Auroville

Study on Sustainable Waste Water Management for the Residential Zones I and II

Part Three
(rev1)

Design Options and Cost Estimates
for Treatment Plants, Sewerage and Associated Components

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Note on the structure of this study (continued from Part 1and 2)

The study is comprised of four major sections. Each section describes an independent activity that builds up on the previous section and forms the basis of the subsequent section.

Part 1. - Surveys and Analysis (January 2013)

In this part the base parameters for dealings with waste water in the Study Area were established. The existing communities were surveyed. National and international norms researched and assessments were made in regard to

a. quantity and quality of wastewater to be treated
b. re-use of recycled water
c. treatment, re-use or disposal of sludge
d. performance of existing treatment plants

Part 2. – Design Parameters and Recommendations (September 2013)

In this section the findings of the previous chapters are reviewed to formulate the design parameters for the

a. New treatment plant
b. Sewage pipe systems
c. Other machinery, pumps
e. Recommendations for upgrading existing plants

Part 3. – Design Concepts (*current volume)*

This section provides conceptual designs and cost estimates of different choices of treatment systems and system components

a. Treatment plant(s)
b. sewer pipe network
c. and other machinery

Part 4. – Discussion

In this section a comparison and discussion of the options of Part 3 will be presented

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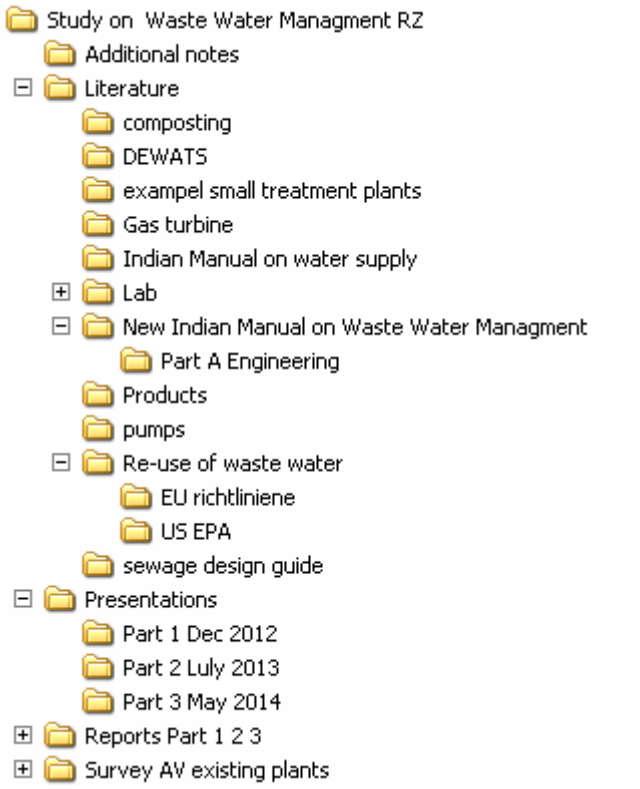
File Sharing

All Files drawings and presentations that were produces under this study, and many research articles and manuals are available in soft copy on a shared Cloud Drive. Access to these files can be given on request by L'Avenier. The current file structure is shown below. As the final Part 4 of the study is still outstanding this structure may change.

File Structure



Introduction

People mostly associate with waste water a repulsive substance that is best not closer examined and disposed off as quickly as possible.
Untreated waste water causes pollution in lakes, rivers and ground water, hence treatment methods were devised and specifications formulated so that the waste water should be disposed of safely without degrading the environment.

The Residential Zone in Auroville has reached a population density were the un-controlled release of semi-treated waste water from a multitude of different septic tanks is not supportable any more. An organized approach for the proper management has to be found.
In a time when water becomes more and more scarce the concept of "waste" water has undergone a transformation and it is now viewed as a potentially valuable resource for agriculture and industry. Correspondingly the target of treatment has shifted from safe disposal to re-use. In tropical-dry countries like Tamil Nadu, India the location of the Study Area, this concept gains even more importance. Hence the treatment goal for all waste water collected in the study area should be that it can be safely re-used for irrigation.

A multitude of treatment technologies exist, each with advantages and disadvantages. These are mostly expressed in terms of treatment efficiency, retention time, reliability, foot print and capital and operational cost. For different types of waste water some treatment methods can be more, others less beneficial. Similarly geographic location, climate and other factors play a role. Hence there is no single "best" treatment method. The chief tasks of this part of the study is to present choices of practical designs along with cost estimates for a centralized treatment plant and sewage connection network.

The current part is part 3 of the study covers three chapters.

Chapter 1 – Discussion of the site for the proposed treatment plant

Chapter 2 –Development of the sewage network.

Chapter 3 - Design examples of waste water treatment plants

Four designs based on different treatment technologies are presented. Two of the designs were obtained from Auroville based companies. The designs are presented "as received" in the call for offers. An evaluation of the designs will be subject of Part 4 of this study.

Summary

Under this part of the study commercial offers were sought for the design, supply and installation of a centralized waste water treatment plant, collection-sewer network and a distribution system for the re-cycled water into the communities.
A suitable site for the treatment plant has been identified at the extension of the Vikas Radial. The sewer network will be developed in phases and expanded as necessary. During the 1st phase a trunk sewer would be laid along the entire Vikas Radial and part of

the Crown Road, leading up the treatment plant. This would provide the possibility that existing projects and several upcoming housing projects like Maytree 3, Arati 3, Green Kasbah could be connected to the new sewer.
The pipe to distribute the re-cycled waste water to the communities will be laid alongside the sewer lines.
For the design and supply of the treatment plant five proposals using different technologies were received.
The total cost of phase 1 of the project for 1000 Person Equivalent is estimated as follows

Site development	Rs 1.7 lakh	(page11)
Treatment plant	Rs 33.7 lakh*	(page52)
Monitoring Equipment	Rs 1.5 Lakh	(page55)
Office and infrastructure	Rs 15.6 lakh	(page11)
Sewage lines	Rs 35.5 lakh	(page22)
Re-distribution line	Rs 4.1 lakh	(page22)
Total	Rs 91.6 lakh**	

The time for execution of the treatment plant, the trunk sewer and selected branch sewers is estimated at 12 month.
Run-in time of the treatment plant is projected with 8-12 weeks after completion. Further branch sewers will provided after the plant is operational.
The operation and maintenance cost of the treatment plant is estimated at Rs 5.2 lakh per year (Page 52), or Rs 43 per person and month (at full capacity). This figure includes charges for electrical power (TNEB) for a maximum load of 5 kW, of Rs 2.0 lakh per annum. If the plant is connected to the high-tension/ private transformer loop of the Residential Zone, this charge would be waved. Cost increase of 5-10% annually should be assumed.
The design includes a sludge processing unit with subsequent composting. The treatment plant has the capacity to process additional sludge (2000 PE) that can be delivered to site from outlying communities.

* The cost of the treatment plant differs from proposal to proposal. The cost for other infrastructure would be similar as indicated.

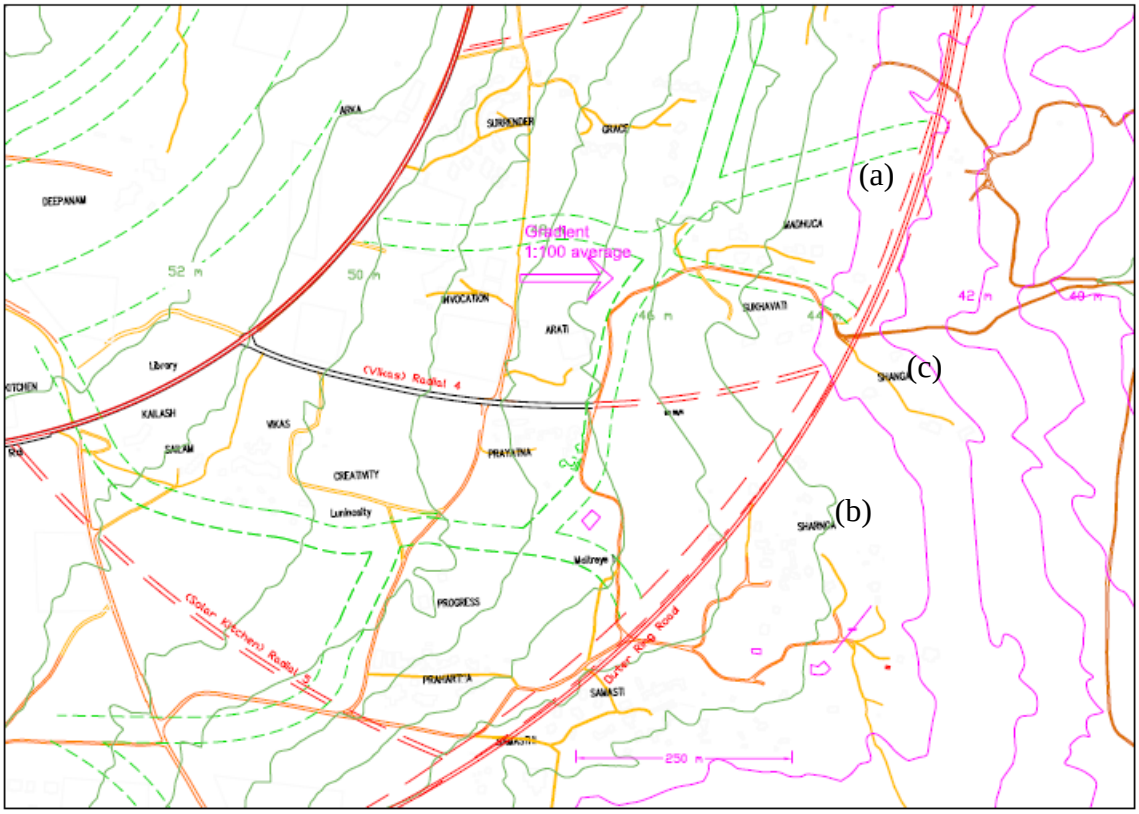
** The cost is based on rates as of February 2013, excluding tax

Chapter 1

Considerations for the location of treatment plant

The sewage system is to be developed based on gravity flow. A lifting pump should be avoided because it would complicate the drainage system. Hence the main criteria for selecting a suitable site for the location of the treatment plant is that it should be at an elevation lower than the area that is to be drained.

The areas with elevation that would fulfill this criteria is indicated in the attached map (magenta colored contours).



Three possible locations for the treatment plant have been identified. -

a) Plot extension east of Grace

b) Plot south-east of Sharnga

and

c) Plot east of Shanga.

Of the three options the option c) was found to be ideally suited. The plot size is about 1800 m2 and efforts are being made to acquire the land. This location shows the following advantages:

- The land is located at an elevation, sufficiently low so that the waste water from the entire RZ I and II can drain by gravity to the treatment plant (see drawing - east of magenta colored contour lines).

- it is “connected” (AV land ownership) to the RZ Zone so that pipes can be either laid along the paramboke land/road, or through Shanga.

- It is located at the extension of the Vikas Radial, which is the chosen alignment of the first trunk sewer.

- It is located only 60 meter outside the Ring Road, hence there is minimum intrusion into the Green Belt

- For the same above reason there is also minimum additional pipe length beyond the required trunk sewer length.

- The size of the plot is about 1800 m2 which matches the land requirement needed for the first phase and there is sufficient adjacent space to accommodate the extensions in phase 2 and 3.

- It is located along the Suchavaty / Madhuca road, which provides good access to the plant for vehicles (tractor and sludge pump)

Site development operation and maintenance

The safe operation and maintenance of the plant would require that the area is enclosed by a fence and access can be restricted through a gate. A store room or container for basic maintenance tools and spare parts would also be indicated.
The controlled feeding- in of sludge from outlying communities that would be scheduled on occasions needs to be supervised. The permanent presence of staff is not necessary but would be advantageous to ensure the smooth operation. It could be combined with a watchman status.
The plant in it’s overall design does have a model character so it could be considered to set up an office and common facilities to accommodate visitors.

Cost of Site Development, Infrastructure and Office

	Cost Estimate Waste Water Treatment Plant (Site development office and common facilities) April 2014		Qty		Rate	cost1	cost2 renewable	cost3 energy
1) Site development	Access Road		100	m	₹ 400.00	₹ 40,000		
	Internal Roads and Pathways					₹ 10,000		
	Fencing & gate		200	m	₹ 400.00	₹ 80,000		
	Landscaping, planting					₹ 30,000		
	Engineering and contingencies				5.00%	₹ 8,000.00		
				Sum site development		₹ 168,000		
2) Office and Infrastructure	Common facilities	size		m2				
	Office	6x4		24.00				
	Store	6x4		24.00				
	Lab	3x2		6.00				
	Shower/Toilet	2x2		4.00				
	Sum			58.00	₹ 14,000	₹ 812,000		
	fresh water tank					₹ 75,000		
	common water supply							
	Office Equipment							
	Desk, chair, files				₹ 35,000			
	PC, Internet				₹ 35,000			
	Alarm				₹ 5,000			
	Phone/3G				₹ 5,000			
	Basic tools				₹ 50,000			
						₹ 130,000		
	Electric room	3x2						
	UG Cable from Shanga or Sukra	150 m	150m	####				
	switchboard			####		₹ 67,500		
	Electric Back-up							
	Generator (auto/start/stop)	10 kVA				₹ 250,000		
	Battery & Inverter	3 h 4 kVA (usable)					₹ 255,000	
	SPV	2.5 kW						₹ 408,000
	Piping In and Out*							
	Main sewer							
	Re-distribution pipe					₹ 50,000		
	Site infrastructure							
	fresh water line				0.75%	₹ 18,000		
	Electric				0.75%	₹ 18,000		
	Pressurized Air / blower	(movable)				₹ 20,000		
						₹ 56,000		
	Site lab	Monitoring/sampling				₹ 50,000		
	Engineering and contingencies				5.00%	₹ 75,000		
				Sum common expenses		₹ 1,565,500		

Chapter 2

Sewer pipe systems

The sewer system will consist of multiple branch sewers that originate at housing project sites and follow the slope of the land to connect to the trunk sewers that leads to the waste water treatment plant. Currently two trunk sewers are envisioned alongside the two Radials. The trunk sewers are sized to accommodate the sewage of the final built-up phase of 5000 PE, so that sewers once laid do not have to be changed any more.
With few exceptions the sewer is laid along existing or planned roads at the appropriate location and depth.
The sewer junctions will be built out with junction boxes which are accessible from above to facilitate flushing of the sewer system. All bends will be equipped with inspection hatches.
In addition to the locations of junctions already identified through existing projects, the trunk sewer will have provisions for junctions at 35 meter intervals to allow future projects to connect without disrupting the operation of the sewer.
The branch sewer connection level at project sites is to be 65 cm below ground level. This allows the connection of all ground floor facilities. Underground facilities require lifting pumps.
The Trunk sewer will be laid at a depth between 0,8 – 2.0 meter below ground level.
The pipes will be of HDPE, PE or PP with rubber-ring elastic joints or solvent/weld joints.

Alignment of sewer

In most cases the sewer lines will be laid along the roads within the assigned infrastructure corridor.
In cases were this is not possible alternative routes can be found, for example by accessing the Green Corridors.
One such case has already been identified as the line between Arka and the crossing Crown Road/Vikas Radial. The elevation in this stretch is “uphill”. In order to nonetheless maintain gravity flow a route is chosen that differs from the road alignment.
Similarly there is a plot of land at the Eastern extension of the Vikas Radial that is privately owned. Here the sewage line will be diverted around the plot.

Methods of pipe laying

“Cut and fill”
in this method the pipe is laid directly into the trench. The pipe should be surrounded with a bedding of river sand to protect the pipe from stones and other sharp objects. A marking tape laid 10-20 cm above the pipe is very helpful when the trench has to be opened again. A safe distance to adjoining other technical infrastructure has to be maintained in order to prevent interference. Here of greatest concern is the safe isolation in horizontal and vertical manner of sewer lines from drinking water supply. (see part 2).
Similarly if excavation is to be done by JCB, then a distance of 40-45 cm equal to the width of the bucket has to be maintained between individual lines and pipes.
In this option the major cost component is the pipe and jointing.

"**Joint Trenching**"

In this option a dedicated trench is fabricated that houses all/most of the technical infrastructure that is to be laid alongside the road.

The trench is lined with reinforced concrete and various infrastructure conduits are fixed along the walls on racks or with clamps.

The advantages are manifold, especially in the situation of phased development that the Residential Zone is undergoing. It is anticipated that during the years to come the increasing demand for more and bigger infrastructure lines will necessitate repeated unearthing of the existing lines, leading to damage and costly patching.

The joint trenching method ensures easy access to all infrastructure. Lines can be renewed and strengthened if and when necessary, without the need for high impact road excavation.

Since the lines can be monitored for damage and leaks, the risk of cross-contamination of drinking water through a faulty sewage line is minimized. Hence distances between these two pipe systems can be much less.

