_e		
$= N_i / (1+K_b \times t_{an}) (1 + K_b \times t_{fac}) (1+K_b \times t_m)^2$	=	**0.72** MPN/100ml
	<	100 MPN/100ml
Hence OK		
Actual Retention time, V/Q	=	3.51 days
BOD of Effluent, $L_e = L_i$ / (1+(0.3x(1.05)$^{T-20}$*t)^2	=	**5.57** mg/l
	<	20.00 mg/l
Hence OK		

Abstract Estimate for 0.4 Mld Waste Stabilisation PondTreatment Plant at Ward No.45 Ambattur Municipality

Sl. No.	Description of item	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
1	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	4,397	cum	28.75	126,413.75
	(As per Data Bank - Lead Charges)				
2	Spreading the available earth in layers of 25cm thick including watering upto Optimum moisture content, consolidation by power roller (Forming bund above GL from suitable excavated earth & laid in layers, watering, ramming & consolidation by rollers as per standard specifications as directed by the Departmental Engineer.	3,014	cum	30.60	92,228.40
	(As per Data Bank - Lead Charges)				
3	Supplying & laying of gravel 150 mm thick below precast slab, levelling the layer, watering and consolidation etc all complete as per standard specification and as directed by the Departmental Engineer.	563	cum	185.40	104,380.20
	(As per Data Bank - Lead Charges)				
4	Supplying and seeding of grass at 50 mm c/c including preparation of earth with sweet earth, 150 mm thick, watering and maintaining the lawn upto 6 months etc all complete as directed by the Engineer.	3,936	sqm	48.05	189,124.80
	(As per Data Bank - Lead Charges)				
5	Supplying and fixing in position RCC precast slabs of 450 x 450 x 50 mm over the bed of gravel to proper level etc all complete as directed by Engineer	2,427	sqm	151.58	367,884.70
	(As per Data Bank - Lead Charges)				
6	Construction of toe wall etc all complete as per standard specification or as directed by the Engineer.				
a)	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	96.67	cum	28.75	2,779.00
b)	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications	29.30	cum	2,110.00	61,812.55
c)	Construction of brick masonry with class II bricks in CM 1:6 in foundation including curing etc all complete as per standard specifications.	36.04	cum	2,371.00	85,456.00
d)	Plastering with C.M 1:4, 12 mm thick including necessary scaffolding, watering the surface etc all complete as per standard specification.	470.08	sqm	64.00	30,090.00
	(As per Data Bank - Lead Charges)				

Sl. No.	Description of item	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
7	Supplying & laying reinforced cement concrete of M 25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforcements which shall be measured & paid under separate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.	53.73	cum	3,258.00	175,053.00
	(As per Data Bank - Lead Charges)				
8	Supplying & erecting centering for sides & walls of outlet chamber including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm c/c etc. complete complying with standard specifications. Centering for RCC works below GL (wall).	160.07	sqm	428.00	68,510.00
9	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.	2,160.44	kg	51.00	110,182.00
10	Supply of NP 3 class RCC pipes as per IS:783, lowering into trenches, laying to proper grade and alignment, cutting the pipes true to axis & jointing the pipes & specials with cement mortar joints including cost of jointing material, testing the pipe to the required pressure as directed by the Departmental Engineer including barricading, provision of danger lights, arranging for watch & ward etc., complete as per specifications at different depths.				
	350 mm diameter	600	m	616.50	369,900.00
15	Supplying, delivery, spreading & fixing of LDPE sheet in all the Anaerobic, Facultative & Maturation ponds for avoiding the seepage / infiltration including transportation and labour charges etc complete as per standard specification and as directed by Engineer-in-charge.	1,660	sqm	100.00	166,000.00
16	Effluent Pump		LS		10,000
	Total Cost				**1,959,814**

Say Rs.19.60 Lakhs

Detailed Estimate for 0.4 Mld Waste Stabilisation Pond Treatment Plant at Ward NO.45 Ambattur Municipality

Sl. No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit
1	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	1				4,397	cum
2	***Spreading the available earth*** in layers of 25cm thick including watering upto Optimum moisture content, consolidation by power roller **(Forming bund** above GL from suitable excavated earth & laid in layers, watering, ramming & consolidation by rollers as per standard specifications as directed by the Departmental Engineer.	1				3,014	cum
3	**Supplying & laying of gravel 150 mm thick** below precast slab, levelling the layer, watering and consolidation etc all complete as per standard specification and as directed by the Departmental Engineer.						
	Anaerobic ponds						
	Sides	2	92.00	4.95	0.15	136.62	
	Top of bund	2	112.00	1.50	0.15	50.40	
	Facultative ponds						
	Sides	2	98.00	2.83	0.15	83.20	
	Top of bund	2	112.00	1.50	0.15	50.40	
	Maturation ponds						
	Sides	4	97.00	2.48	0.15	144.34	
	Top of bund	4	110.00	1.50	0.15	99.00	
	Net quantity					**563.00**	cum
4	**Supplying and seeding of grass** at 50 mm c/c including preparation of earth with sweet earth, 150 mm thick, watering and maintaining the lawn upto 6 months etc all complete as directed by the Engineer.						
	Anaerobic ponds						
	sides	2	127.00	3.53		896.62	
	bottom	2	140.00	1.00		280.00	
	Facultative ponds						
	sides	2	126.10	3.29		829.74	
	bottom	2	138.30	1.00		276.60	
	Maturation ponds						
	sides	4	120.20	2.37		1,139.50	
	bottom	4	128.40	1.00		513.60	
	Net quantity					**3,936.00**	**Sqm**
5	Supplying and fixing in position RCC precast slabs of 450 x 450 x 50 mm over the bed of gravel to proper level etc all complete as directed by Engineer						
	Anaerobic ponds	2	92.00	4.95		910.80	
	Facultative ponds	2	98.00	2.83		554.68	
	Maturation ponds	4	97.00	2.48		962.24	
	Net quantity					**2,427.00**	**Sqm**