The draw-back of this method is the somewhat high initial investment. When doing a cost impact comparison, the cost of the trench should however be shared between all the infrastructure lines that are to be laid in the trench. If for example a joint trench is to be shared between four major distribution system (minor systems such as street light are not considered),

1. Waste water and recycled water for irrigation
2. Drinking water distribution and mains supply
3. Telephone, fiber optic, internet
4. Electrical, HT, mains distribution and supply

The cost might be divided equally amongst this services.

An example for a "joined trench" along the Vikas Radial is given here below. It is highly recommended to consider this technology along the main Radials. The calculation-example assumes that the trench is concreted in situ, alternatively pre-fab elements can be used.

In the estimation of numbers of consumer, it is assumed that the technical infrastructure along a Radial (for example Vikas) will service the projects lying along this radial. Approximately half the projects of Sector I and half of the projects of Sector II. Projects within the Residential Zone located along the Crown might not connect through the Radial, but rather connect to infrastructure lines that are running along the Crown.

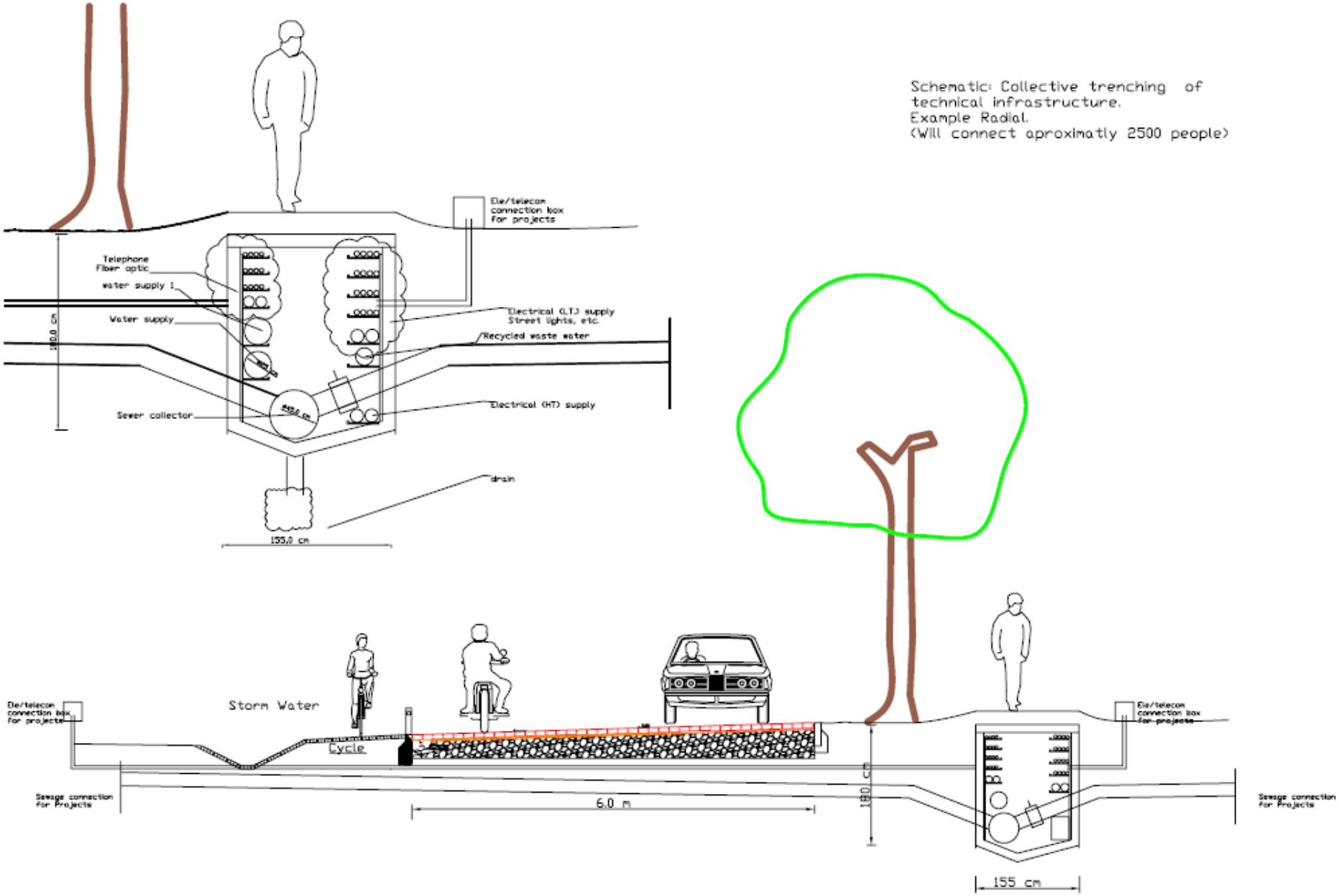
Technical Underground Infrastructure to be included in joint trench

1.0	**Lines to be included**		**Concerns and comments**
1.1	Electrical		high hazard
		High Tension	
		Low tension main supply	
		Low tension area supply	
		Street light	
1.2	Telephone		
		Main Cables	keep distance
		Area Supply	from electric supply
		Project supply	and/or shielding
1.3	Fiber optical cable		
1.4	Gas line		high hazard, doubtful if it will ever be implemented (bottled gas at project site is standard)
1.5	Water		
		Water tank filling from various wells and desalination plant	joint repair work
		Water main (ring pipe) water distribution branch	
1.6	Recycled waste water		
1.7	Waste water		
		Main canal	gravity flow
		Inspection / flushing	
1.8	Storm water		doubtful if it will be implemented (percolation at source is preferred)
1.9	Fire hydrant		take from main water
2.0	Other concerns		
	Ventilation		
	protect from rodents		
	protect from flooding		
	drainage		natural (soak pit) or pump
	access points		
	how to connect to various lines*		
	security		
		damage/ vandalism	
		unauthorized connections	
		safety for children…	
	Access coordination		
	Maintenance		access from top only, by removing cover slabs

Estimate of cable ducts, line sizes and diameters

				Simplified Assumptions*					
	In the following it is assumed that infrastructure for					**2500**	PE will be channeled		
							through the joint trench along the radial		
	In the case that the number of apartments is relevant. For this purpose					**2.5**	residents per apartment are assumed		
						Comments:			
Water	main								
		velocity in pipe		1 m/s		higher velocity is permissible			
		Persons		2500					
		peak time consumptions		5	l/person/minute				
		Volume		0.21	m3/s				
		required pipe diameter		0.26	m				
Waste Water	main and collector	Slope		0.50%					
		design as above							
		Pipe dia		0.45	m				
Electrical cable		3 phase supply				High tension is brought to a centrally located transformer			
	main	HT				from there low tension is distributed with dedicated cables			
		Dia		0.1	m				
						no of cores	size	max load	
	distribution	LT cable dia		0.04	m	3 1/2	120 mm2	180	A
		Peak consumptions		2000	Watt per household				
				3.5	Ampere per household				
		each dedicated LT cable serves		40	households				
		current per line		139	Ampere		23%	reserve!	
		number of lines		25					
Telephone cables		main lines		0.01		3	cables	(estimate)	
		Distribution							
		Dia		0.05	m	100	pairs		
			1 1/2	no of connections per household					
			1500	pairs					
Recycled wastewater		Dia		0.2				estimated	
Street lights		Dia		0.03					

Schematic lay-out of "Joint Trench" along Vikas Radial



Considerations for trench design – cost estimate

Estimated size:	As far as feasible all relevant technical Infrastructure (electrical, telecom, water etc) should be accommodated in the common trench sufficient space should be provided to allow access for servicing of all lines It is estimated that a inner free space of	width x height = 1,3 x 1,6m would accommodate this
Preferred alignment:	along the roads follows clear geometrical line not under the traffic right of way free from alley trees possible under pedestrian / cycle walkway	
Geometry	rectangular trench with concrete cover or stepped rectangular shape or rounded floor - for better drainage	
profile	Space requirement is decided by required conduct / pipe sizes and required distances from other duct For this joint trench a design is chosen that allows access from the top only - no walk through. Since sewage should have gravity flow and all other lines are independent, the sewer line is dominating This can require additional depth	
Execution	Waterproof re-enforced concrete with cover slab, sealed All connections/joints on infrastructure lines inside the trench have to be waterproof	

Cost estimation

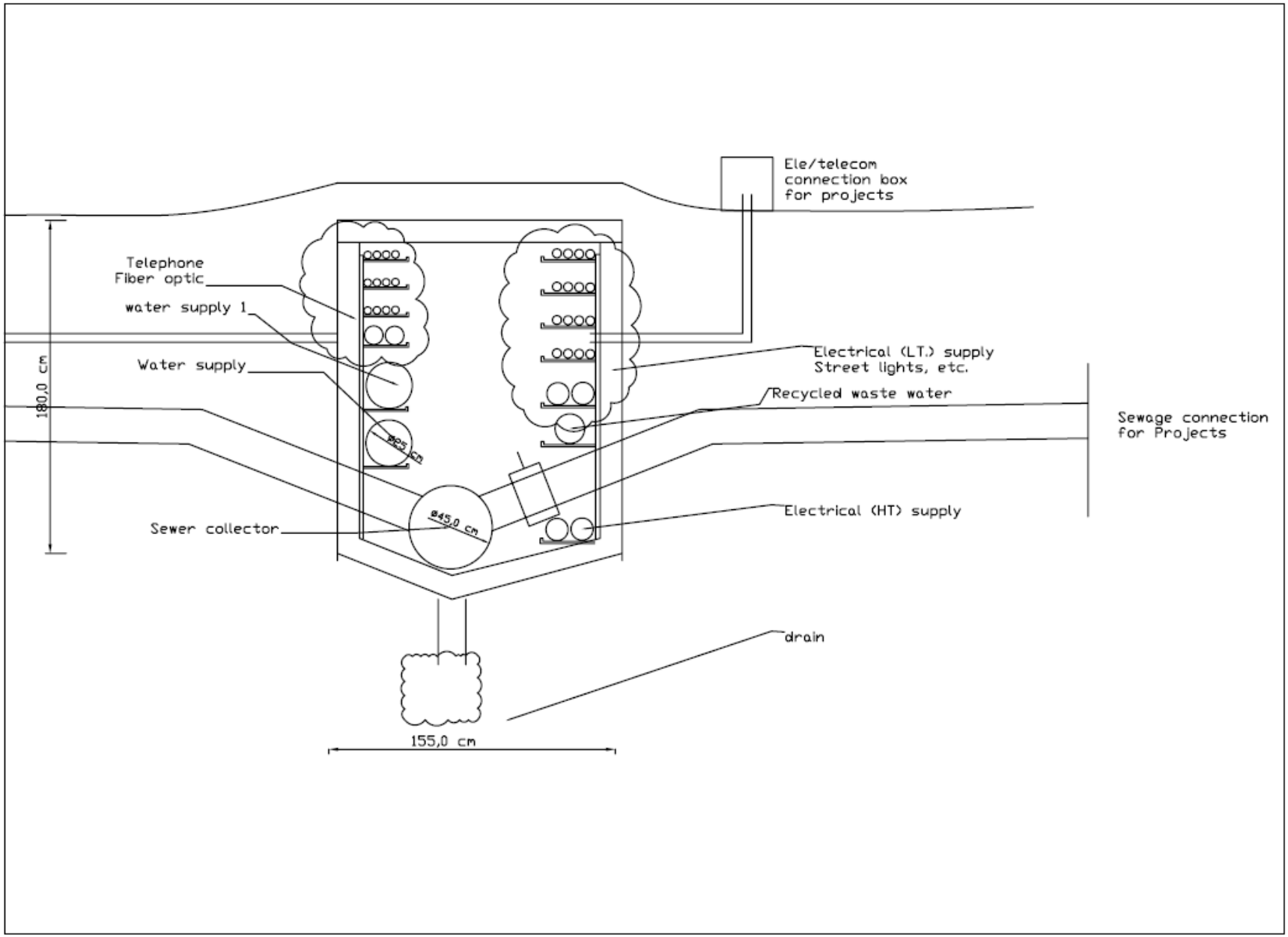
Civil work:

per running meter

Inner free space:		width x height = 1,0 x 1,6m		(RS)
		qty	rate	
clearing				100
digging	m3	2.88	200	576
clean layer				250
concrete-	one-sided shuttering	3.2	120	384
concrete (12 cm)		0.72	7800	5616
steel	8 mm at 12	26.4	55	1452
brackets for wall mounting				500
		Rs / meter	say 9000	Rs 8878

	Vikas Radial from Crown Rd crossing to Arati 400 meters	Rs 3,600,000
Line Work	Re-allocation of existing infrastructure into common trench	To be budgeted

Schematic of joint trench: In situ cast RCC with prefab covers; cables and pipes are fixed with brackets onto the RCC walls



How do people connect, joints and branches

Canal waste water	joint with riser pipe at relevant locations projects connect here
Electrical supply	
	non-dedicated cable is raised to distribution box (above ground) and re-enters into trench
	sub- distribution cables may be laid in trench until they reach (perpendicular) destination
Telephone	Dedicated cables are raised to distribution box (above ground)
	cable is raised to distribution box (above ground) and re-enters into trench
	sub- distribution cables may be laid in trench until they reach (perpendicular) destination
Water	Main distribution pipe has (branch) joints at relevant locations, with valve
	secondary branch pipes may be laid in trench until they reach (perpendicular) destination.
	Tertiary project distribution pipes (with meters?) branch off
High tension	dedicated from transformer to transformer, no joint
Fire hydrant	branch from secondary or tertiary water distribution
street light	branch from nearest distribution box. Cables may be laid in trench until they reach (perpendicular) destination
Recycled waste water	Same connection mode as fresh water

Sewage line Phase 1

Sewage lines of Phase 1 consists of a trunk sewer that will run along the Vikas Radial and extend about 60 meter beyond the Ring Road to connect to the sewage treatment facility.
A second branch will run along the Crown Road and connect the communities of Arka and the new Health Complex.

Vikas Radial	- 680 m
Extension to sewage treatment plant location	– 100 m
Crown Road crossing Vikas Rad to Arka	- 260 m
Total Trunk sewer, length	-1040 m

The branch sewers of the first Phase connect the close-lying existing communities and up-coming projects.

RZ 1	
Branch 1 (Invocation)	-175 m
Branch 2 (Maytreye 3)	– 110 m
Branch 3 (Sukhravati)	– 200 m
RZ 2	
Branch 1 (Luminosity, Creativity, Progress)	– 150 m
Branch 2 (Maytreye 2)	– 200 m
Total Branch Sewer, length	- 745 m

Both trunk and branch sewer system will be extended as necessary.