Sl. No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit
6	**Construction of toe wall** etc all complete as per standard specification or as directed by the Engineer.						
	Anaerobic ponds	2	76.16			152.32	
	Facultative ponds	2	88.16			176.32	
	Maturation ponds	4	88.16			352.64	
	Net quantity					**681.28**	**Rmt**
a)	Earth work excavation & depositing on bank with an initial lead of 30 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standarad specification and as directed by Engineer.	1	681.28	0.43	0.33	96.67	cum
b)	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications	1	681.28	0.43	0.10	29.30	cum
c)	Construction of brick masonry with class II bricks in CM 1:6 in foundation including curing etc all complete as per standard specifications.	1	681.28	0.23	0.23	36.04	cum
d)	Plastering with C.M 1:4, 12 mm thick including necessary scaffolding, watering the surface etc all complete as per standard specification.	1	681.28	0.69		470.08	sqm
7	Supplying & laying reinforced cement concrete of M 25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforcements which shall be measured & paid under separate items) including curing, complying with standard specifications as directed by the Departmental Engineer using sulphate resisting cement.						
a	**RCC for inlet chamber**						
	Columns	12	0.23	0.23	2.00	1.27	
	Base slab	2	7.45	2.30	0.20	6.85	
	Vertical walls	2	18.90	1.10	0.15	6.24	
	Partition wall	2	2.00	1.10	0.15	0.66	
	Foundation	12	1.20	1.20	0.50	8.64	

Sl. No.	Description of item	No.	L (m)	B (m)	D (m)	Quantity	Unit
b	Refer Enclosure					30.07	
	Total					**53.73**	**24cum**
8	Supplying & erecting centering for sides & walls of outlet chamber including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to centre & supported by causarina props 10 to 13 cm diameter spaced at about 75 cm c/c etc. complete complying with standard specifications. Centering for RCC works below GL (wall).						
	Columns	12	0.69	2.00		16.56	
	Base slab	2	7.45	2.30		34.27	
	Vertical walls	4	18.90	1.10		83.16	
	Partition wall	4	2.00	1.10		8.80	
	Foundation	12	1.20	1.20		17.28	
	Total					**160.07**	sqm
9	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforcement in all positions, all labour & materials complete complying with standard specifications & drawings as directed by the Departmental Engineer.						
	Walls	16.81	100.00			1,680.66	
	Floors	6.85	70.00			479.78	
	Total					**2,160.44**	Kg
10	Supply of NP 3 class RCC pipes as per IS:783, lowering into trenches, laying to proper grade and alignment, cutting the pipes true to axis & jointing the pipes & specials with cement mortar joints including cost of jointing material, testing the pipe to the required pressure as directed by the Departmental Engineer including barricading, provision of danger lights, arranging for watch & ward etc., complete as per specifications at different depths.						
	350 mm diameter	1	600			600	Rmt
11	Supplying, delivery, spreading & fixing of LDPE sheet in all the Anaerobic, Facultative & Maturation ponds for avoiding the seepage / infiltration including transportation and labour charges etc complete as per standard specification and as directed by Engineer-in-charge.						
	Anaerobic Pond	2	20	9		360	
	Facultative Pond	2	25	10		500	
	Maturation Pond	4	20	10		800	
	Net quantity					**1,660**	sqm

RCC Estimation for STP

Descrption of Item	CL	W	H	Volume
Anerobic Pond				
Wall A	1.80	0.15	2.00	0.540
Wall B	1.50	0.15	1.00	0.225
Wall C	1.50	0.08	0.30	0.036
				0.801
Wing Walls				
abb'c'a'	0.50	0.15	1.72	0.129
bb'c	0.22	0.15	0.22	0.004
b'c'dd'f'c	1.50	0.15	1.50	0.338
ded'	1.50	0.15	1.50	0.169
f'd'ef	2.20	0.15	2.20	0.363
				1.002
For 2 Wing Walls				**2.004**
Flooring (Slab)				
a'c'f'	1.80	1.80	0.15	0.486
f'f	3.11	1.80	0.15	0.840
fg	0.15	1.80	0.30	0.081
				1.407
Grand Total				**4.211**
Maturation Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	0.15	2.00	0.540
Wall B	1.50	0.15	0.85	0.191
Wall C	1.50	0.15	0.50	0.113
				0.844
Wing Walls				
abkij	0.50	0.15	1.75	0.131
bck	0.50	0.15	0.50	0.019
kcdhgi	1.58	0.15	1.25	0.296
deh	0.75	0.15	0.75	0.042
efgh	0.75	0.15	0.50	0.056
				0.545
For 2 Wing Walls				1.089
Flooring (Slab)				
Flooring	1.90	1.80	0.15	0.513
Projection	0.15	1.80	0.15	0.041
				0.554
Grand Total				**2.487**
Facultative Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	0.15	2.50	0.675
Wall B	1.50	0.15	1.00	0.225
Wall C	1.50	0.08	0.80	0.096
				0.996
Wing Walls				
abjik	0.50	0.15	2.15	0.161
bcj	0.70	0.15	0.70	0.037
dgij	1.55	0.15	1.45	0.337
deh	0.95	0.15	0.95	0.068
efgh	0:95	0.15	0.50	0.071
				0.674
For 2 Wing Walls				1.348
Flooring (Slab)				
Flooring	2.15	1.80	0.15	0.581

Descrption of Item	CL	W	H	Volume
Grand Total				**2.925**
Reinforcement				
slabs @ 70 kg/cum	7.3494	70		514.458
Wall @ 100 kg/cum	22.7185	100		2271.852
	30.0679			**2786.31**
Centring				
Wall A	1.80	-	2.00	3.600
Wall B	1.50	-	1.00	1.500
Wall C	1.50	-	0.30	0.450
				5.550
Wing Walls				
abb'c'a'	0.50	-	1.72	0.860
bb'c	0.22	-	0.22	0.048
b'c'dd'f'c	1.50	-	1.50	2.250
ded'	1.50	-	1.50	2.250
f'd'ef	2.20	-	2.20	4.840
				10.248
For 2 Wing Walls				20.497
Flooring (Slab)				
a'c'f'	1.80	**1.80**	-	3.240
f'f	3.11	**1.80**	-	5.598
fg	-	**1.80**	0.30	0.540
				9.378
Grand Total				**35.425**
Maturation Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	-	2.00	3.600
Wall B	1.50	-	0.85	1.275
Wall C	1.50	-	0.50	0.750
				5.625
Wing Walls				
abkij	0.50	-	1.75	0.875
bck	0.50	-	0.50	0.250
kcdhgi	1.58	-	1.25	1.975
deh	0.75	-	0.75	0.563
efgh	0.75	-	0.50	0.375
				4.038
For 2 Wing Walls				8.075
Flooring (Slab)				
Flooring	1.90	1.80	-	3.420
Projection	0.15	1.80	-	0.270
				3.690
Grand Total				**17.390**
Facultative Pond				
Item	**CL**	**W**	**H**	**Volume**
Wall A	1.80	-	2.50	4.500
Wall B	1.50	-	1.00	1.500
Wall C	1.50	-	0.80	1.200
				7.200
Wing Walls				
abjik	0.50	-	2.15	1.075
bcj	0.70	-	0.70	0.490
dgij	1.55	-	1.45	2.248
deh	0.95	-	0.95	0.903
efgh	0.95	-	0.50	0.475

Descrption of Item	CL	W	H	Volume	
				5.190	
For 2 Wing Walls				10.380	
Flooring (Slab)					
Flooring	2.15	1.80	-	3.870	
Total				**21.450**	226.2096

Summary

Component	East Zone	West Zone	Total	RCC (cum)	Total RCC (cum)
Anerobic Pond	1	1	2	4.211	8.423
Maturation Pond	2	2	4	2.487	9.947
Facultative Pond	2	2	4	2.925	11.699
		TOTAL RCC QUANTITY			**30.07**

Earthwork & Refilling Quantity for new STP

Sl. No.	Description	Height (m)	Bottom Width (m)	Top Width (m)	Area (sqm)	Length (m)	Volume	Total
	Bunds							
1	Point A	1.49	5.21	1.50	5.00			
2	Point B	1.41	5.03	1.50	4.60			
3	Point C	0.78	3.45	1.50	1.93			
					3.84	114	438.26	
4	Point D	1.90	6.25	1.50	7.36			
5	Point E	1.05	4.11	1.50	2.95			
6	Point F	1.19	4.46	1.50	3.55			
					3.94	297	1,170.18	
7	Point G	1.40	5.00	1.50	4.55			
					4.05	93	376.47	
8	Point H	1.43	5.06	1.50	4.69			
9	Point I	1.97	6.41	1.50	7.79			
					5.50	298	1,639.00	
10	Point J	1.06	4.15	1.50	2.99			
11	Point K	0.79	3.48	1.50	1.97			
					3.31	297	983.07	
12	Point L	1.59	5.48	1.50	5.55			
13	Point M	1.34	4.84	1.50	4.25			
					5.85	300	1,755.00	
14	Point N	0.89	3.71	1.50	2.32			
					3.27	252	824.04	
15	Point O	1.26	4.64	1.50	3.87			
					3.57	252	899.64	
A	Total Earth from Existing Bunds						8,085.66	**8086 cum**
16	Silt in Inlet Zone						12,316.50	
17	Silt in West Zone						16,417.50	
18	Silt in East Zone						8,250.00	
B	Total Silt						36,984.00	**36984 cum**
	For New Treatment Plant							
	WEST ZONE							
a	Anerobic Pond	1.90	6.25	1.50	7.36	253.00	1,862.08	
	Bottom Filling						367.78	
b	Facultative Pond	1.75	5.88	1.50	6.45	727.50	4,692.38	
c	FP-Central Bund	2.00	6.50	1.50	8.00	199.25	1,594.00	
	Bottom Filling						7,435.16	
d	Maturation Pond	1.15	4.38	1.50	3.38	574.00	1,940.12	
e	MP-Central Bund	1.75	5.88	1.50	6.45	169.00	1,090.05	
C	Bottom Cutting						2,656.80	**2657 cum**
	Total Earth for Bunds and Filling						18,983.92	18984 cum
	EAST ZONE							
f	**Anerobic Pond**	1.75	5.88	1.50	6.45	214.00	1,380.30	
	Bottom Filling						194.59	
g	**Facultative Pond**	1.65	5.63	1.50	5.88	601.50	3,536.82	
h	FP-Central Bund	2.00	6.50	1.50	8.00	164.25	1,314.00	
	Bottom Filling						1,494.23	
D	Cutting New Area						1,276.35	
E	Cutting Triangle Area						9.56	
I	**Maturation Pond**	1	4	1.5	2.75	474	1,303.50	
j	MP-Central Bund	1.75	5.875	1.5	6.453	139	896.98	
F	Bottom Cutting						2,653.20	
G	Cutting New Area						2,690.81	
H	Cutting Triangle Area						43.02	
	Total Earth for Bunds and Filling						9,925.38	9929 cum
	Earth from Cutting						6,867.52	6868 cum

Sl. No.	Description	Height (m)	Bottom Width (m)	Top Width (m)	Area (sqm)	Length (m)	Volume	Total
	Filling Area in Inlet						17,365.14	
	Filling Area in between Facultative Ponds						2,653.74	
	Filling behind M Pond						1,902.05	
	Total Filling in Existing STP						21,920.93	21921 cum
	Summary							
	Total Earthwork in cutting							
	(A + B + C + D + E + F + G + H)							
	Total bund making							
	(a + b + c + d + e + f + g + h + i + j)							

WASTE WATER TREATMENT PLANT FOR WARD 45
AMBATTUR MUNICIPALITY (Conventional system)

DESIGN OF MODIFIED ACTIVATED SLUDGE SEWAGE TREATMENT PLANT
1 MLD CAPACITY

Population & Sewagw generation

Ward 45 has 39 streets.
Population as per 2001 census - 5047
Rate of decadal growth 30%

	Projected population		
Base year 2008 -	6106		
Ultimate design year -	10650		
Percapita water supply			110 lpcd
Sewage generation @80% of water supply ignoring infiltration			88 lpcd
		Say	90 lpcd
Total sewage generated = 0.9585 mld		Say	1.0 mld

Average sewage flow	=	1000 m^3 / day
	=	41.67 m^3 / h
	=	0.694 m^3 / min
	=	0.012 m^3 / s
Peak flow	=	3000 m^3 / d
	=	125.00 m^3 / h
	=	2.083 m^3 / min
	=	0.035 m^3 / s
BOD of influent sewage	=	250 mg/l

I. Pre Treatment Units

(a). Stilling Chamber

No. of Units	1
Detention time	10 min
Volume	21 m^3
Liquid Depth	2.00 m
Area of the Chamber	10.42 m^2
Dimensions	4.00 x 3.0 x 2.50 m

(b). Screen Chamber

No. of Units	1 No.
Velocity in approach channel at peak flow	0.60 m/s
Velocity in approach channel at average flow	0.30 m/s
Velocity through screen at peak flow	0.90 m/s
Cross sectional area of approach channel = 0.035 / 0.60	0.058 m^2
Cross sectional area of screen 0.041 / 0.9	0.039 m^2
Water depth U/S of screen	0.50 m
Water depth D/S of screen	0.35 m
Width of the channel	0.138 (or) 0.15m
Adopting screen with 12mm bars @ 25mm clear space	
Cross area of screen (0.046 x (3.7 / 2.5))	0.057 m^2