Cost Estimate for sewer pipe in “cut and fill” method, Phase 1

Cost estimate for sewer pipe system in the RZ, 1&2 Phase 1

Jul-14

Main Sewer

		(mm) / Rs/m
Pipe dia		300
Pipe type		Jain Pipes "Nu Drain", HDPE or similar
Base cost		₹ 1,650
VAT	5%	₹ 83
digging		₹ 60
sand bed		₹ 40
laying		₹ 10
joint		₹ 17
back-filling		₹ 20
Manholes at 100 m		₹ 230
junctions at 35 m		₹ 36
Sum		₹ 2,145
Total pipe length		1040 m
Cost		₹ 2,231,152 (1)

Branch Sewer

		(mm) / Rs/m
Pipe dia		200
Pipe type		Jain Pipes "Nu Drain", HDPE or similar
Base cost		₹ 900
		₹ 45
digging		₹ 60
sand bed		₹ 40
laying		₹ 10
joint		₹ 17
back-filling		₹ 20
junctions at 35 m		₹ 36
Sum		₹ 1,128
		745 m
		₹ 840,239 (2)

Sum Trunk and Branch sewer	(1) + (2)	₹ 3,071,391
Connection within the projects	10%	₹ 307,139
Engineering and contingencies	5%	₹ 168,927
round		-₹ 457
Grand sum		**₹ 3,547,000**

Return Line for Recycled Waste Water

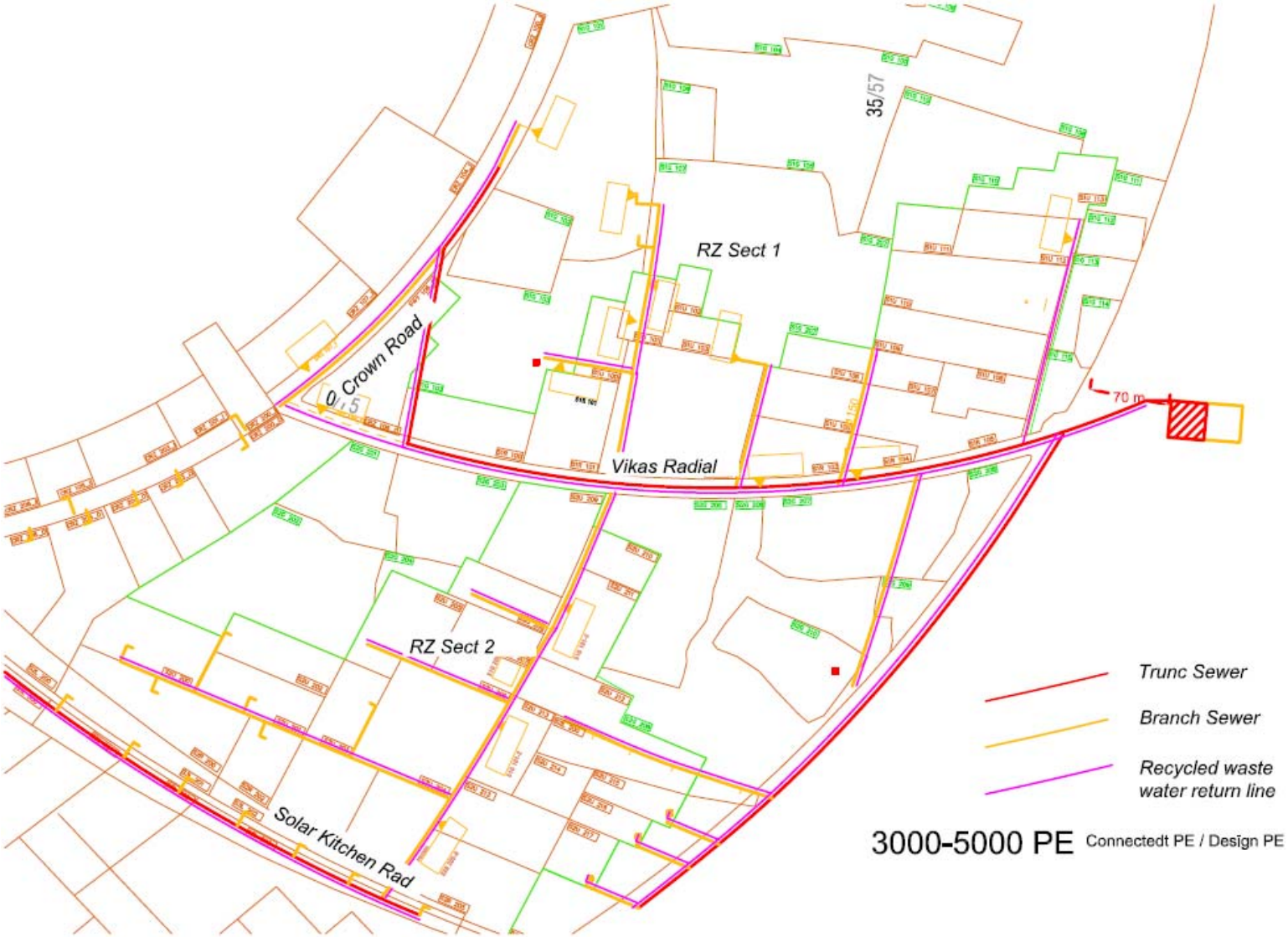
Total Pipe length (m)	1758
HDPE 110 mm (pipe is laid alongside the sewer hence no additional cost for laying)	₹ 404,340 (3)

Re-distribution of re-cycled water

The re-cycled water is provided at the treatment plant at a mains pressure of 2.0 bar. Re-distribution into the communities requires a dedicated line. It is proposed to lay a (110 mm) 4” HDPE line alongside the sewer lines for this purpose.

Sewer network extension Phase 2/3

The sewer network will be extended in two more phases as shown on the next page.
A second trunk sewer will be laid along the Solar Kitchen Radial and the Ring Road



Sewer phase 1 cost summary

The cost per running meter of trunk sewer (HDPE, ID=300mm) in "cut and fill" method is estimated at 2145,- Rs/m.

The additional cost of RCC trench to accommodate "joint trenching" is estimated at 8878,- Rs/m. This cost should be shared equally amongst the four major service providers, hence ¼ or 2220,- Rs/m would be shared by the sewage and recycled waste water network.

The cost of man-holes, digging and laying (~ 350 Rs/m) falls away in this option. Hence the pipe cost in joint trenching (partial cost) would be about 4015 Rs /meter compared to Rs 2145 per meter, about 85% more.

The branch sewers should be executed in traditional cut and fill method and is estimated at 1128 Rs/meter.
The cost of sewer re-connection for existing projects to the nearest branch sewer is not included, but can be estimated at 1128 Rs/m (as branch sewer)

The entire cost for phase 1 sewer work as described above is estimated at Rs 37 Lakh in "cut and fill" method.
Additional cost for "joint trenching" of the length of the Vikas Radial (400m) is estimated at RS 36 lakh. The total cost of sewer network phase 1 with joint trenching of Vikas Radial (400 m) is estimated at &3 Lakh.

Chapter 3

Waste Water Treatment Plant

In order to evaluate different treatment technologies it is helpful to have conceptual designs and cost estimates for the specific installation.
Hence a call for proposals was sent to several companies established in supplying waste water treatment plants.

The call for proposals included the compiled data for inlet parameters and the desired outlet parameters as established in Part 1. Included also was the request to provide a validation of the performance claims either by calculation (provisioned in Part 2) or by prototype test data by a third party. Companies were also informed beforehand of the criteria for evaluation their offer.

Criteria for the evaluation of different designs of treatment plants

A) General criteria

- Drawings of major structural and operational components of the plant

- Schemata of flow and processes of waste water and compounds through out the plant, along with time-line under different loading scenarios
- Space (land) requirements, surface and underground, secondary use of space
- Explanation of why the technology is suitable and how it is ensured that the treatment goal will be achieved
- Expandability (phased construction)
- Cost (capital and operation/maintenance)
- Reliability of operation (ruggedness, power outages etc.)
- Method of installation, time-frame (phase I)
- Operational requirements – number of persons, level of training
- Energy requirements
- Continued operation under fault condition (machine fault, repairs etc..)
- Maintenance requirements – cleaning, repair, replacement and spare parts, availability
- Design life
- Sensitivity to inhibiting substances, recovery
- Nuisance (noise, odor, visual impact)
- Estimated running-in time
- Operation outside normal design parameters (under/over-capacity)

B) Sludge Management

The designs should offer details on a comprehensive sludge management process up to the point were the sludge can be safely transported and used as compost.

C) Additional sludge treatment capacity

The designs should also provide for the option that additional sludge from settlers of outlying waste water treatment systems can be treated and processed at site. For this purpose it is assumed that an additional quantity of 330 m3/year (2000 PE, with safety factor of 1.5) of digested and de-watered sludge (0.3 l/PE/d) may be delivered to site with a maximum daily load of 30 m3/day (three tractor trailers). If the sludge and sludge-liquor are to be processed in the main treatment plant then they should pass through the primary settler with adequate retention time to ensure that the effluent quality does not suffer due to the additional load.
Alternatively the sludge can be processed in a separate digester.
In the case that sludge post processing is envisioned under open air (drying beds), then adequate storage facility for the sludge during the monsoon time (60 days) has to be provided.

D) Recycled waste water distribution

- Intermediate storage of treated water during 24 h for irrigation
- Measures to keep the irrigation water “fresh” during storage

- Details on operational differences during dry season and rain season (de-watering of sludge, effects of temperature, disposal of treated water)
- Alternative means of disposal of water after treatment (if irrigation water is not required)
- Operation during power outages
- Use of renewable energy (Solar electric/thermal, wind,)
- Utilization of bio gas (methane, CO2 etc) that is generated and captured in the treatment plant

None of the commercial offers received provided all the details as requested, but this may have been also too much to ask.
However four useful designs were received and their details are listed here below.

An independent 5th design was prepared under this study. In this design all details as listed above are provided. The designs received were:

Company	City	Name of System	Description
AWS	Auroville	Trickling Filter	Attached growth process
CSR	Auroville	DEWATS , Vortex	Anaerobe, baffle reactor
AKAR IMPEX PVT. LTD	Noida, U.P.,	Bio Reactor	Attached growth process On suspended bio media and Lamella settler
Indus Ecowater	Hyderabad	Moving Bed Bio Reactor (MBBR**)**	Attached growth process On suspended bio media
Sharpenn Industries	MUMBAI	Moving Bed Bio Reactor (MBBR**)**	Attached growth process On suspended bio media

Design and cost estimate of Plant Type 1 – prepared under this study

The proposed design of the waste water treatment plant is based on the concept of a trickling filter, which is a simple and effective technology and well-proven over decades. Commercial systems are being offered under proprietary terms such as "Bio Tower"

The treatment plant is to be built in 3 phases providing for initially 1000 residents (PE) and in the final phase for 5000 residents.
The design takes into account that in each expansion phase all components from the previous phase are continued to be used so that no redundancy occurs.
The design is flexible in regard to waste water quantity fluctuation and can efficiently operate at rates up to 130% of the design capacity.

The process chain is described as 2 parallel running processes:

1) removal of pollutants from the waste water.

2) concentrating and processing these solids in from of sludge to produce compost.

The waste water enters the plant and is passed through a primary settler. During this process about 40-50% of the pollutants are removed. After the primary settler it flows into an equalization tank. From there it is pumped to the top of the trickling filter (Bio Tower) and passes through the filter media. This process removes about 30-40% of pollutants (based on the original content). The water is at this point almost clear and is collected at the base of the filter and passes through a secondary clarifier. Then it flows into a polishing pond which serves as storage tank before the water is re-circulated into the communities. After having undergone this treatment sequence the water is safe to use in irrigation and meets the standards set by WHO for this purpose.

The sludge is processed in a digester tank for 35 days until bacterial activity has neutralized all pollutants. The sludge does not need to be handled at any time before this.
After 35 days when digestion is completed the sludge is released onto a drying bed were it is de-watered and then dried by the sun. It can then be composted. After composting it is sieved and can be offered as bio-compost in parks and communities as valuable nutrient supply for plants.

The sludge digesters are dimensioned so that while processing the sludge of the design population of 1000 PE, they can accept an additional quantity of sludge equal to 2000 PE per year from septic tanks from outlying communities. This sludge will be delivered to the treatment site by sludge tanker/tractor.
It is estimated that when the plant is running at design capacity of the 1st Phase, treating the waste water of 1000 PE approximately 10 tons of compost will be produced per year.

The capital cost of the treatment plant along with site development, and infrastructure is projected with Rs 41.4 lakh (Rs 4.140,- per person).

The construction time is estimated at 12 month. Run-in time of the treatment plant is projected with 8-12 weeks after completion.
The operation and maintenance cost of the treatment plant with two operators is estimated at Rs 5.00.000 per year, or Rs 42 per connected person and month (at full capacity).

Power is required to operate two pumps in the plant and constitutes about 38% of the operational cost. The system can absorb power outages up to 1 hour through buffer tanks. In order to ensure operation during power failure lasting beyond this time span the plant is equipped with a diesel generator back up.

The performance can be considerably improved by integration of renewable energy.
In Phase 1 and 2 a solar-electric system could be installed to provide part of the power for the pumps this would reduce the operation time of the diesel generator during daytime power outages and lower the overall amount of power drawn from the utility. This is listed in the financial outline as an option. The additional cost is Rs 2.0 lakh for battery/UPS back up and Rs 1.8 lakh for SPV.
In phase 3 bio gas production volume from the sludge digestion would be sufficient large so that it could be utilized for power generation.

Basic parameters for the design

Population benchmarks for phased development

Time	Building Phase	Total (Res./PE)	Quantity per Person (l/day)	Total Quantity (m^3/day)
Immediate	Phase 1	1000	175	175
	Phase 2	3000	175	525
	Phase 3	5000	150	750

Peak flow can be assumed as 24/14 of mean hourly flow.
Phase 1: Q peak= 13m3 per h
Initially the flow will be considerably below the design flow (assume Q min =1 m3/h).
Once the capacity of the plant is reached, min flow can be assumed as 24/36 of mean.
For Phase 1: Q min = 5m3 per h

Characteristics of the waste water

Inlet parameters (per PE (Domestic Waste Water))

PH	6.5-8.5
BOD	250-300 mg/lit.
COD	400-500 mg/lit.
Suspended Solids	200-250 mg/lit.
Oil & Grease	10-15 mg/lit.

Treatment Goal:

Effluent parameters of the waste water treatment plant should meet the (international WHO) standard for use in irrigation (unlimited):

Effluent parameters
E. coli < 10^3 count/100 ml (95% evaluation)
Helminth eggs < 1 per liter.
BOD5 < 25 mg/l
COD < 125
TSS < 35.0 mg/l
Turbidity < 2 NTU

Sludge

Processing in digesters and subsequent composting and storage.
< 25% moisture, free from worm eggs.

Grit removal and screening

The waste water is entirely of domestic origin and enters the treatment plant through a closed pipe system.
In absence of any storm water, a grit removal process seems unnecessary. Similarly it is assumed that the maximum size of any flotsam or debris in the waste water is limited by the domestic drain size to about 80-100 mm.
These debris are settled/ held back in the primary settler and processed along with the sludge.
Objects that do not fully decompose during the sludge processing will be sieved out after 3 month composting period.
However since retro-fitting of the plant with a screen after operations have started is considerably more complex, it is suggested to make provisions for fitting a screen in the incoming channel. This can be provided for in form of slide-in rails inclined at 65 degree in the concrete inflow channel. Should at any point of time it become necessary to fit a screen, then this can be easily achieved.

Pre- treatment

As the waste water enters the plant it is passed through a primary settler. The settler provides a retention time of 2.5-3 hours and the water velocity is so slow that any settle able solids sink to the bottom of the basin. The basin floor is inclined and has a opening slot the solids path through this slot into the lower lying sludge chamber. The primary settler is equipped with a submerged wall at the outlet to retain any floating matter.
Approximately 30-40 % of impurities are removed during this process.

Equalization

The connected sewer system is relatively short and it can be assumed that waste water quantities fluctuate considerably during 24 hours.
Hence after the primary settler the water passes into an equalization tank.

Lifting

From the equalization tank the water is pumped (2 kW / 1 KW, head = 5 meter) lifted to the sprinkler of the trickling filter (Bio Tower).

Trickling Filter

The trickling filter is a circular tank of 9 meter diameter and 4 meter hight, filled with granite rocks of 4 - 7 cm size.
The tank has openings in the floor to allow free air circulation. The water is evenly sprinkled over the rock bed and percolates during 15-20 minutes to the bottom of the filter, were it is collected in channels. The sprayer rotates with 2-3 rounds per minute.

Due to the continuous spraying of the rock with high nutrient water an aerobic bacterial skin develops on the surface of the rock that is highly active and is able to remove 80-90 % of the remaining impurities from the water.

Once the bacterial skin develops a thickness beyond 3-5 mm it is washed off by the passing water. After the trickling filter the water passes into the secondary clarifier, here the slewed-off bacteria skin is settled. The secondary clarifier is slightly elevated and the floor is inclined so that the settled sludge collects in the centre and can be returned to the primary sludge chambers through drain pipe by gravity.

Polishing and re-circulation

After passing through the trickling filter most of the water is passed into the polishing pond for final purification and storage.
There is a provision to re-circulate part of the water from the trickling filter back into the equalization tank. This ensures that at times of low waste water inflow the sprinkler of the trickling filter receives sufficient water to operate evenly. At the same time this brings the advantage that since the re-circulated water has a high oxygen content it helps to keep the waste water in the equalization tank fresh and free from odor. The amount of water that is re-circulated is controlled by a floating valve.

Re-distribution and percolation

The polishing pond is dimensioned to store the water volume that would accumulate in 24 hours. A pressure actuated pump provides for sufficient head to return the re-cycled water into the communities. After having undergone the above treatment process the re-cycled waste water can be safely used for irrigation in the communities

At times of low demand for irrigation water, during the monsoon for example, the polishing pond overflows into a percolation pipe system. These are slotted pipes that are lain in a grid in the ground.

Sludge Processing

Concentration

When the settleables from the primary and secondary settler are passed into the sludge chamber (below the primary settler), the sludge contains 98% water (100 gram dry matter to about 5 liter water). During the first 2 days of sludge digestion the water content is reduced by more than half to 95% (100 gram dry matter about 2 liter water).
When the sludge chamber is full, the operation of this settler is discontinued and the flow of waste water is switched to the other settler.
The sludge remains 30-35 days in the digester. After this time the sludge has stabilized and most bacterial processes have slowed down so that it is almost free from odor. The water content is at this point 90% (100 gram dry matter 900 ml water).

Drying

The sludge is then released from the digester by gravity flow and spread onto the drying bed in a layer of about 25 cm thickness. The drying bed consists of a rectangular earth enclosure which is slightly inclined towards it's centre line. A slotted drain pipe is laid along this line and covered with a bed of gravel and this in turn is covered by a layer of sand.
Within a few hours the sludge liquor drains out and the water content is reduced to 72% (100 gram dry matter 250 ml water). The sludge liquor is collected in the slotted pipe and returned into the primary settler.
During the next few days water content is reduced to 30% (100 gram dry matter 40 ml water) by evaporation.
At this point the sludge has an earth like consistence and can be moved to the composting bed. Since some of the sand from the drying bed will also be removed along with the sludge, the sand has to be replaced occasionally.
If the sludge is co-composted with other organic matter such as leaves and shredded wood a superior final product can be achieved.

At the end the compost is passed through a 1' screen, during this process all material that was not bio-degraded during the past process is removed. The components removed during the sieving are burned in an incineration unit.

During the rain season drying of the sludge is not possible. Hence the two digesters are dimensioned sufficiently large to bridge this period.

The alternating mode of operation of the two settlers during 12 month is shown in attached graphic.

Processing of additional sludge from outlying communities

The sludge digesters are dimensioned so that while processing the sludge of the design population of 1000 PE, they can accept an additional quantity of sludge equal to 2000 PE per year from septic tanks from outlying communities this sludge would be delivered to the treatment site by sludge tanker/tractor. The maximum additional daily load the plant can handle is 10.000 liter per day..
Additional deposit of such large quantity of sludge in the settler would cause a flash load in the plant and result in a decline in effluent quality. Hence the sludge is first unloaded from the truck into a dosing funnel. From this funnel the sludge is gradually released into the settler over a period of several hours.

Operation of the plant

The operation of the plant is very straight forward. The plant can operate un-supervised over long periods of time.
The active involvement of the staff in the treatment process is required when the operation between the twin-settlers is switched (at 35 days intervals) and to release the sludge from the digester onto the drying beds for further processing. At this point the sludge is neutral in smell and color and poses no sanitary thread. The handling of the sludge is not repulsive.

The staff is also required when sludge from septic tanks of outlying communities is brought to site for processing.
One operator should be present at most of the time during the day for supervision and maintenance of the plant.
It is proposed to employ one operator and one helper. This ensures that a trained back-up operator is available when needed. The staff should have absolved 10^{th} grade schooling and have basic English and computer knowledge to be able to keep records. They do not require any other pre-qualification and adequate training can be provided at the plant within a few weeks.

Power consumption for operation.

Beside power requirements for the usual office for computer (record keeping) , lights and fans, the operation of the plant requires two pumps of 2 kW each. One pump is installed after the primary settler and lifts the water to the height of the trickling filter. This pump runs continuously and could be replaced by a lower power pump during night-time hours. The other pump re-circulates the treated water back into the communities for irrigation. This pump is pressure activated and will run during day-time (6:00 am to 20:00 pm) when there is a demand and a tap is opened. Each pump has an identical back up pump as stand-by. It is proposed to install high-efficiency pumps.
The system can absorb power outages up to 1 hour through buffer tanks. In order to ensure operation during power failure lasting beyond this time span the plant is equipped with a diesel generator back up. The diesel back-up / mains switch over should be automatic.
The performance can be considerably improved by integration of renewable energy. In Phase 1 or 2 a solar-electric system could be installed to provide part of the power for the pumps this would reduce the operation time of the diesel generator during daytime power outages and lower the overall amount of power drawn from the utility.

Maintenance and consumables

The pumps have to be replaced occasionally (two year interval)

The sand in the drying beds has to be replaced occasionally (one load every 6 month)

The rotating sprinkler on the trickling filter needs to be cleaned occasionally (once per month). In case it is blocked, temporary alternative spinners have to be placed on the filter so that operation is not interrupted .

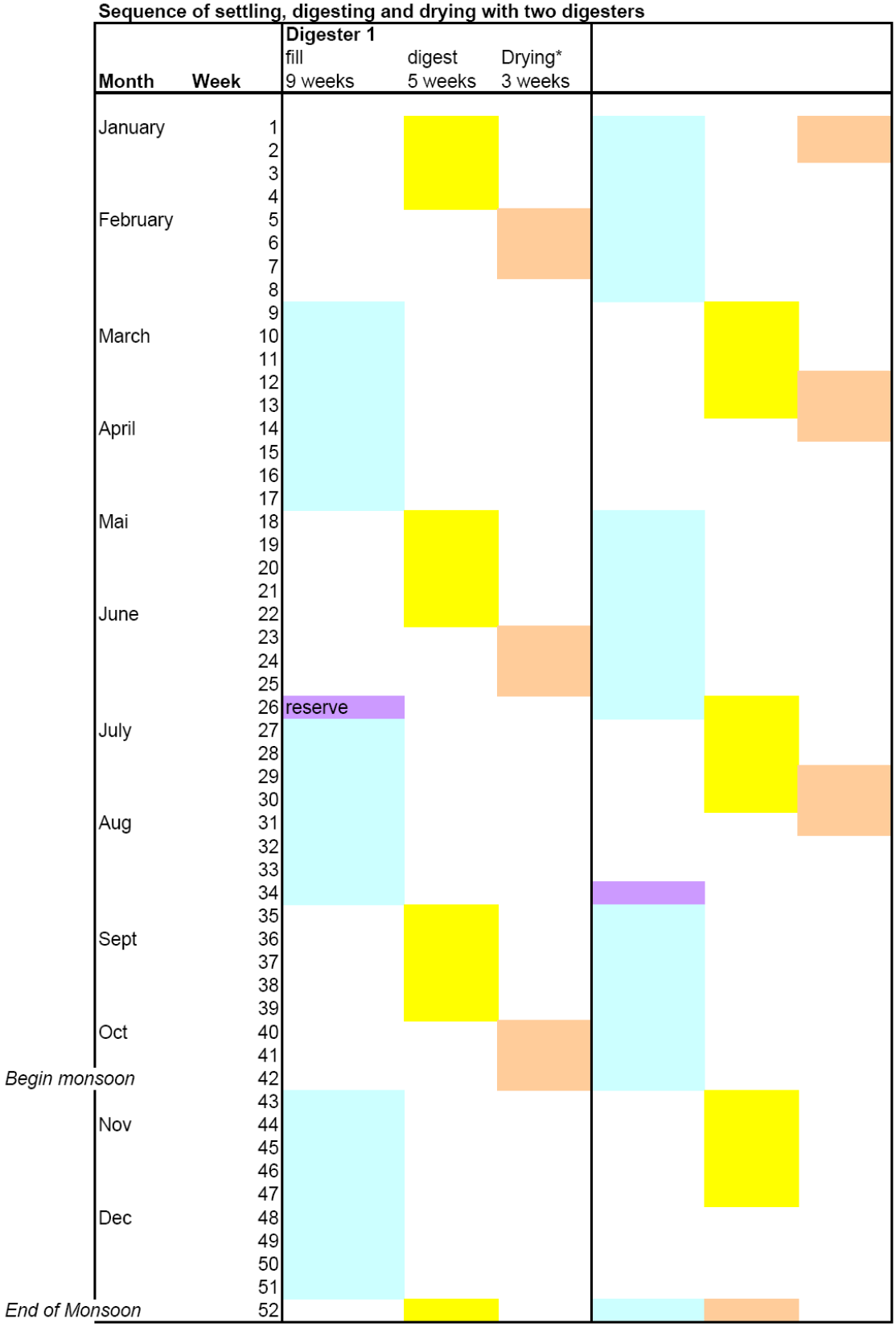
The site is provided with a movable high pressure jet, so that prior to a repair parts and components can be cleaned.

A movable sludge pump is provided to resolve any blockage in the sludge pipe systems.

A movable aerator is provided. In case of need this can be placed in the polishing pond or secondary settler to aerate the water.

Alternative operation of the twin –settler/sludge chambers

Sequence of settling, digesting and drying with two digesters



Phased expansion of the treatment plant

The waste water treatment facility is designed so that it can be expanded as the population in the Residential Zone increases,

The design provides for two expansion stages from the initial design capacity of 1000 PE to 3000 PE and the final build out stage of 5000 PE.

The task allocation and operation during each of the phases is described in tabular form below.

The most note-worthy change in the development phases is that in the final build out stage a dedicated sludge digester is added so that both twin primary settler can be operated simultaneously.

Waste Water Treatment Plant for the Residential Zones 1 and 2

- Phased construction, utilization of components -

		Phase 1	Phase 2	Phase 3
Treatment Capacity		**1000 PE**	**3000 PE**	**5000 PE**
Volume of Waste Water (100-130%)		**175 - 225 m3**	**525 - 680 m3**	**750-975 m3**
Land requirement (estimated)		**1800 m2**	**2500 m2**	**3000 m2**
Components of treatment plant	**Primary settler**	two settler are operated alternating	Settler size is sufficient	2 Settler operated simultaneously
	Digester	two digester are operated alternating	Digester size is sufficient	separate digester is built
	Biogas			gas turbine for power supply
	Trickling filter	One filter is operated at low rate	One filter is operated at medium rate	One filter is operated at high rate, or second filter is added
	Secondary settler	The secondary settler sized for 5000 PE		
	Drying beds	165 m2	expansion of drying beds or filter press	expansion of drying beds or filter press
	Composting	120 m3 (3000 PE)	expansion	expansion
	Recycled waste water storage	Expansion horizontally or vertically	Expansion horizontally or vertically	Expansion horizontally or vertically
	Recycled waste water percolation	Expansion	Expansion	Expansion
	Pumps (primary)*	1 + 1 standby, operated alternating	upgrade to required size	upgrade to required size
	Pumps (recycled waste water)*	1 + 1 standby, operated alternating	upgrade to required size	upgrade to required size
Site Development	**Office**	dimensioned for final phase	-	-
	Access Road			
	Parking	dimensioned for final phase	-	-
	Storage	dimensioned for final phase	-	-
	Power	Switchboard is designed for final size	Extension of wiring were needed	Extension of wiring were needed
	Fencing	Arial of current phase	Extension	Extension
	Water	Meets requirement of current phase	Extension	Extension

***** *Pumps are assumed to have a two year turn-over*

Design Calculations

In the following pages the design calculations for different components of the treatment plant are given.

Settler, Sludge Digester

Settler, digester and Sludge volume

	Mean Temperature C	22					
	Average digestion time (d)	35					
	Required storage time during monsoon (d)	60					
1)	Dimension Sludge Tank Size						
	Accumulated sludge			**Time**	**Sludge Volume**		
1a)	Continuous from waste water treatment plant in the Residential Zone		PE	days	l/day per PE	m^3	
		Sludge Consistency [1]		after no days			
		fresh	1000	2	1.8	3.6	
		thickened		33	0.9	29.7	
		digested / Storage (Monsoon)		25	0.3	7.5	
1b)	residue sludge		10%			4	
1c)	Secondary settler			60	0.63	37.8	
		total sludge	after days	60		82.6	
2)	**Outlying communities**						
2a)	Maximum size of single load example: Community with 60 PE after 3 years	digested	60	1095	0.3	19.7	single load (one day)
2b)	Average	digested	2000	365	0.3	219.0	per year
		Storage (Monsoon	2000	60	0.3	36	
			Total 1) + 2)			**118.6**	

3) Feed in time for sludge from outlying communities
(Sludge liquor should pass through primary settler with adequate settling time)
built feed-in container

Normal operation

Qty l/d	175		
Waste water	175	m3 per day	
mean (day and night)	7.3	m3 per h	
max (12/7)	13	m3 per h	
min (night mean)	5	m3 per h	
day mean	10	m3 per h	

Primary settler retention time
(hours)

3	design -normal operation
2	peak operation
4	min operation (night)

retention tir

Load capacity of vacuum sludge pump vehicl 10

total volume (sludge + mean flow) should not exceed
peak capacity
Free capacity 3 m3 per hour

total (active

In order to keep the retention time
Sludge has to be added over 3.6 hours option 1 Vehicle waits
preferably during the night (after 22:00) option 2 additional container for dosing

5) required free height for floating sludge in settler

estimated 0.3 m

B) Delayed sludge release structure

Active Volume	10.0	m3			
Chosen depth: (straight walled)	**1.8**	**m**			
round Doughnut D=	**2**	**m**			
lower "funnel" of settler volume - slope =	1.4				
h funnel	1.23		or	scraper	
total height	3.03	m			

Cone

Volume	1/3 PI x r^2 x h			
Surface	pi x r x S		5.8	m2

cylinder=	11.3	m3	11.3	m2
V cone=	1.3	m3		
Sum	12.6	m3	Sum 17.1	m2

Equalization and Lifting Tank

Should have the capacity to buffer 3 h of power cut and equalize the peak-load.
Design volume 27 m3 , delta h = 2.25 m

Trickling Filter

Pre-dimensioning of low loaded trickling filter
(enter yellow values)

Waste water quantity:
EW 1000

Load

Carbon	40 gr BSB/Ew d		
Nitrate	10 gr TKN/EW d	50 mg/l	
		175 l	
		8.75 TKN/EW d	

Loading PE/m3

Tropfkoerper	
with Nitrification	5
without	10
compare with activated sluge basin	
with Nitrification	12
without	25

Desired max filter loading

300 gr BSB5/m3 d	mean temperature is 25 degree, higher loading than for European
75 gr TKN/m3 d	countries can be assumed

Required Filter Volume
(low loading)

Carbon	133.3 m^3
TKN	133.3 m^3
Volume	266.7 m^3

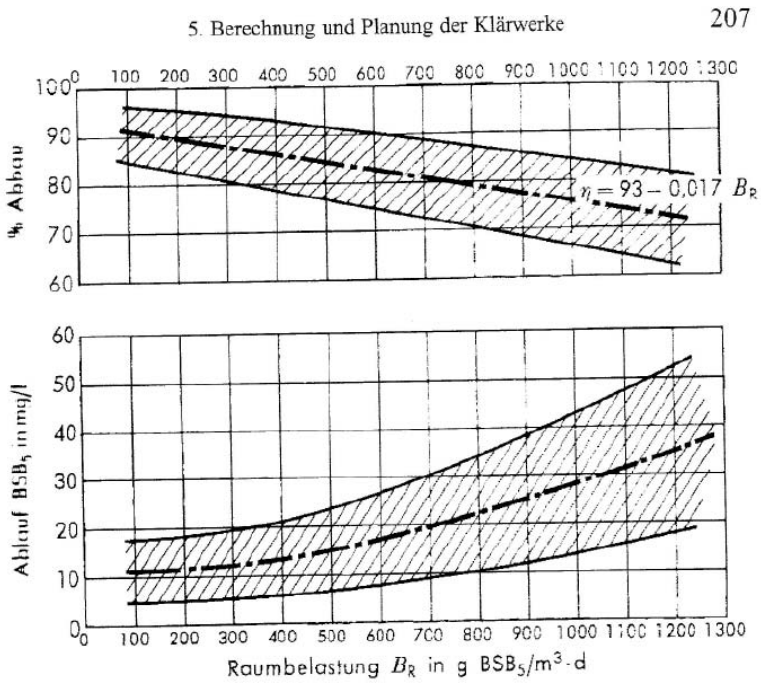
Filter Dimension
single Filter
A "pi x d2/4

single filter

V=	266.7 m^3
H=	3.5 m
D=	9.8 m

or
two filter

V=	133.3 m^3
H=	3.5 m
D=	7.0 m



Clarifier

Secondary Settler
(after slow trickling filter)

A)	For Phase 3		1000	PE	
			150	l/PE	
	retention time	3		h	
	mean (day and night)	6.3		m3 per h	
	Active Volume of settler		18.8	m3	
	Choesen depth: (streight walled)		1.5	m	
	Area		12.5	m2	
	round Dougnut D=		3.99		
	lower "funnel" of settler volume - slope =		1		"1 : 1.4"
			1		"1:1
	h funnel		1.49	or	scraper
	total height		2.99	m	

B)	For Phase 3		5000	PE	
			150	l/PE	
	retention time	3		h	
	mean (day and night)	31.3		m3 per h	
	Active Volume of settler		63.8	m3	
	Choesen depth: (streight walled)		**2**	**m**	
	Area		31.9	m2	
	round Dougnut D=		6.37	**5.5**	**m**
	lower "funnel" of settler volume - slope =		1.4		
	h funnel		3.76	or	scraper
	total height		5.76	m	

Cone

Volume	1/3 PI x r^2 x h	
Surface	pi x r x S	

take upper 3rd of (height) of cone volume into account

V cone=	29.8	m3
V upper 1/3=	21.0	m3
cylinder	47.5	m3
Sum V =	68.5	m3

Outer channel

Polishing Pond

7)	Polishing pond		
	24 h storage		
	Allways retain volume 1/3	232.75	m3
	depth	2.5	m
	area	93.1	m2
	Width	5.96	m
	Length	15.6	m