Velocity above screen at peak flow 0.9 x 2.5/3.7		0.608 m/sec
Head loss through the screen 0.0729 (0.9^2-0.608^2)		0.0321 m
If the screen openings are half plugged velocity through screen is doubled.		
Head loss = 0.0729 (1.8^2 - 0.608^2)		0.21 m
Width of the channel		0.15 m
Water depth u/s screen		0.50 m
Water depth d/s screen		0.468 m
Assuming an inclination of the screen to horizontal as 60°, the Gross area of screen needed would be.(2 /(√3))*0.057		0.0659

Dimensions	
Length	1.50 m
Width	0.15 m
Depth of water	0.50 m
Free Board	0.50 m
Total Depth	1.00 m

(c). Grit Chamber With Parshall Flume

No. of Units		1
Horizontal velocity		0.30 m/sec
Maximum flow		40.51 lps
Minimum flow		11.57 lps
From Table 11.2 of CPHEEO manual upto 5 Mld throat width (W)	=	0.075 m

Determination of Z

$d_{min} / d_{max} = 1 / 3.5 = \dfrac{1.1\ (11.57/2264 \times 0.075)^{2/3} - Z}{1.1\ (40.51/2264 \times 0.075)^{2/3} - Z}$ =

1.1 (11.57/2264 x 0.075)2/3

1.1 (40.51/2264 x 0.075)2/3

1/3.5 = 0.1835 – Z / 0.3847 – Z

Z =0.10302 = 0.2577

$d_{min} = 1.1\ (11.57/2264 \times 0.075)^{2/3} - Z$

= 0.1835-0.10302= = 0.081 m

$d_{max} = 1.1\ (40.51/2264 \times 0.075)^{2/3} - Z$

= 0.3847-0.10302 = 0.2817 m

Width of the Grit Chamber

b = Qmax / 1000 x dmax x Vmax = Qmin / 1000 x dmin x Vmin

40.51/ 1000 x 0.2871 x 0.3 = 11.57 / 1000 x 0.081 x 0.3 = 0.4703

The ideal over flow rate is 1300 $m^3/d/m^2$

for the lowest Temperature of 18°c, over flow is 1.24x1300

Applying correction factor of 0.666,

Over flow rate	=	10.75 (or) say 1000 $m^3/d/m$
Q/A	=	1000 $m^3/d/m^2$
Area	=	3 m^2
Width of the chamber	=	0.476 m
Length of chamber	=	6.30 (or) say 7.5m
Detention Period, V/Q =(3.5*0.2817*1440)/3500	=	0.41 Min

II. Primary Treatment -

a) Primary Settling Tank (1 mld)

Peak factor	=	3
Average flow	=	1.00 Mld
Surface loading rate	=	25 $m^3/d/m^2$
Surface Area required	=	40 m^2
Area required for surface loading rate of 59$m^3/d/m^2$ for peak flow = 3000 / 59 = 50.5 m^2	=	50.85 m^2
Area needed for Solids loading rate of 125kg/day/m^2 = (1000x3000)/(125x1000)	=	24 m^2
Area needed for Solids loading of 250kg/day/m^2 for peak flow = (3000x3000)/(250x1000)	=	36 m^2
Adopting the higher Surface area of 59.32 (or) 50.85 m^2	=	50.85 m^2
Diameter	=	8.704 (or) say 8.80m
Detention period	=	2 1/2 hrs
Depth	=	1.71 (or) Adopt 2
Weir loading rate = 1000/(πx8.8)	=	36.17 $m^3/d/m^2$

Hence O.K

Outlet arrangement for Primary Clarifier-1Mld

1). Effluent weir

Length of effluent weir plate π x 8.8	=	27.64 m
Provide 90° v notches @ 25cm c/c		
Total No. of notches = 27.15 x 4	=	110
Average discharge per notch = 1000/(24x60x60x110)	=	0.0001052
		1.047 x 10^{-4}

The discharge through a V notch is $Q = 8/15\ cd\ \sqrt{2g}\ \tan\theta/2\ H^{5/2}$

cd = 0.584 θ = 90°

Head over V notch at peak flow =$[(15x3.682x10^{-4})\ /\ (8x0.584x\sqrt{2x9.81})]^{2/5}$ = 0.037m

Provide 5 cm deep 90° V notches @ 25cm c/c

Effluent Channel

Assume the width as 0.15m

Critical depth at the end of effluent channel Y_2 is

$Y_2 = [(1000/(24x3600))^2 / (0.15^2x9.81)]^{1/3}$

= 0.085m

Depth at upper end

$Y_1 = \sqrt{Y_2}+2(1000/(24x3600)x2)^2 / 9.81x0.15^2x0.085$

= $\sqrt{0.085^2}+2(1000/24x3600)x2)^2 / 9.81x0.15^2x0.085$

= 0.254

Provide a depth of 0.40m

III. Secondary Treatment

a). Aeration Tank

Average Flow	=	1000 m^3/d
BOD of influent to aeration tank = 250x 0.65	=	162.5 mg/l
Efficiency =142.5/162.50	=	0.88
F/M =0.3 , MLSS(Xt) =3000mg/l	=	
F/M = (Q. LA)/(VXt/1000)		
= (1x162.5x1000)/(Vx3000)	=	0.2
V	=	217 m^3
Check for Hydraulic Retention time		
HRT = (V / (Qx1000)) x 24		
= (217 / 1x1000)) x 24	=	5.21
Volumetric Loading Q x La / V = 1x195 / 217	=	0.749 (or) 0.8
Within permissible range of 0.8 to 2		
Return Sludge (SVI = 100)		
Qv / Q = (Xt / ((10^6 / SVI)-Xt))		
= (3000 / ((10^6 / 100) - 3000))	=	42.86 %
With permissible range of 25 to 50%		

Tank dimensions

Adopting a depth of 3m		
Area = 217 / 3	=	72.33 m^2
Provide a tank of size 9m x 8m x 3.5m		

Excess Sludge

QwXs = 0.5x1000x175.5-0.06x3000x217	=	87750 g/d
	=	87.75 kg/d

Sludge Recirculation

Sludge Recirculation ratio =3000/10000	=	0.00
As this ratio is bet 0.25 & 0.8 it is acceptable however provide a ratio of 0.33		0.33
Sludge recirculation pump capacity = 0.33 x 1000		330 m^3/d

Oxygen Requirement

$(Q(S_0-S)) / f) - 1.42 Qw Xs)$		
((1000*175.5)/0.68)-1.42*48690	=	133483.24 g / d
Kg O_2 required / kg BOD removed		
188948.4/(1000*175.5)	=	0.76
This is only marginally higher than that the permissible value of 0.8 to 1.0		
Hence acceptable		
Capacity available aerator equipment = 1.20 kg of O_2/kwh		
Therefore power requirement for aeration equipment		
((188.948/24)/1.2) (1 Mld)		4.63 kwh