Pipe and trench sizes

PE		**1000**		
Normal operation			l/s	
PE	Qty l/d	175		
Reference	Waste water	175	m3 per day	
	mean (day and nigh	7.3	m3 per h	2.0
	max (12/7)	13	m3 per h	**3.5**
	min (night mean)	5	m3 per h	1.4
	day mean	10	m3 per h	2.7

Pipe/ Trench sizes

Waste Water		**Sludge**	
Part filled		[1] ->	0.25 m
min V to prevent deposits		with compressed air support	
[1] ->	0.4 m/s		
min grad	**0.50%**		
at 1/4 filling			
Max Quantity			
Pipe size 168 mm (6")	0.15 m		
Prandtl-Colebrook ->			
Q=	12 l/s	sufficient up to	3456 PE

Sludge Volume

The sludge volume that would be generated in the plant annually is estimated below. Experience sows that the estimated volume often differ from the actual produced volume, three different calculation approaches are given:

Sludge 1			**Quantity**	**content of solids**	Total Annually
		PE	l/PE/d	(%)	
When the sludge is released from the digester the average density is (Pre-settler and 2nd settler)		1000	1.5	3%	
The sludge is spread onto the drying / de-watering beds moisture is reduced to and			0.16	28%	
after drying to			0.06	75%	**22 m3**

Sludge 2					
Sludge:					
Waste water	175	l/PE			
reduce TSS from	225	mg/l			
to	35	mg/l			
delta	190	mg/l		75%	**16 m3**

Sludge 3			"Suresh"			
			Sew Vol	175	m3	
suspended solids	225	mg/l	Susp sosl	250	mg/l	
waste water	175	l	Volt solids	60%		
Sludge	39.375	gr/PE	Ret time	20	days	
			VSS destruction	70%		
			sludge vol			**18.4 m3**

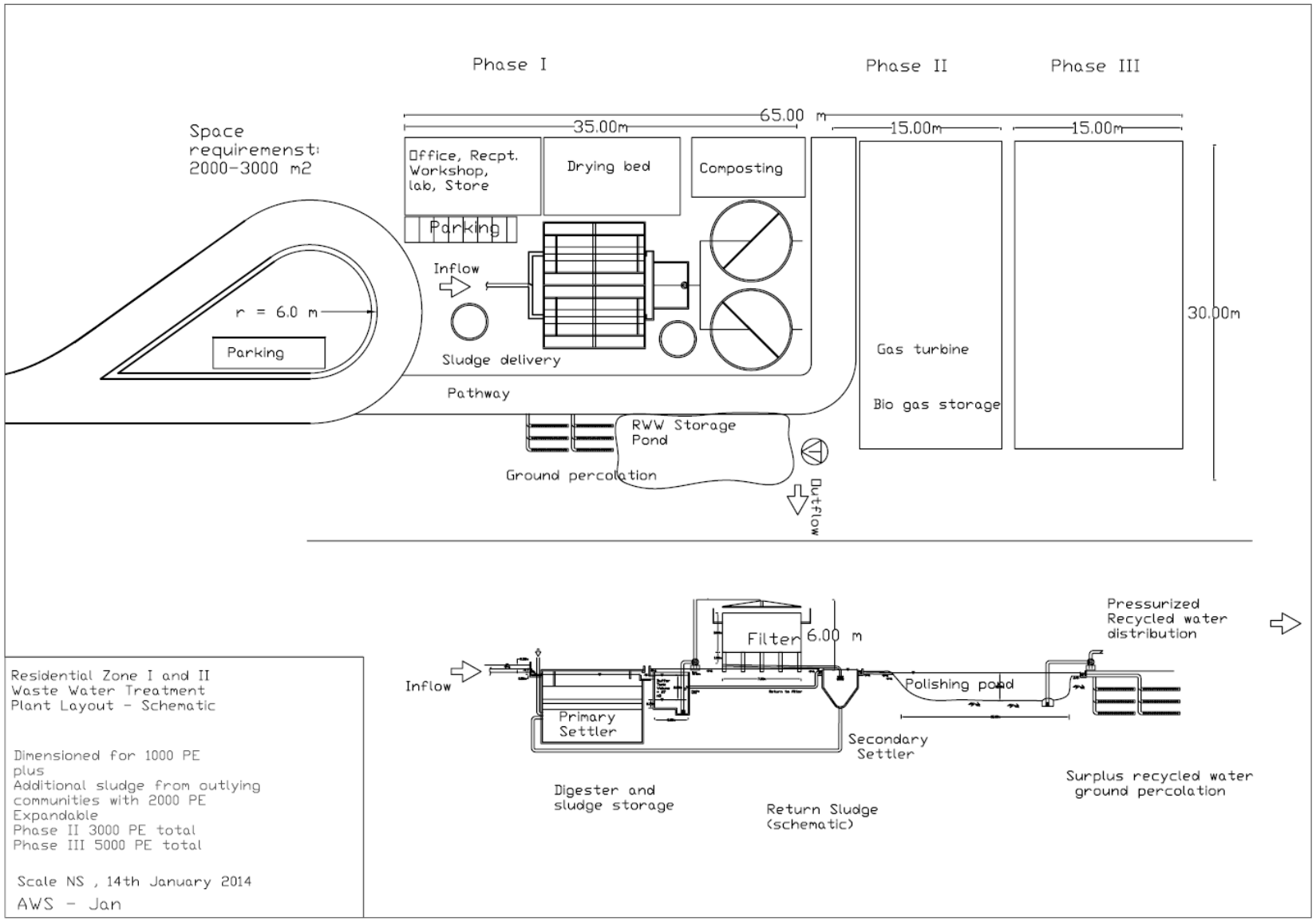
Power from Bio gas

During the sludge digestion biogas (CO and CH4 are generated). This gas can potentially be used to supplement the power demand of the treatment plant.
The bio gas potential of the sludge from outlying communities is not known, hence only the sludge produced on the plant itself is taken into account.
In this case, due to the low quantities the utilization of the biogas with a gas turbine would only be feasible in phase 3.

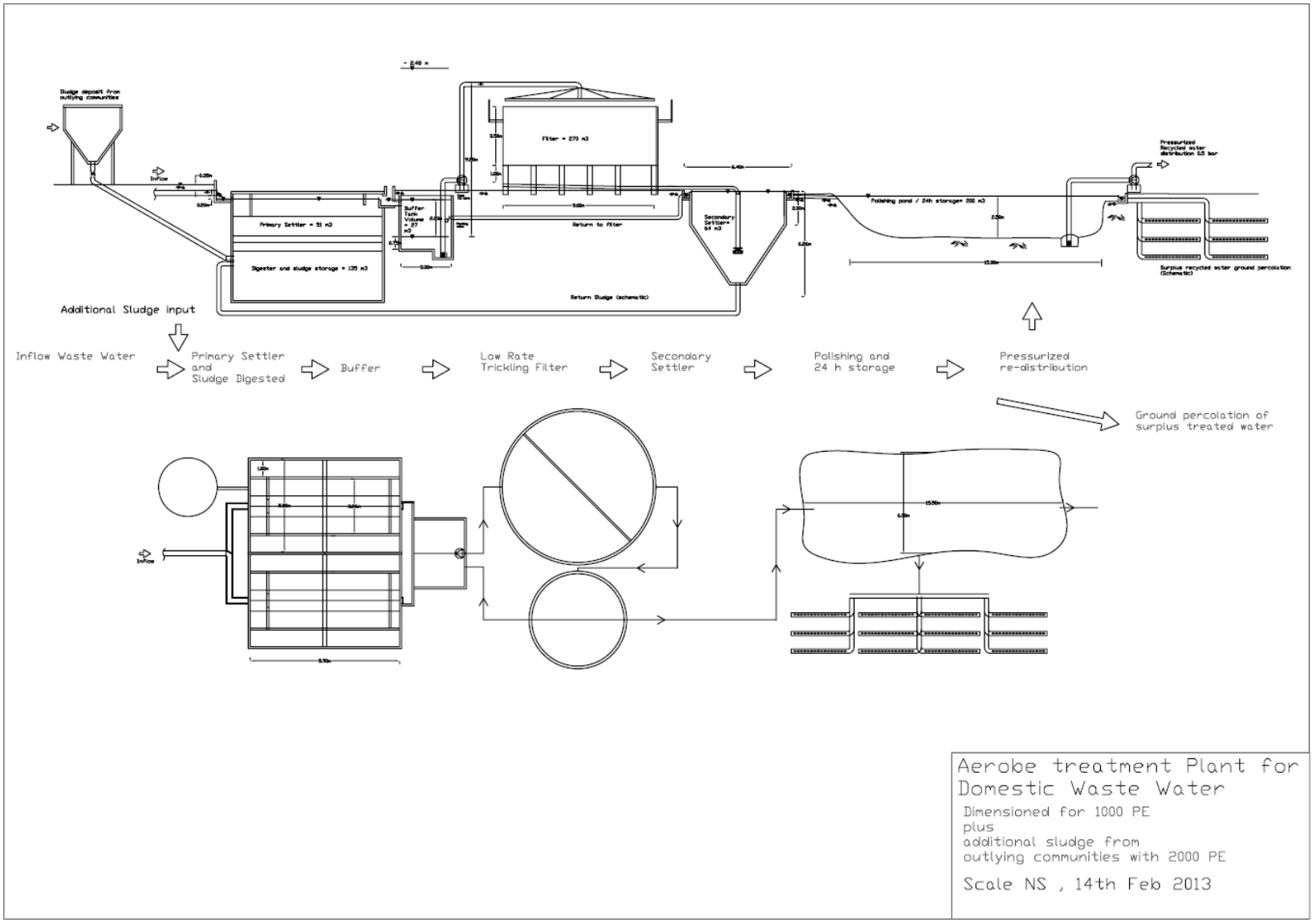
Gas from fully digested Sl	**13.3**	**l/PE/day**
Gas Development		
digestion temperature	25	deg C
digestion time	25	days
qty gas	400	l/kg sludge
PE	1000	
fresh sludge (Dry content)	40	gr/PE/d
degree of methane conversi	100%	
Gas production	16	l/PE/d
	16	M3/d
gas capture efficiency	80%	
calorific value		
	8	kwh/m3
gas turbine efficiency (ele)	50%	
Energy output	**51.2**	**kWh/d**

Smallest commercially available as turbine
"Capstone 30 kW"

Schematic lay-out of Site, Office and Treatment Plant



Process Schematic



3D Animation

Financial

The entire cost for phase 1 for 1000 Person Equivalent including sewerage, site development, office and infrastructure, treatment plant, re-distribution of re-cycled water is estimated at Rs 91.6 lakh.
Total time for execution of the treatment plant, the trunk sewer and selected branch sewers is estimated at 12 month.
Run-in time of the treatment plant is projected with 8-12 weeks after completion.
Further branch sewers will provided after the plant is operational.
The operation and maintenance cost of the treatment plant is estimated at Rs 4.70.000 per year, or Rs 40 per person and month (at full capacity).

Financial details, phased expansion and renewable energy

The projected cost for the treatment plant and extension in each phase are listed below:

(Treatment plant only)

Phase	Capital Cost	Operation and Maintenance
Phase 1 (1000 PE) Basic Design	Rs 33.5 lakh	Rs 4.7 lakh per year
Phase 2 (3000 PE) Additional site development Expansion of drying beds and composting area additional polishing pond	Rs 10 lakh	as above +10% (for consumables)
Phase 3 (5000 PE) Additional site development 2nd trickling filter sludge digester filter press	Rs 22 lakh	as above +20% (for consumables)

Option 1 During any phase SPV power supply	3.8 lakh	Reduces power consumption by 30-50%
Option 2 Bio-gas dual fuel electric generator	Estimate pending	Reduces power consumption by 20-30%

Cost Estimate Waste Water Treatment Plant

				Qty		Rate	Cost
		Material		rate	cost per unit	no	Cost
Primary Settler		concrete					
concrete walled (t=16 cm)	excavate	included					
0.4% reinforcement	clean layer	included					
	Shuttering	included					
	tank	23.50	m3				
	cover	6.85	m3				
	cone	7.89					
	Triangle	2.37					
	Front and back	9.41					
	submerged walls 5%	1.90					
	Sum	51.92		₹ 12,000	₹ 622,989	2	₹ 1,245,978
Equalization tank							
w x d x h =	walls	7.17	m3				
3 x 4 x 3.2 m	floor	1.92					
(buffer volume 27 m3)	slab	2.11					
	sump	0.50					
	Sum	11.70		₹ 12,000	₹ 140,400	1	₹ 140,400
Trickling filter							
round d =9 m, h=4m	Supporting columns	3.03					
0.4% reinforcement	(25x25x220) 22 no						
	Foundations						
	0.75x0.75x0.15	5.57					
	base slab perforated	9.54	m3				
	walls	13.85	m3				
	or						
	reinforced brick						
	and steel						
	Sum	23.40		₹ 12,000	₹ 280,764	1	₹ 280,764
	Collection level						
	(Painted Ferro cement channel)	40.00	m	₹ 600	₹ 24,000	1	₹ 24,000
	Filtering material	222.7	m3	₹ 940	₹ 209,301	1	₹ 209,301
	granite 2 "						
	or						
	molded plastic Rs/m3			₹ 9,000			
	or						
	crush ton or slack material						
	Sprinkler arm SS	1 +1			₹ 40,000	2	₹ 80,000
	Fly and mosquito netting	42					
	with Support	64					
		106	m2	₹ 300.00	₹ 31,809	1	₹ 31,809
							₹ 625,874
Secondary settler		13	m3	₹ 12,000	₹ 152,208		
	outer collection channel	3	m3	₹ 12,000	₹ 33,778		
	overflow wear	20	m	₹ 800	₹ 16,085		
					₹ 202,071		₹ 202,071
Drying beds	level sand beds enclosed with PCC wall				₹ 50,000		₹ 50,000
Composting	level earth						
Storage pond	PU foil, clay 10 cm	200	m2	₹ 500.00	₹ 100,000		₹ 100,000
	excavation						
Miscellaneous	hatches and man holes						
	in and outflow structure					10%	₹ 330,000
	ladders and rails						
Piping*							
on site	Primary settler sludge release						
paint, pipes and fittings	Secondary Settler Sludge Return					5%	₹ 165,000
	Basin to basin						

	Return to filter Ground percolation					
Pumps	Grunfoss (high end), Sharp (normal)					
primary 2 x 2 kW		₹ 8,000	2	₹ 16,000		
re-distribution 2 x 2 kW		₹ 8,000	2	₹ 16,000		
pressure switches		₹ 6,000	2	₹ 12,000		
						₹ 44,000
	support colums	0.7				
	foundation ring	0.4				
	cover slab	0.3				
	cyliner					
	tank	2.7				
10 m3 silo	Sum	4.15	₹ 12,000	₹ 49,850	1	₹ 49,850
	conecting pipes and dosage valve					₹ 15,000
						₹ 64,850
	sieve and conveyor belt					₹ 50,000
					10.00%	₹ 330,000
				Sum treatment plant		₹ 3,348,172

Operation and Maintenance

Waste water treatment plant for the Residential Zone

Estimated operation and maintenance expenses

	Monthly				**Annual**
Staff	base salary	add	total	Qty	
1st operator	₹ 9,000	₹ 1,170	₹ 10,170	1	₹ 122,040
2nd operator	₹ 5,000	₹ 650	₹ 5,650	1	₹ 67,800
	consumption (units)		rate		
power*	2160		₹ 7.0		
	tax		5%		
	base charge	5	₹ 120.0		
					₹ 194,112
phone			₹ 500		₹ 6,000
Internet			₹ 600		₹ 7,200
water			₹ 500		₹ 6,000
Site maintenance		1%			₹ 13,000
Plant maintenance		1%			₹ 24,000
Lab			₹ 1,500		₹ 18,000
3rd party monitoring			₹ 5,500		₹ 66,000
				Sum	₹ 524,152
				per person and year	₹ 524

* with introduction of SPV power expenses will be reduced by half
* *with introduction of the gas turbine in Phase 3 power expenses will be further reduced

Treatment Plant Performance Monitoring

Regular monitoring of performance parameters of the treatment plant can serve several purposes.
- Initially during run-in time, which can last several weeks, it gives an indication when the plant is fully operating and that it is achieving the treatment goal.
- During the normal operation it can give a warning when some operational parameters are out of the normal and the operator can take early corrective action
- And lastly it helps to document the performance of the plant in terms of scientific values.

Hence in the treatment plant it would be desirable to monitor several system performance parameters.

Initially we anticipate 4-5 independent sampling sequences:

a) during run-in time (6-12 weeks)– to determine at which point the plant is fully operational

b) performance monitoring during normal operation

c) safety of effluent for irrigation is maintained (worm eggs)

d) full analysis to ensure organic/inorganic toxic pollutants are within acceptable limits (heavy metals, phenolic compounds, insecticides etc….)

e) Sludge and compost analysis (nutrient value, non-toxic, safe)

f) After an incident of malfunctioning – to ensure that the plant is operating normally again (same procedure as run-in)

The approach should be flexible so that over time the parameters, the location and the frequency of sampling can be adapted to achieve a clear overview of the performance of the plant and yet keep the cost (and effort) at a reasonable level.

a) During run-in time performance of the plant in terms of COD inflow to COD outflow (mixed sample over 24 h), at weekly intervals.

b1) Performance of the plant simple (monthly)

quantity (occasionally to establish the water losses in each sub-system)
inflow (V-notch wear after primary settler)
outflow (V-notch wear at polishing pond)
water re-distribution system (meter)

	Water Quality Parameters				
		Settler		**Polishing pond**	
Sampling Location		**Inflow**		**Outflow**	
	COD	X		X	
	BOD	X		X	
	Total N	X		X	
	Total P	X		X	
	TDS	X		X	
	Ph	X		X	
	TDS	X		X	

B2) Performance of the plant extended (quarterly)

	Water Quality Parameters				
		Settler	**Trickling filter**	**Clarifier**	**Polishing pond**
Sampling Location		**Inflow**	**Inflow**	**Inflow**	**Inflow and Outflow**
	COD	X	X	X	X
	BOD	X	X	X	X
	Total N	X	X	X	X
	Total P	X	X	X	X
	TDS	X	X	X	X
	Ph	X	X	X	X
	TDS	X	X	X	X

c) re-distribution treated water. worm eggs, e.coli (monthly during first 6 month, later quarterly)

d) and e) once per year

The analysis of the samples at site would require the setting up of an adequate laboratory and employment of trained staff. Beside the initial capital investment this also would add considerably to the running costs of the plant.
As an alternative solution it is explored that that Environmental Monitoring Service takes up this work on a contract basis. EMS is a state of the art laboratory in close vicinity of the plant. They would undertake the sampling and the analysis.

The following equipment should be available at site:

- Store room (size)
- Table
- Fridge

Analysis at site

To ensure the good performance and uninterrupted operation of the treatment plant it would be desirable to monitor one or two indicators at short intervals (daily) in order to detect un-normalities at an early stage.
This could for example be low dissolved oxygen level in the polishing pond as an indicator for eutrophication. This could occur some times during the hot season and if detected early enough controlled aeration through increased re-circulation of water through the trickling filter or air diffusers would prevent any problems arising.

It is proposed to install the following monitoring equipment at the plant
- Waste water flow (quantity)
- temperature
- dissolved oxygen

The cost of the on-site monitoring equipment is estimated at Rs 1.50.000

The cost of 3rd party services for monitoring after run-in period is estimated at 5500,- per month.

Design and cost estimate of Plant Type 2 - by CSR

(see separate file in Annexure)

Design and cost estimate of Plant Type 3 - Indus Ecowater

(see separate file in Annexure)

Design and cost estimate of Plant Type 4 - Sharpenn Industries

(see separate file in Annexure)

Design and cost estimate of Plant Type 4 - Akar Impex

(see separate file in Annexure)

Sources:

(complete list of sources and References will be given at the end of Part 4 of the Study)

[1] Imhoff
[2] Indian Manual on Waste Water
[3] Ireland EPA Water Treatment Manual
[4] US EPA 2000
[5] Agences de l'Eau, France
[6] EM Water
[7] BORDA, DEWATS Handbook
[8] Performance evaluation of integrated treatment plant of trickling filter and constructed wetland, Jan 2012

Annexure : (All annexure are available in “soft copy” at the l'avenir's google drive)

Survey of existing treatment plants.

Photos

Map with GPS positioning

Inflow an outflow test results

Possible scenario for population density and distribution in the Study Area

Considerations for the use of recycled waste water for toilet flushing

Publications:

Indian Standards

Indian Manual on Water Supply and Treatment, 1999

Manual on Sewerage and Sewage Treatment Systems, Ministry of Urban Development, 2013

National Urban Sanitation Policy
Ministry of Urban Development, Government of India

MINISTRY OF URBAN DEVELOPMENT
RECENT TRENDS IN TECHNOLOGIES IN SEWERAGE SYSTEM, 2012, GOVERNMENT OF INDIA

Guidelines for Water Quality Management, CENTRAL POLLUTION CONTROL BOARD, 2008

Surface Water Quality Standards IS: 2296

Simplified sewerage manual

WHO

Safe reuse of WW WHO Vol 1
Safe reuse of WW Agriculture WHO Vol 2
Safe reuse of WW Agriculture and excreta WHO Vol 3
Safe reuse of WW excreta and greywater WHO Vol 4

International Standards

Composting dewatered sewage sludge, U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE/

Use of Municipal Solid Waste Compost and Waste Water Biosolids with Co-Composting Process, M.H. Hasanimehr, H. Amini Rad, V. Babaee and M. Sharifzadeh ,2011

EU

91271EEC
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

Developing a New Bathing Water Policy, 2000
Revised by Directive 2006/7/EC of the European Parliament management of bathing water quality

US

Guidelines for Water Reuse U.S. Environmental Protection Agency, 2004
California: Health and Safety Code, Title 22

Company Brochures and leaflets

Sewerage

Underground-drainage-system
Lakshmi-corporations
Nu-DrainUDS system
UPVC pressure pipes and fittings
SWRMultiPage

Gas Turbines

CR30 MicroTurbine Renewable Fuels

Study for Sustainable Waste Water Development in the Residential Zone I & II

Annexure to Part 3

AUROVILLE RESIDENTIAL ZONE
SECTORS 1&2

Implementation of Vortex Dewats & Sludge management concept

Concept Note

January 2014

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AUROVILLE
RESIDENTIAL ZONE - SECTORS 1&2

Concept Note

Implementation of Vortex Dewats & Sludge management concept

Auroville Centre for Scientific Research (CSR)

28 January 2014

1 PREFACE

L'Avenir requested a study in June 2012 on a concept for wastewater management for the Residential Zone, sectors 1&2. Based on this study, a brief, dated 16 December 2013, was received by CSR, entitled "Request to provide the design and operational details of a waste water treatment plant for the Residential Zone 1 and 2". Considering the absence of information on final site conditions the present document is developed as a concept note. A detailed technical study (including dimensioning drawings) can be done only once the site conditions are defined and the concept approved.

CSR's proposed technology is Vortex-Dewats, not "baffle reactor" as mentioned in the brief. This technology is endorsed by Central Pollution Control Board and promoted by the Ministry of Urban Development (MOUD).

The proposal includes a sludge management concept.

Auroville requires sewage treatment systems for processing the produced sewage and allowing safe and adequate recycling.

The sectors 1 & 2 are planned for a population of **5000 people** with related housing and other public facilities.

Considering that Auroville's area is classified as water scarce, and that water accessibility will be become more and more challenging and costly, it is necessary to promote the implementation of sustainable and green practices in the context of Auroville.

The present note analyses the basic parameters as proposed in the brief, in comparison to National Building Code values and as per green practice code. Accordingly the adapted design parameters will be defined, in order to evolve as a role model for future town developments.

In the water sector, this approach culminates in major savings regarding water consumption, both for the general domestic use and for the common facilities. In turn, this leads to a major reduction of wastewater generation: the final total wastewater flow as per l'Avenir's brief is **750KLD**, a per NBC statutory norms it should be **540KLD**, while consumption after implementing

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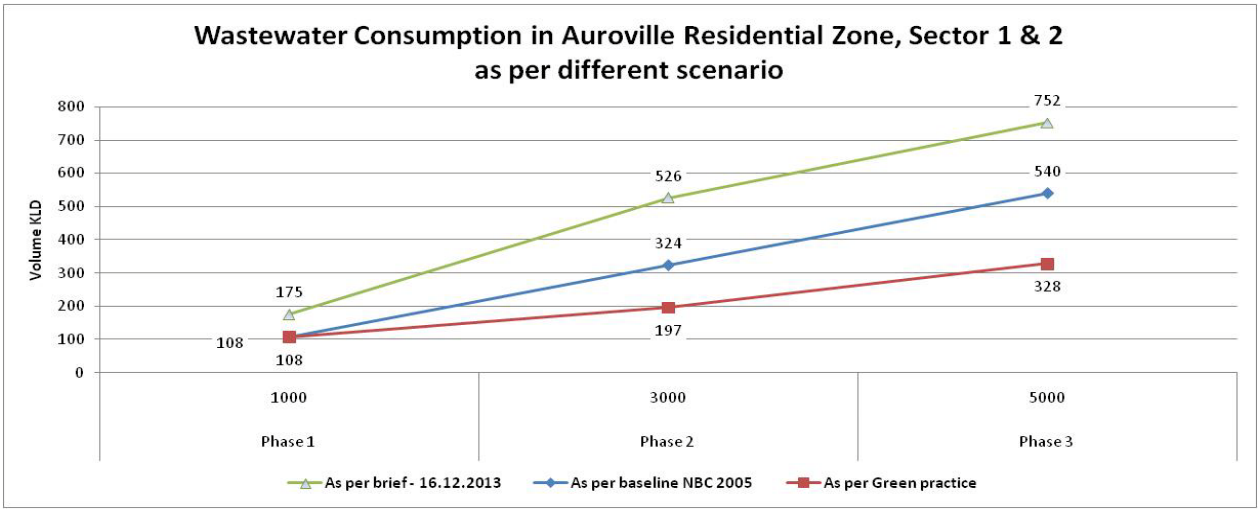
proper water saving practices and low flow features and devices reduces this volume to **288KLD** only, which is 44% of the initial flow as per l'Avenir brief.

We would like to underline these essential facts and integrate the revised standards within the design features of the concept note to achieve a cost effective and sustainable waste water treatment proposal.



CSR is aware that it is stepping out of the defined parameters of the brief, having experience in the area of integrated water management and especially wastewater management together with the concern for promoting sustainable practices, we believe that this is the way to move forward for implementing water and waste water projects.

Apart from the basics parameters of the brief, some comments are offered on the appropriateness of the choices made in terms of parameters and scope for recycling.

This note does not discuss the appropriateness of a centralized approach in regard to draining and processing the sewage, nor the eventual usage of renewable energy, which can be explored separately.

It is however necessary to point out that the integration of the existing waste water treatment plants, is not defined or proposed as a possibility. Considering that the existing STPs achieve various levels of treatment, that the processed wastewater is most of the time already reused on site, that they altogether represent important assets, and that the investment to re-connect the settlements to a new facility would be considerable.

The existing waste water treatment systems serve an actual population of 520 people (~10% of final population), and should reach 920 with the actual sanctioned projects (~18.4% of final population).

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A plan to improve and to upgrade the existing STPs to a desirable standard is therefore advisable.

Our recommendation is to look afresh at the required capacity for the proposed STP. While the maximum capacity for the STP is planned for 5000 people, the above observations lead to estimate that only 4000 people will be connected. The corresponding reduction of the sewage flow is 18% and the related required drainage, treatment and recycling capacity do represent important financial implications.

1.1 Observations in regard to Volume parameters

The reason why the water consumption in Auroville is higher today than NBC standards has been discussed extensively in other studies. A major part of it is due to an inadequate distribution network, while this is changing due to the effort done to improve the piping system. Part is due to low quality features, and usage of freshwater for irrigation purpose. We do not consider necessary to develop further on this point, for new development would anyhow require a proper piping network, up to the end user.

We should try to achieve the National Building Code standards in the immediate future, overcoming the challenges, while best green practices should be proactively promoted through building codes, rating of water and guidance to the architects, planners and developers.

Today in India there are several projects integrating successfully such practices, demonstrating they are realistic, achievable and cost effective.

CSR considers it imperative to promote this direction.

Overview of fresh water consumption as per various guidelines and population.

The value for Green Practice in phase I is maintained as per NBC in order to ensure a smooth transition towards further reducing the consumption of water and moving towards a sustainable resource water usage.

Freshwater consumption		**As per brief - 16.12.2013 (1)**		**As per baseline NBC 2005**		**As per Green practice**	
Building Phase	**Total**	**Quantity per Person**	**Total Quantity**	**Quantity per Person**	**Total Quantity**	**Quantity per Person**	**Total Quantity**
	PE	lcd	KLD	lcd	KDL	lcd	KDL
Phase 1	1000	219	219	135	135	135	135
Phase 2	3000	219	657	135	405	82	246
Phase 3	5000	188	940	135	675	82	410

Note: (1) this value is derived from the brief's value of 175lcd of generated wastewater. As per common practices, wastewater generation is accounted for 80% of fresh water consumption. Hence, fresh water consumption is 219lcd initially and 188lcd at phase 3, as per the brief.

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It must be noted that the figures mentioned in "as per Green practice" column are currently used in new national residential complexes, the reduced water consumption figures are based on readily available market products like dual flush toilets, low flushing toilets, faucets aerators and proper piping system. It is not based on sophisticated or costly devices, it is realistic to achieve and cost effective.

Out of this freshwater consumption, part turns into wastewater.

The common figure for wastewater generation retained all over India is 80% of freshwater consumption for domestic-like usage. Considering that this is a well established and verified value, we take this as valid standard.

It is necessary that the proposed waste water treatment system takes into account:

- The evaluated flow
- The NBC flow norms
- The reevaluated flow and pollution load reaching the STP, after applying the saving practices and devices.

The extra load due to rain infiltration into the sewer lines (conditioned by the number of connection chambers) is not part of the present value, the sewer network being unknown at this stage.

The below table for wastewater generation is derived from the previous one.

Waste Water Quantity		As per brief - 16.12.2013		As per baseline NBC 2005		As per Green practice	
Building Phase	Total	Quantity per Person	Total Quantity	Quantity per Person	Total Quantity	Quantity per Person	Total Quantity
	PE	lcd	KLD	lcd	KDL	lcd	KDL
Phase 1	1000	175	175	108	108	108	108
Phase 2	3000	175	526	108	324	66	197
Phase 3	5000	150	752	108	540	66	328

Considering all the previously mentioned elements, the design parameters for the treatment system are:

1. The pre-treatment (settlers) and balancing systems, designed to fulfill NBC norms with the sewer line rain infiltration flow.
2. The main treatment devices designed as per Green practice values. Note that for phase I the wastewater production per capita as per Green Practice is maintained at 108lcd (NBC values) in order to ensure a smooth learning transition. The system will ensure appropriate storage capacity for irrigation practices.
3. The system will ensure appropriate storage capacity for toilet flushing.

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1.2 Observations in regard to Quality parameters

Green practices in regard to water are based on implementation of water saving practices, efficient water saving devices and recycling of wastewater. Today's requirement in many Indian states is to treat wastewater at a level sufficient to allow for recycling for irrigation AND for toilet flushing. CSR consider that such level of treatment should be promoted.

In this regard it is worthwhile stating the norms that the Ministry of Urban Development (MOUD) is promoting. We do not see why Auroville should deviate from the National standards.

As per Manual of sewerage and sewage treatment system, Ministry of Urban Development, November 2013, the recommended norms of treated sewage quality for specified activities at point of use are as follow:

	Parameter	Toilet flushing	Fire protection	Vehicle Exterior washing	Non-contact impoundments	Landscaping, Horticulture & Agriculture			
						Horticulture, Golf course	crops		
							Non edible crops	Crops which are eaten	
								raw	cooked
1	Turbidity (NTU)	<2	<2	<2	<2	< 2	AA	< 2	AA
2	SS	nil	nil	nil	nil	nil	30	nil	30
3	TDS	2100							
4	pH	6.5 to 8.3							
5	Temperature °C	Ambient							
6	Oil & Grease	10	nil	nil	nil	10	10	nil	Nil
7	Minimum Residual Chlorine	1	1	1	0.5	1	nil	nil	nil
8	Total Kjeldahl Nitrogen as N	10	10	10	10	10	10	10	10
9	BOD	10	10	10	10	10	20	10	20
10	COD	AA	AA	AA	AA	AA	30	AA	30
11	Dissolved Phosphorous as P	1	1	1	1	2	5	2	5
12	Nitrate Nitrogen as N	10	10	10	5	10	10	10	10
13	Faecal Coliform in 100 ml	Nil	Nil	Nil	Nil	Nil	230	Nil	230
14	Helminthic Eggs / litre	AA	AA	AA	AA	AA	<1	<1	<1
15	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	AA	Colourless	Colourless
16	Odour	Aseptic which means not septic and no foul odour							

NOTE: All units in mg/l unless specified; AA-as arising when other parameters are satisfied; A tolerance of plus 5% is allowable when yearly average values are considered.

We like to point out that the discharge parameters defined in the brief do not fulfill the norms either for irrigation, or toilet flushing.

Urban agriculture is likely to be practiced in in Auroville. Therefore, the processed wastewater quality must fulfill appropriate hygiene criteria, which basically turns both requirement for irrigation and toilet flushing into one single set of criteria.