Sludge Generated
Primary Sludge Solids
1000x480x0.75x1/1000 = 360 kg/d
Primary Sludge Volume
360/40 (assumed) 40kg/m^3 = 9.00 m^3/d
Secondary Sludge Solid = 4.87 m^3/d
Total Sludge Volume = 15.51 m^3/d

(b). Secondary Clarifier
Peak factor = 3
Average flow = 1000 m^3/day
Peak flow = 3000 m^3/day
Adopting a surface loading rate 20$m^3/d/m^2$ at average flow
Surface area required = 1000/20 = 50 m^2
Area required Surface loading of 50$m^3/d/m^2$ at peak flow =3000/50 = 60 m^2
Area needed for Solids loading rate of 125kg/day/m^2 at average flow
= (1000x2000) / (125x1000) = 16 m^2
Area needed for Solids loading rate of 250$m^3/d/m^2$ at peak flow
= (3500x2000) / (250x1000) = 28m^2 = 24 m^2
The higher surface area of 70m^2 is adopted
Diameter = 9.44 (or) 9.5 m
Detention time = 2 hrs
Depth = 83.33 / 70.88 = 1.18 (or) say 2.0r
Weir loading = 1000/(πx9.5) < 150$m^3/d/m^2$ = 33.51 < 150 $m^3/d/$
Hence O.K

Outlet arrangement for Secondary Clarifier
1). Effluent weir
Length of effluent weir plate = πx9.5 = 29.85 m
Provide 90° V notches @ 25cm c/c
Total No. of notches = 29.85 x 4 = 119
Average discharge per notch = 1000 / (24x60x60x119) = 9.6951E-05
= 9.65×10^{-5}

The discharge through V notch is $Q = 8/15\ cd \sqrt{2g} \tan \theta/2\ H^{5/2}$
cd = 0.584 $\theta = 90°$
Head over V notch at peak flow
$=[(15 \times 3.378 \times 10^{-4})/(8 \times 0.584 \times \sqrt{2 \times 9.81})]^{2/5}$ = 0.036m
Provide 5 cm deep 90° V notches @ 25cm c/c

Effluent Channel
Assume the width as 0.15m
Critical depth at the end of effluent channel Y_2 is
$Y_2 = [(1000/(24 \times 3600))^2 / (0.15^2 \times 9.81)]^{1/3}$ = 0.085m

Depth at upper end

$Y_1 = \sqrt{(0.085^2+2(1000/24x3600)^2/9.81x0.15^2x0.085)}$

$= 0.254$

Provide a depth of 0.40m

(c). Sludge Well

Volume of Primary sludge	9 m^3/d
Volume of excess secondary sludge	4.87 m^3/d
Total Volume of sludge	13.87 m^3/d
Volume of sludge well	1.45 m^3
Dia of well	1.00 m
Depth of well	1.85 (or) 2 m

(d). Sludge digester

1). Raw effluent SS	480 mg/l
2).SS removal efficiency in primary sedimentation tank	75%
3). Quantity of Primary sludge generated Qx0.48kg/m^3x0.75	360 kg/d
4). At 4% consistency of 40 kg/m^3 SS concentration primary sludge volume	9 m^3/d
5). Excess activated sludge generated	48.70 kg/d
6). At 1% consistency of SS concentration of 10kg/m^3 the volume of excess activated sludge	4.87 m^3/d
7). Total Volume of raw mixed Sludge	13.87 m^3/d
8). Total quantity of raw mixed Sludge (360+48.70)	408.7 kg/d
9). SS concentration of raw mixed Sludge (408.7/13.87)	29.47 kg/m^3
10). Appropriate % of Volatile Matter (VM)	70%
11). Quantity of VM in raw mixed sludge (0.7x408.7)	286.09 kg/d
12). Quantity of Non VM or inorganic (0.3x408.7)	122.61 kg/l
For sludge temperature of 30°c the solid retention time (SRT) required	20 days
Digester Volume 13.87x20 (Volume of fresh sludge x retention time)	277 m^3
Choosing Two digester	2 nos.
Capacity each digester	139 m^3
Diameter 6m Φ	
Effective Depth	4.92 m
Additional storage for monsoon period (12 days) 13.87 x 12	166.44 m^3
Equivalent depth	2.94 m
Free Board	0.50 m
Total depth	9.00 m

(e). Sludge Drying Bed

1). Volume of digested sludge ((286.09x0.5+122.61)/50)	5.31 m^3
2). Dewatering, drying and sludge removal cycle	10 d
3). Depth of application of sludge	0.30 m
4). Total plan area of sludge drying bed	177 m^2
5). No. of beds	4
6). Size of bed	10 x 4.5 m

DETAILS OF WARD 45 OF AMBATTUR MUNICIPALITY

Sl. No.	Node	Name of Street	Pipes Length (m)	Size (mm)	Depth (m)	No. of House Connections
1	1-2	Vallalar Street	140			35
2	3-4	Kalaivanar Nagar Main Road	149			37
3	5-6	Dr.Radhakrishnan Street	93			26
4	7-8	Thiruvalluvar Street	99			27
5	9-10	J.N. Street	182			44
6	11-12	Rajaji Street	180			44
7	12-17	Nethaji Main Road	839			0
8	13-14	Logmania Thylakar Street	99			28
9	15-16	Kambar Street-1	98			27
10	17-18	Subbash Chandra Boss Street	167			42
11	19-20	X1	34			14
12	21-22	X2	37			16
13	23-24	Part of Kattabomman Street	41			16
14	25-26	Kattabomman Street	64			20
15	27-28	Kambar Street-2	75			22
16	29-30	Tank Street	105			30
17	31-32	Tank Cross Street	34			14
18	21-33	Kambar Street-3	144			0
19	34-35	V.O.C Street	133			35
20	35-47	TVS Main Road Parallel Road	195			0
21	36-37	Jawahar Street	135			36
22	38-39	Bharathiyar Street	139			35
23	40-41	Ambatkar Street	133			35
24	42-43	Anna Street-1	132			34
25	43-44	Anna Street-2	73			22
26	45-46	Amman Koil Street	189			45
27	47-48	Thiruvalluvar Street	219			50
28	49-50	Raja Raja Chozhan Street	151			33
29	24-51	Manikkavasakam Street	69			21
30	18-20	Thiru Vi Ka Street	179			44
31	48-22	Thendral & Manikkavasakam St.	109			29
32	52-53	Vivekanandar Street	153			38
33	53-20	Part of Thiru Vi Ka Street	31			13
34	20-54	Bharathiyar Street	178			43
		Total Length	**4798**			**955**