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CSR therefore reframed the discharge parameters in respect to national discharge standards.

Parameters	Unit	Inlet parameters	Outlet parameters as per brief	Outlet parameters required
pH	-	6.5-8.5		6.5-8.5
BOD 3	mg/l	250-300	< 25	< or = 10
COD	mg/l	400-500	< 125	< or = 100
Suspended Solids	mg/l	200-250		
Oil & Grease	mg/l	10_15		**< or = 5**
TSS	mg/l		< 35.0	< or = 10
Turbidity	NTU		< 2	< 2
Color				Colorless
Odor				Unobjectionable
E. coli	count/100 ml		< 103	None
Helminth eggs	per liter		< 1	None

The parameters as per brief will be retained for irrigation practices while the other one will be used for toilet flushing parameters.

The objective is to treat the effluent according the following design criteria:

1. Discharge quality of sewage meets all national standard criteria
2. Processed effluent shall be odorless, color and turbidity are unobjectionable
3. Safe recycling of processed effluent for decorative water bodies.
4. Safe recycling of processed effluent for irrigation of the green spaces wherever required.
5. Safe and hygienic recycling of processed effluent for toilet flushing
6. Integration of final stage treatment devices (second set of vortex system) as landscape elements
7. If necessary, safe discharge of excess water in water bodies or nearby water ways.

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2 TECHNOLOGY INTRODUCTION – VORTEX-DEWATS

Natural Decentralized Waste Water Treatment Systems with integrated vortex system (Vortex-DEWATS) are based on several natural physical treatment techniques, put together in different combinations according to the needs, the physical constraints, the natural site conditions, the discharge regulations and the involved investment. The different devices cover primary, secondary and tertiary treatment stages.

The treatment applications are based on the principle of minimal maintenance. The critical parts of the treatment system work continuously and uninterrupted with low energy inputs. The technology provides treatment for domestic and industrial (non-toxic) sources and is able to treat effluent flows from 1 up to 1000 m^3 per day.

Operating on biological principles and employing non mechanical devices, the technology is tolerant towards inflow fluctuation and does not require complex maintenance practices. The life time of the main civil constructed components is estimated at 30 years. Due to these characteristics, it can be adapted to a large range of site conditions and provide cost effective solutions comparing favorable with conventional solutions.

The technology produces safe and odorless discharge of effluent, reaching all required effluent parameters. Furthermore, landscape integration introducing flowing water in small water bodies, waterfalls, vortex systems can add esthetical value.

Executing a Vortex-DEWATS system will require to follow precise standards in the execution of the construction work, especially for the hydraulic components: levels require extra care and attention, while the overall civil structure requires proper execution and finishing to ensure a life time functioning.

3 BIOLOGICAL PRINCIPLES OF EFFLUENT TREATMENT

Natural effluent treatment processes are achieved through methods that make use of physical principles combined with biological activities of microorganisms. Microbial colonies in the treatment devices are generated from microbial populations that occur naturally in the wastewater. The technology is based on the integration and optimization of these natural processes. Nature is effectively using and decomposing organic matter through specialized microorganisms who live in the waste substances. These microorganisms digest the substances present in waste water. The conversion process turns these harmful products into stable, safe end-products. Colonies of microorganism will actively digest the available waste which is present in the sewage or effluent flow through processes involving aerobic or anaerobic conditions. By creating and combining these alternate conditions of oxygen poor and oxygen rich environment, the waste water flow progresses towards clear, odorless, colorless, harmless treated water.

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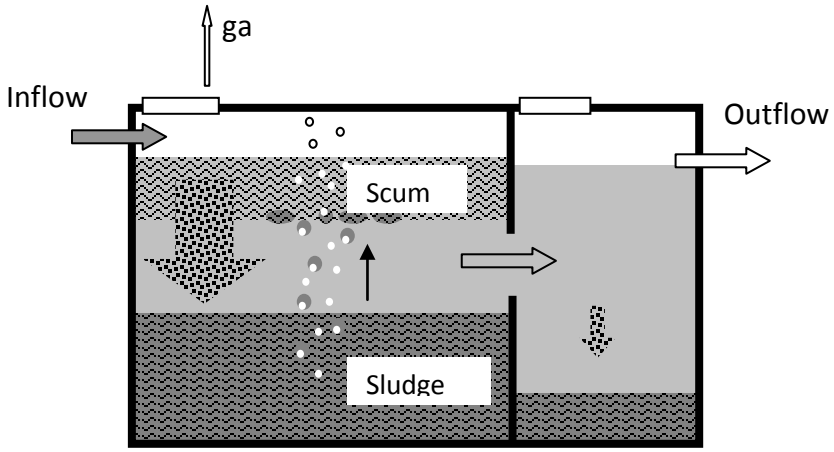
By taking advantage of the powerful purification effects of microorganisms and by designing the various stages of treatment to further enhance this potential, incorporating site conditions, climatic parameters, minimum power requirements, low maintenance practices, no chemical inputs, the designed waste water treatment system accomplishes the highest sustainable requirements.

4 DEWATS PRINCIPLES AND DEVICES

4.1 Pre-treatment cycle: the settler

A pre-treatment device is used for the sedimentation process to take place, in which the liquid part is separated from the solid matter. A device called **a settler** is used for this phase. If needed, a screening device, for preventing unwanted large materials to enter the system can also be installed. It is useful to install near the kitchen outlet a grease trap, a device designed to intercept most greases and solids before they enter the wastewater disposal system. A grease trap needs very regular cleaning and a special place for the disposal of the removed scum layer.

The settler is an underground constructed tank with **one partition wall**. Within the settler two main treatment processes take place, first a sedimentation and second a stabilization and digestion of the settled sludge through biological treatment. Storage volume is provided for 12 upto 36 months, this parameter defines the necessary desludging period.



Typical Section of a Settler

Desludging is the process of emptying the sludge at regular intervals from the first and second chamber, which is an absolute necessity. Sludge is very rich with useful bacteria. While desludging it is necessary to ensure that a portion is left in the bottom of the settler, this in order to provide fresh inoculation material for restarting the process after the regular - 1 year interval - cleaning period.

The settler can be a separate device or can also be incorporated with the main treatment componants.

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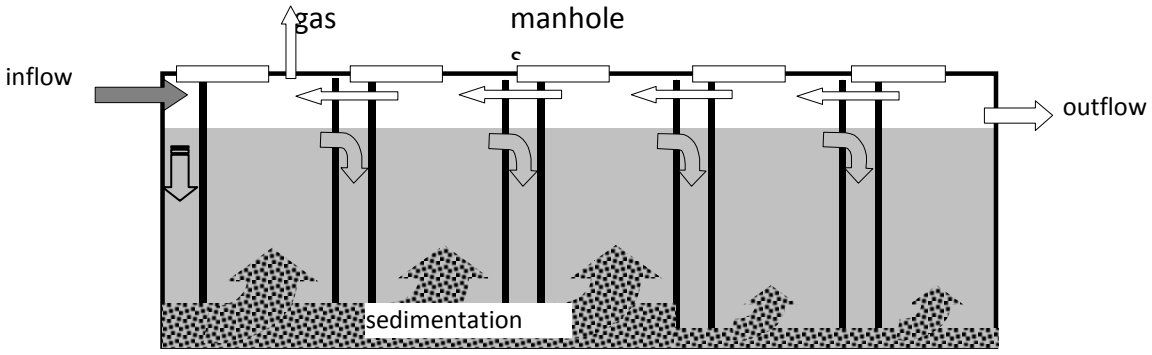
4.2 First treatment cycle: the anaerobic baffled tank

In the first treatment phase, biological and natural chemical processes are used to digest and remove most of the organic matter.

A device called an anaerobic **baffled tank** is used for this phase. Several tanks are constructed in series to digest degradable substances. Baffle walls or down-flow PVC pipes direct the waste water stream between the chambers from top to bottom and up again. During this process the fresh influent is mixed and inoculated for digestion with the active blanket deposit of suspended particles (floating bacteria media) and microorganisms occurring naturally at the bottom of each chamber. Because of the physical separation (multiple chambers), various microorganisms are present at different stages, allowing a high treatment efficiency.



Inoculation of fresh wastewater with active sludge

Typical section of an Anaerobic Baffled Tank

Desludging will also be required at regular interval for this component as it will naturally accumulate in the chambers of the baffled reactor. Sludge is the media in which helpful bacteria develop and where the treatment occurs in the baffled reactor. During desludging it is necessary to keep a 30cm portion in the bottom of the settler, in order to provide fresh inoculation material for restarting the process after the regular - 1 year interval - cleaning process.

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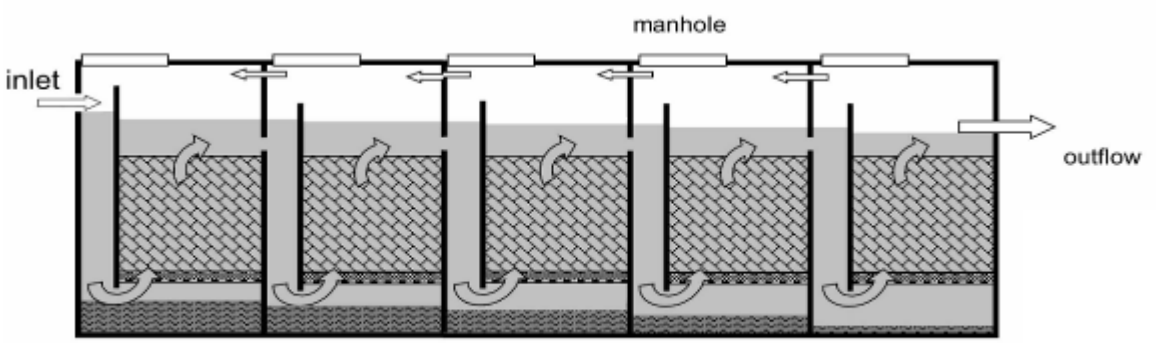
4.3 Second treatment cycle: the anaerobic filter

After passing through the multiple chambers of the baffled tank reactor the sewage is virually free of easily settling solids, hence very little sludge can accumulate at the bottom of the chambers and no proper further treatment can occur in this context. At this stage, extra chambers are designed as an **anaerobic filter** in order to improve further the treatment efficiency. A filter media that allows widespread contact with the effluent stream is used which is also efficient in retaining and digesting the left over pollutants. The problem of encountering clogging is minimized due to the digestion and treatment that occurred already in the baffled tank treatment. The process works with fixed bacteria media. Self cleaning mechanism is eased by providing free space below the filtering media, where sludge can accumulate and be removed easily.

The effluent passing out of the anaerobic filters will have at least a 90% of the original pollution load removal.



Typical section of an Anaerobic filter

Desludging, while less in comparison to settler and baffled reactor, will be required at regular intervals . It is necessary to desludge every year.

The pre-treatment (settler), first treatment (baffled tank) and second treatment (anaerobic filter) can be constructed underground and integrated into various building spaces. The different treatment phases can be constructed together, or as separate modules.

The required discharge standards are met at this stage and the wastewater can be, if required, safely reused for infiltration into the soil and recharge the ground water table.

The system works by gravity and does not require any mechanical part as far as the treatment process is concerned. More compact designs can integrate the necessity to equilibrate the flow fluctuation and/or spread it over a longer period. In such cases, a balancing tank equipped with a pump may be required for achieving the necessary flow.

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4.4 Third treatment cycle

4.4.1 Third treatment cycle: the vortex system

A slow speed vortex system is a device for advanced treatment with excellent results. The new device replaces completely the previously used and space demanding planted filter. The vortex system has the advantage of having a tiny implementation footprint but necessitates an electrical supply.

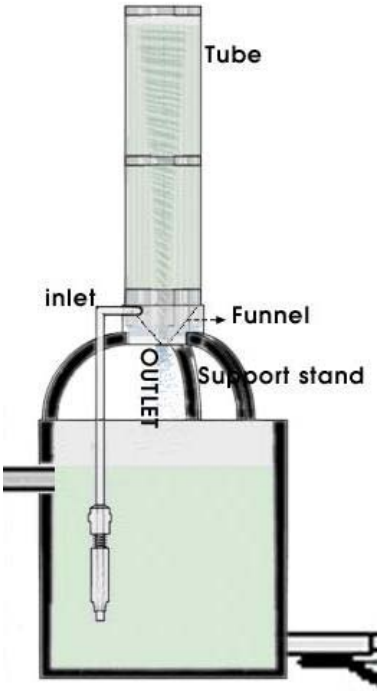
Odour with this innovative device is completely controlled while BOD and COD are further reduced since the effluent receives extra continuous oxygen through the vortex movement.

Vortex systems include a sump used to guarantee enough looping of the water through the vortex, which in turn ensures that the water reach full oxygen saturated with maximum oxygen supply.

The sump can be equipped with a specially designed aerobic filtering media system, which in turn will ensure efficient turbidity and color control, reaching the required discharge levels.

At this stage, 95% of the original pollution load removal is achieved.

This efficient device offers plenty of scope for beautification and can easily be part of the onsite landscape design.



Typical section of vortex

4.5 Post-treatment cycle: the polishing tank (open water body)

This is an optional treatment

While the entire treatment is ensured at this stage, it is possible to collect the processed water in a polishing pond. Further than offering storage for further recycling, it can also be part of the beautification of the site, changing the otherwise functional oriented STP into an aesthetic element.

At this stage the recycled wastewater is extremely valuable for irrigation; the water is high in nutrient contents and beneficial for plant growth.

The above described devices concern the main treatment components of the system. Secondary elements play a role in operating such system but not in the process as such. They are described further

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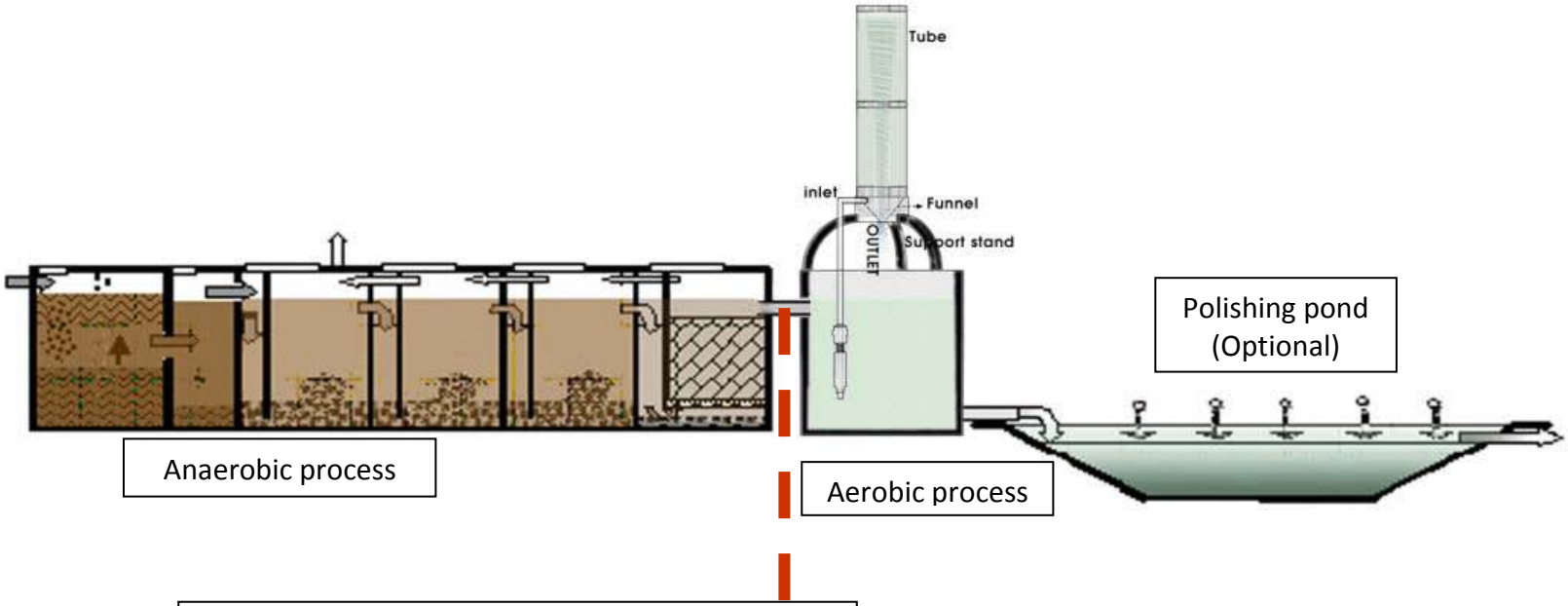
Schematic overview of a typical Vortex DEWATS (decentralized waste water treatment system):



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5 PROPOSED DESIGN PARAMETERS

5.1 Basic characteristics of sewage

As per received data, the site sewage has the following characteristics:

Parameters	Unit	Inlet parameters	Outlet parameters for irrigation	Outlet parameters for toilet flushing
pH	-	6.5-8.5		6.5-8.5
BOD 3	mg/l	250-300	< 25	< or = 10
COD	mg/l	400-500	< 125	< or = 100
Suspended Solids	mg/l	200-250		
Oil & Grease	mg/l	10-15.		**< or = 5**
TSS	mg/l		< 35.0	< or = 10
Turbidity	NTU		< 2	< 2
Color				Colorless
Odor				Unobjectionable
E. coli	count/100 ml		< 103	None
Helminth eggs	per liter		< 1	None

In addition parameters like nitrates affecting the quality of treated water to be recycled will be controlled.