Estimate for Sewage Treatment Plant (MASP) - 1 MLD for Ward 45- Ambattur Municipality

Sl. No.	Description of work	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
1	Earth work excavation & depositing on bank with an initial lead of 10 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standard specification and as di	844.16	cum	28.75	24,269.59
2	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications	63.98	cum	2,110.00	135,007.97
3	Supplying & laying Reinforced Cement Concrete of M25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforceme	377.23	cum	3,539.00	1,335,025.21
4	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforc	37723.23	Kg	51.00	1,923,884.87
5	Supplying & erecting centering for sides & walls including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to	2538.19	sqm	428.00	1,086,343.18
6	Supply and filling filtermedia in drying bed				
	a) Clean river sand of eff size 0.5to0.75 mm	54	cum	580.50	31,347.00
	and uni. Coeff.not>4 30 cm		cum		
	b) HBG jelly 20mm 15cm	27	cum	780.00	21,060.00
	c) HBG jelly 40mm 15cm	34	cum	560.00	19,040.00

Sl. No.	Description of work	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
7	Supplying and installation of following machineries including all electrical works and labour charges etc complete as per standard specifications and as directed by Engineer-incharge				
	Machinery				
	Bar screen	1	no.	5,000.00	5,000.00
	scraper motor-reduction gear primary clarifier (Including scraper mechanism)	1	no.	20,000.00	20,000.00
	aeration tank (1 HP)	4	nos.	25,000.00	100,000.00
	scraper motor- secondary clarifier	1	no.	30,000.00	30,000.00
	sludge recirculation pump	1	no.	10,000.00	10,000.00
	sludge well pump	1	no.	8,000.00	8,000.00
	stirrer- digester	2	nos.	25,000.00	50,000.00
	Filtrate pump (1 HP)	1	no.	10,000.00	10,000.00
8	Earth work excavation & depositing on bank with an initial lead of 10 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely.soil as directed by the Departmental Engineer. (Pipeline	237	cum	57.50	13,627.50
9	Supply of 200 mm diameter of DI pipes (K9 class) as per IS:8329-2000 with sulphate resistance cement with inner lining of high alumina cement as per IS:783 with epoxy coating outside of the spigot portion and poly solution coating inside the socket portio	250	m	1,229.80	307,450.00
10	Supply and laying 200 mm GSW pipe loose jointed underdrains				
	drying beds	40	m	197.00	7,880.00
12	Supply and installation of following size of CI Double Flanged Sluice Valves (PN 1.0) with cap and confirming to IS:14846, to site, including flanged tail pieces and other specials as required, loading, unloading, transportation charges & stacking at site				
	sluice valves 200 mm	4	nos.	10,128.00	40,512.00
	Sluice valve at Sludge drying beds 100mm	4	nos.	4,100.00	16,400.00
#REF!	#REF!	#REF!			10,000.00

Sl. No.	Description of work	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
13	Supplying and fixing of 150 W HPSV street light fixture with single piece, deep drawn aluminium reflector, copper wound ballast, capacitor, junction box, porceline terminal box, 40 NB class 2 GI pipe for fixture mounting, cleats etc. complete in all respe	6	nos.	4,500.00	27,000.00
14	Providing Internal electrification arrangement including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer incharge	1			6,800.50
15	Construction of Office cum Electrical room of size of 6 x 3 x 4 m at STP I premises including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer-incharge	1	No.	136,010.00	136,010.00
17	Construction of Compound wall for 180 m length for STP I premises including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer-incharge				
	compound wall	180	m	1,042.41	187,633.80
	Gate 2.5x2.1m	1	no	17,443.00	17,443.00
18	Construction of WBM road in the STP site including a) supplying and spreading gravel of 100 mm thickness, including labour charges b) providing and laying WBM 75 mm (Grade II) compacted thickness with Grade II metal using 1 m^3 of 63 to 45 mm HBG metal wit	43.75	cum	1,619.55	70,855.31
					410
	TOTAL COST				**5,651,000**

Detailed Estimate for Sewage Treatment Plant (MASP) 1 MLD for Zone II									
Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	RATE	AMOUNT
1	Earth work excavation & depositing on bank with an initial lead of 10 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely etc all complete as per standard specification and as directed by TWAD Board Officers								
	Inlet Chamber (Stilling Chamber) column	4	1.05	1.05	1.60	7.06			
	Screen Chamber column	1	1.05	1.05	1.60	1.76			
	Grit Chamber column	2	1.05	1.05	1.60	3.53			
	Parshall flume column	1	1.05	1.05	1.60	1.76			
	Inlet chamber to primary clarifier column	2	1.05	1.05	1.60	3.53			
	Primary clarifier	1	16.96			16.96			
	Primary clarifer (central portion)	1	3.141*1^2/4		0.50	0.39			
	Aeration Tank	1	10.40	9.40	1.25	122.20			
	Secondary clarifier	1	75.59			75.59			
	Secondary clarifer (central portion)	1	3.141*1^2/4		0.50	0.39			
	Sludge well	1	3.141*2.9^2/4		2.10	2.79			
	Sludge digestor	2	3.141*7.26^2/4		2.00	113.08			
	Sludge Drying Beds	8	6.90	5.40	1.60	476.93			
	Sludge drying Beds channel (central portion)	4	10.30	1.00	0.50	20.60			
	Filtrate well	1	3.141*1.3^2/4		2.00	2.65			
	Effluent well	1	3.141*1.3^2/4		1.50	1.99			
	Net quantity					**851.22**	**cum**	**26**	22132
2	Providing and laying base concrete in foundation using Plain Cement Concrete 1:3:6 including consolidation and levelling etc as per standard specifications								
	Inlet Chamber (Stilling Chamber)column	4	1.05	1.05	0.10	0.44			
	Screen Chamber column footing	1	1.05	1.05	0.10	0.11			
	Grit Chamber column footing	**2**	1.05	1.05	0.10	0.22			
	Parshall flume column footing	**1**	1.05	1.05	0.10	0.11			
	Inlet chamber to primary clarifier column footing	**2**	1.05	1.05	0.10	0.22			
	Primary clarifier	**1**	2.12			2.12			
	Primary clarifer (central portion)	1	3.141*1^2/4		0.10	0.08			
	Aeration Tank	1	10.40	9.40	0.10	9.78			
	Secondary clarifier	1	9.45			9.45			
	Secondary clarifer (central portion)	1	3.141*1^2/4		0.10	0.08			
	Sludge well	1	3.141*2.9^2/4		0.10	0.13			
	Sludge digestor	2	3.141*7.26^2/4		0.10	5.65			
	Sludge Drying Beds	8	6.90	5.40	0.10	29.81			
	Sludge drying Beds channel (central portion)	8	6.90	1.00	0.10	5.52			
	Filtrate well	1	3.141*1.3^2/4		0.10	0.13			
	Effluent well	1	3.141*1.3^2/4		0.10	0.13			
	Net quantity					**63.98**	**cum**	**2203.85**	141013

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Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	RATE	AMOUNT
3	Supplying & laying Reinforced Cement Concrete of M25 grade using machine crushed hard broken granite stone jelly 20 mm for RCC works in all types of foundations, floor slabs of all shapes (Excluding cost of providing centering & fabrication of reinforceme								
	Inlet/ stilling chamber								
	side walls all around	1	14.30	2.50	0.15	5.36			
	base slab	1	4.30	3.30	0.15	2.13			
	columns	4	0.30	0.30	3.00	1.08			
	footing	4	0.75	0.75	0.20	0.45			
	baffles	3	3.00	0.10	2.00	1.80			
	screen chamber								
	side walls	1	3.60	1.00	0.15	0.54			
	base slab	1	1.80	0.45	0.15	0.12			
	columns	1	0.30	0.30	3.00	0.27			
	footing	1	0.75	0.75	0.20	0.11			
	grit chamber								
	side walls	2	7.65	1.00	0.15	2.30			
	base slab	1	7.65	0.80	0.15	0.92			
	columns	2	0.30	0.30	3.00	0.54			
	footing	2	0.75	0.75	0.20	0.23			
	Parshall flume								
	side walls	2	1.20	1.00	0.15	0.36			
	base slab	1	1.20	0.65	0.15	0.12			
	columns	1	0.30	0.30	3.00	0.27			
	footing	1	0.75	0.75	0.20	0.11			
	Chamber- inlet to primary clarifier								
	side walls around	1	2.60	2.00	0.15	0.78			
	base slab	1	1.00	0.65	0.15	0.10			
	columns	1	0.30	0.30	1.90	0.17			
	footing	1	0.75	0.75	0.50	0.28			
	Primary clarifier								
	side wall	1	28.10	0.15	3.00	12.65			
	bottom slab	1	65.01		0.15	9.75			
	effluent channel slab	1	29.67	0.30	0.10	0.89			
	effluent channel side wall	1	30.93	0.10	0.40	1.24			
	aeration tank								
	side walls allround	1	35.60	0.30	4.50	48.06			
	base slab	1	9.80	8.80	0.15	12.94			
	beam for fixing aerators	2	8.80	0.45	0.45	3.56			
	Secondary clarifier								
	side wall	1	30.30	0.15	3.00	13.64			
	bottom slab	1	75.39		0.15	11.31			
	effluent channel slab	1	31.71	0.30	0.10	0.95			
	effluent channel side wall	1	32.97	0.10	0.40	1.32			
	Sludge well								
	side wall	1	6.75	0.15	2.50	2.53			
	base slab	1	4.15		0.15	0.62			
	Digester								
	side wall	2	19.88	0.33	9.00	118.06			
	base slab	2	34.82		0.20	13.93			

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Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	RATE	AMOUNT
	roof	2	36.42		0.10	7.28			
	Drying bed								
	side wall	8	21.60	0.15	2.00	51.84			
	base	8	6.90	5.40	0.15	44.71			
	Filtrate well								
	side wall	1	3.61	0.15	2.50	1.35			
	base slab	1	1.33		0.15	0.20			
	Effluent well								
	side wall	1	3.61	0.15	4.00	2.17			
	base slab	1	1.33		0.15	0.20			
	Net quantity					**377.23**	**cum**	**3424.31**	1291760
4	Supplying, fabricating & placing in position MS or deformed steel bars for all RCC items of work including cost of steel transporting, straightening, cutting, bending, cranking, binding etc. including cost of binding wire charids, laps to fix the reinforc	1	100		377.23	37723	Kg	36.475	1375955
5	Supplying & erecting centering for sides & walls including supports & strutting for plain surfaces with all cross bracings using 25 mm thick boards suitable purlined over silver oak (country wood) joists of size 10 x 6.5 cm spaced at about 90 cm centre to								
	Inlet/ stilling chamber								
	side walls all around	2	14.30	2.50		71.50			
	base slab	1	4.30	3.30		14.19			
	columns	4		1.20	3.00	14.40			
	footing	4	4.20		0.50	8.40			
	baffles	3	6.00		2.00	36.00			
	screen chamber								
	side walls	1	3.60	1.00		3.60			
	columns	1	1.20		3.00	3.60			
	footing	1	4.20		0.50	2.10			
	grit chamber								
	side walls	2	7.65	1.00		15.30			
	base slab	1	7.65	0.80		6.12			
	columns	2	1.20		3.00	3.60			
	footing	2	4.20		0.50	2.10			
	Parshall flume								
	side walls	2	1.20	1.00		2.40			
	base slab	1	1.20	0.65		0.78			
	columns	1	1.20		3.00	3.60			
	footing	1	4.20		0.50	2.10			
	Chamber- inlet to primary clarifier								
	side walls around	1	2.60	2.00		5.20			
	base slab	1	1.00	0.65		0.65			
	columns	1	1.20		1.90	2.28			
	footing	1	4.20		0.50	2.10			
	Primary clarifier								

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Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	RATE	AMOUNT
	side wall	2	28.10		3.00	168.60			
	effluent channel slab	1	28.73	0.15		4.31			
	effluent channel side wall	2	30.14		0.40	24.12			
	aeration tank								
	side walls allround	2	35.60		4.50	320.40			
	base slab	1	36.40		0.15	0.00			
	beam for fixing aerators	2	8.80	1.25		22.00			
	Secondary clarifier								
	side wall	2	30.30		3.00	181.80			
	effluent channel slab	1	31.56	0.15		4.73			
	effluent channel side wall	2	32.34		0.40	25.87			
	Sludge well								
	side wall	2	6.75		2.50	33.75			
	Digester								
	side wall	4	19.88		9.00	715.68			
	roof	2	36.42			72.84			
	Drying bed								
	side wall	16	21.60		2.00	691.20			
	base	8	21.60		0.15	25.92			
	Filtrate well								
	side wall	2	3.61		2.50	18.06			
	Effluent well								
	side wall	2	3.61		4.00	28.89			
	Net quantity					**2538.19**	**sqm**	**330.08**	837804
6	Supply and filling filtermedia in drying bed								
	a) Clean river sand of eff size 0.5to0.75 mm	8	6	4.5	0.3	64.80	cum	580.5	37616
	and uni. Coeff.not>4 30 cm								
	b) HBG jelly 20mm 15cm	8	6	4.5	0.15	32.40	cum	713	23101
	c) HBG jelly 40mm 15cm	8	6	4.5	0.2	43.20	cum	**518**	22378
7	Supplying and installation of following machineries including all electrical works and labour charges etc complete as per standard specifications and as directed by Engineer-incharge								
	Machinery								
	Bar screen	1				1	no.	5000	5000
	scraper motor-reduction gear primary clarifier (Including scraper mechanism)	1				1	no.	20000	20000
	aeration tank (1 HP)	4				4	nos.	25000	100000
	scraper motor- secondary clarifier	1				1	no.	30000	30000
	sludge recirculation pump	1				1	no.	10000	10000
	sludge well pump	1				1	no.	8000	8000
	stirrer- digester	2				2	nos.	25000	50000
	Filtrate pump (1 HP)	1				1	no.	10000	10000
8	Earth work excavation & depositing on bank with an initial lead of 10 m & lift of 2 m for depths in hard stiff clay, stiff black cotton, hard red earth mixed with small sized boulders & hard gravely soil as directed by the Departmental Engineer. (Pipeline								
	Inlet chamber to primary clarifier	1	10	0.80	1.00	8			

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Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	RATE	AMOUNT
	Aeration to secondary clarifier	1	10	0.80	1.00	8			
	Primary clarifier to sludge well	1	40	0.80	1.00	32			
	Secondary clarifier to sludge well	1	5	0.80	1.00	4			
	Secondary clarifier to Aeration	1	45	0.80	1.00	36			
	Sludge well to Digester	1	10	0.80	1.00	8			
	Digester to sludge drying beds	1	35	0.80	1.00	28			
	Sludge drying bed to effluent well	1	25	0.80	1.00	20			
	Filtrate well to primary clarifier	1	30	0.80	1.00	24			
	Effluent well to sludge drying bed	1	30	0.80	1.00	24			
	Effluent well to surplus course	1	25	0.90	2.00	45			
	Net quantity					**237**	**cum**	**52**	12324
9	Supply of 200 mm diameter of DI pipes (K9 class) as per IS:8329-2000 with sulphate resistance cement with inner lining of high alumina cement as per IS:783 with epoxy coating outside of the spigot portion and poly solution coating inside the socket portio								
	Inlet chamber to primary clarifier	1	12			12			
	Aeration to secondary clarifier	1	18			18			
	Primary clarifier to sludge well	1	40			40			
	Secondary clarifier to sludge well	1	5			5			
	Secondary clarifier to Aeration	1	45			45			
	Sludge well to Digester	1	30			30			
	Digester - sludge drying beds	1	45			45			
	Sludge drying bed to effluent well	1	25			25			
	Effluent well to sludge drying bed	1	30			30			
	Net quantity					**250**	**m**	**1520**	380000
10	Supply and laying 200 mm GSW pipe loose jointed underdrains								
	drying beds	4	10			40	m	197	7880
11	Supply of 300 mm diameter NP 3 class RCC pipes with sulphate resistance cement with inner lining of high alumina cement as per IS:783 with epoxy coating outside of the spigot portion and poly solution coating inside the socket portion, lowering into trenc	1	25			25	m	544.7	13618
12	Supply and installation of following size of CI Double Flanged Sluice Valves (PN 1.0) with cap and confirming to IS:14846, to site, including flanged tail pieces and other specials as required, loading, unloading, transportation charges & stacking at site								
	sluice valves 200 mm	4				4	nos.	12017.7	48071
	Sluice valve at Sludge drying beds 100mm	4				4	nos.	4615.88	18464
13	Supplying and fixing of 150 W HPSV street light fixture with single piece, deep drawn aluminium reflector, copper wound ballast, capacitor, junction box, porceline terminal box, 40 NB class 2 GI pipe for fixture mounting, cleats etc. complete in all respe	6				6	nos.	4500	27000

Sl. No.	Description of work	No.	L (m)	B (m)	D (m)	Quantity	Unit	RATE	AMOUNT
14	Providing Internal electrification arrangement including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer-incharge	1			LS	1		6800.5	6801
15	Construction of Office cum Electrical room of size of 6 x 3 x 4 m at STP I premises including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer-incharge	1				1	No.	117622	117622
16	Providing water supply and sanitary arrangement to Office cum Electrical room including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer-incharge					1	NO	3000	3000
17	Construction of Compound wall for 180 m length for STP I premises including all cost of materials and labour charges etc complete as per standard specifications and as directed by Engineer-incharge	1				1	M	382538	382538
	Gate 2.5x2.1m					1	No.	17443	17443
18	Construction of WBM road in the STP site including a) supplying and spreading gravel of 100 mm thickness, including labour charges b) providing and laying WBM 75 mm (Grade II) compacted thickness with Grade II metal using 1 m^3 of 63 to 45 mm HBG metal wit	1	50.00	3.50	0.25	43.75	cum	1619.55	70855
	LEVELLING THE SITE								1625
									5092000

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Abstract Estimate for Collection System					
DEWAT for Ward 45 , Ambattur Municipality					
	(Waste water collected through existing septic tanks of house holds)				
Zone I		Length/No	Rate	Amount	
	Supplying, Laying (Small bore sewers)				
	PVC Pipes 110 mm	1020	183.63	187303	
	PVC Pipes 125 mm	1682	227.6	382823	
	PVC Pipes 140 mm	578	329.57	190491	
	Construction of Chambers				
	1.05 x 0.9m x1m Depth	3	8926	26778	
	1.5m Depth	3	11427	34281	
	2.0m Depth	3	13917	41751	
					863427
Zone II					
	Supplying, Laying (Small bore sewers)				
	PVC Pipes 110 mm	1009	183.63	185283	
	PVC Pipes 125 mm	1910	227.6	434716	
	PVC Pipes 140 mm	321	329.57	105792	
	Construction of Chambers				
	1.05 x 0.9m x1m Depth	5	8926	44630	
	1.5m Depth	4	11427	45708	
	2.0m Depth	3	13917	41751	
					857880
Zone III					
	Supplying, Laying (Small bore sewers)				
	PVC Pipes 110 mm	600	183.63	110178	
	PVC Pipes 125 mm	1091	227.6	248312	
	PVC Pipes 140 mm	62	329.57	20433	
	Construction of Chambers				
	1.05 x 0.9m x1m Depth	3	8926	26778	
	1.5m Depth	3	11427	34281	
	2.0m Depth	2	13917	27834	
					467816
				Total	2189123
				Say	Rs.21.90 lakhs