Efficiency of the treatment is guaranteed under given climatic and population variations.

The treated wastewater is safe for toilet flushing, gardening, usage in decorative water bodies and landscaping elements and for discharge in open drains or channels. The processed water will be odorless, color transparent and safe for human handling (hygienic).

5.2 Optimization

The sizing of the Vortex-DEWATS is determined, amongst other parameters, by the hourly peak flow. In order to reduce the size of the installation and consequently the investment it is advisable to balance and distribute the sewage flow after the settler over a larger number of hours than occurring through natural flow. For that reason a balancing tank and related measurement and distribution devices are part of the design of the STP.

It must be noted that the Vortex capacity can be adjusted to a rather large extend. Therefore, there is no need to change the vortex while the system will evolve, but simply to adapt them. The pumps will need to be changed to fit with the flow requirement.

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5.3 Design parameters

Below is a synthesis of all required design parameters.

NOTE: In order to fulfil the requirement of CPCB, one need to justify that the capacity of the STP at inlet point is sufficient to address NBC standards, while there is no further concern for the capacity in the following stages. Consequently, the design parameters take into account NBC volume standards during the 1stage, while in the second stage treatment the actual sewage flow is used.

Sr. No.	Parameters	Values for Vortex Dewats	
1	**Implemented Technology**	**Vortex-Dewats**	
2	Peak factor	1,7	
3	Operating Period	12h/d	
4	Minimum sewage flow required	1/10 of reference flow	
5	Volume to be processed	1st stage as per NBC	2nd stage as per real flow
	Phase 1	108	108
	Phase 2	324	197
	Phase 3	540	328
6	Inlet parameters		
a	PH	6.5-8.5	
b	BOD 3	250-300 mg/lit.	
c	COD	400-500 mg/lit.	
d	Suspended Solids	200-250 mg/lit.	
e	Oil & Grease	10-15 mg/lit.	
7	Output parameters		
a	pH	6.5-8.5	
b	BOD 3	<or =10 mg/lit.	
c	COD	<or =100 mg/lit.	
d	Suspended Solids	<or =10 mg/lit.	
e	Oil & Grease	<or =5 mg/lit.	
f	TSS	< or = 10 mg/l	
g	Turbidity	< 2 NTU	
h	Color	Colorless	
i	Odor	Unobjectionable	
j	E. coli	None	
k	Helminth eggs	None	
8	Level of Automation	Automatic	

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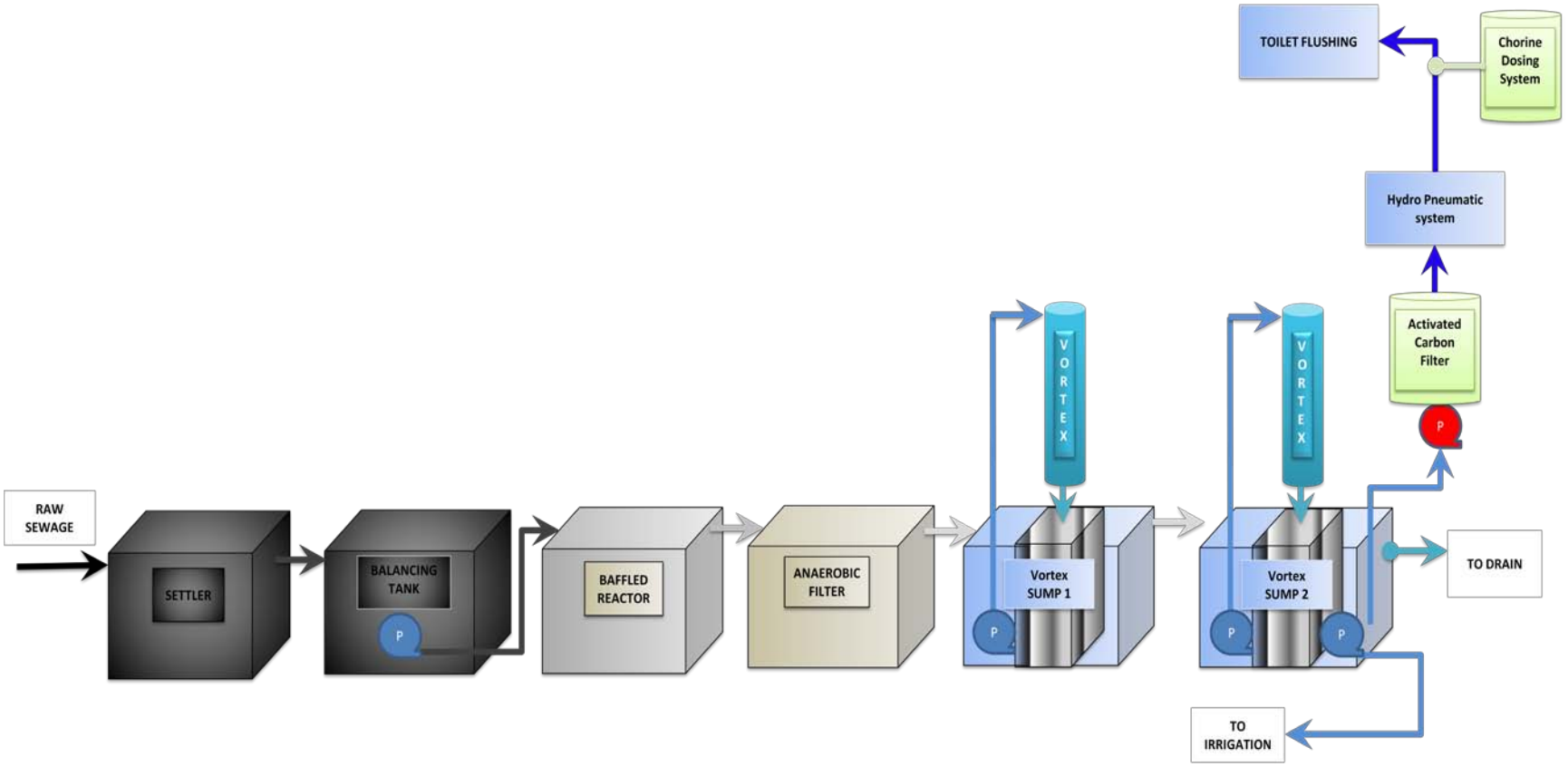
5.4 Simplified Flow Diagram



Note: the present flow diagram is indicative only. Considering that standards requirement are similar, the recycling line for irrigation and for toilet flushing could be combined. The final choice is to be made in accordance site specifications and chosen standards.

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5.5 Proposed sequence of devices

The sequence of devices will be the same for the 3 phases. The flow is mentioned for each phase.

The system is design based on the premises that most of the effluent flow will be generated 10 hours per day. Furthermore, the system can absorb the expected flow variations, including a peak flow factor of 1.7 from average. The proposed design system is sturdy and flexible, allowing predictable changes from the submitted basic flow data and has a long-lasting life cycle.

Ref	Component	Description	Sewage Flow to process As per phases
1	Bar screen chamber	**Bar screen chamber**, accessible underground structure, to screen out large unwanted solids to enter and eventually chock the STP. The grit chamber is equipped with a bar screen and is manually cleaned once a day. Concerning the cost and energy demand, an automatic cleaning mechanism is not proposed.	108 KLD peak flow 18.4m3/h 324 KLD peak flow 45.4m3/h 540 KLD peak flow 91.8m3/h Operating time approx 10h/d
2	Inlet box	**Inlet box,** underground structure, serving as an entry point to the STP, where all wastewater generated from the site is collected. The inlet box is equipped with a manhole and the main vent lines for the entire system.	108 KLD peak flow 18.4m3/h 324 KLD peak flow 45.4m3/h 540 KLD peak flow 91.8m3/h Operating time approx 10h/d
3	Settler	**Settler,** underground structure, divided into two chambers. Equipped with inlet box, air tight manholes, appropriate openings, vent lines and piping. Handling part of the flow as per sewer layout. Connected by gravity to the main treatment devices through a separate sewage line up to the inlet box. Flow and location as per site layout and sewer system design.	108 KLD peak flow 18.4m3/h 324 KLD peak flow 45.4m3/h 540 KLD peak flow 91.8m3/h Operating time approx 10h/d
4	Balancing tank	**Balancing tank**, underground structure, equipped with level control, 2 submersible pumps running on alternate days, flow regulating valves, related piping and an overflow structure (for emergency), vent lines.	108 KLD peak flow 18.4m3/h 324 KLD peak flow 45.4m3/h 540 KLD peak flow 91.8m3/h Operating time approx 10h/d
5	V-notch Box	**V-notch bo**x, on top of Balancing tank, composed of a decompression chamber and a measurement channel equipped with a V-notch plate for flow measurement purpose, in order to ensure that the flow reaching the next treatment devices is adequate. Equipped with a removable cover	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d

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6	Repartition box	**Repartition box**, on top of Balancing tank, allowing proper flow distribution to the parallel lines of the subsequent devices. The repartition boxes are equipped with a V-saw plate, a distribution channel and **3** compartments. The connection will be done as per phase extension. Equipped with airtight manholes.	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d
7	Distribution channel	**Distribution channel**, underground structure, ensuring that every line gets an optimal flow distribution from the entry point. Equipped with air tight manholes, proper piping and vent lines	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d
8	Baffled Reactor	**Baffled Reactor,** underground structure, made of 3 parallel lines with **5** chambers each. All lines work with an equalized sewage flow. Equipped with air tight manholes, proper piping and vent lines	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d
9	Anaerobic filter	**Anaerobic Filter,** underground structure, consisting of 3 parallel lines with **4** chambers each. The chambers are with perforated slabs and filled with a filtering media (cinder) All lines work with equalized flow. Equipped with air tight manholes, distribution pipes, desludging devices and vent lines	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d
10	Collection channel	**Collection channel**, underground structure, collecting by gravity the 3 parallel lines to the next device. Equipped with air tight manholes, a sampling opening for monitoring purpose and vent lines.	As per requirement
10	First vortex sump	**First vortex sump**, underground structure, allowing for vortex treatment. The sump includes a partition wall, perforated slab and filtering media (cinder). Equipped with level control and overflow structure for emergency, air tight manholes, 2 submersible pumps running on alternate days for Vortex system feeding, Equipped with flexible pipes and floating devices for feeding to the irrigation system, vent lines provided.	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d
11	First vortex system	**First vortex systems**, equipped with proper regulation system. Made of stand, funnel, inlet pipe of appropriate dimension, flow control system and appropriate piping. The vortex system is equipped with a timer in order to run the	108 KLD 197 KLD 328 KLD

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		system as per requirement, and is calibrated to ensure optimal treatment effects. The first vortex system is connected to the first vortex sump. It is installed on the vortex sump or alternatively in the pump house.	Operation time 20h/d max
12	Second vortex sump	**Second vortex sump**, underground structure, allowing for vortex treatment , and including extra storage capacity for toilet flushing purposes (50% of daily demand) and for irrigation (2/3 of daily flow). The sump includes a partition wall, perforated slab and filtering media (cinder). Equipped with level control and overflow pipe for emergency, air tight manholes. 2 submersible pumps running on alternate days for Vortex system feeding, Piping devices, provided to supply the hydro pneumatic system for toilet flushing, equipped with flexible pipes and floating devices for feeding to the irrigation system. Vent lines provided.	108 KLD hourly flow 5.4m3/h 197 KLD hourly flow 9.9m3/h 328 KLD hourly flow 16.4m3/h Operation time 20h/d
13	Second vortex system	**Second vortex systems** equipped with proper regulation system. Made of stand, funnel, inlet pipe of appropriate dimension, flow control system and appropriate piping. The vortex system is equipped with a timer in order to run the system as per requirement, and is calibrated to ensure optimal treatment effects. The vortex system is connected to the second vortex sump. It is installed on the vortex sump or alternatively in the pump house.	108 KLD 197 KLD 328 KLD Operation time 20h/d max
14	Activated Carbon filter (optional)	**Activated carbon Filter**, installed in the Pump house, to ensure no left over particles leave the system before entering the recycling lines. The ACF is equipped with proper piping and backwash system and proper pressure control system.	108 KLD 197 KLD 328 KLD
15	Hydro-pneumatic system	**Hydro-pneumatic**, installed in the Pump house, system equipped with proper control system, pumps, electronic control etc, to maintain the pressure in the treated water distribution network. Installed in the pump house. Excluded from CSR's consultancy job.	As per requirement
16	CDS	**Chlorine dosing system**, installed in the Pump house, equipped with a storage barrel for chlorine solution and a dosing pump. Connected to the outlet of the hydro pneumatic system.	As per requirement

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17	Pump house	**Pump house**, housing the electrical control panel, the first vortex system, the hydro pneumatic system, the chlorine dosing system, small tools for operation and maintenance. It is provided with proper access for daily operation and replacement of equipment.	As per requirement
18	Control system	**Wattmon Control system (Cynergy)**, installed in the Pump house, will ensure easy and optimized control and operation for the entire operation of the STP, evolving in parallel to the phases. It can operate through internet.	As per requirement

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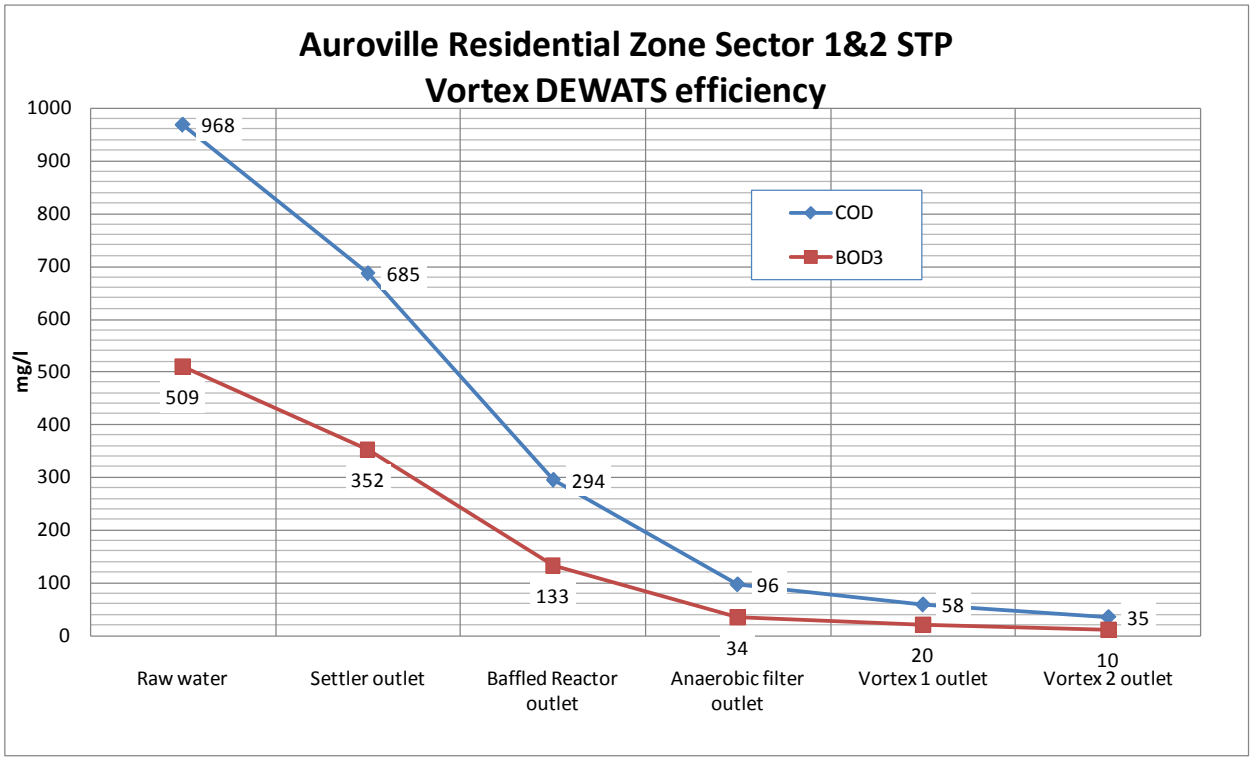
5.6 Treatment Efficiency



5.7 Approximate space requirement

NOTE: In absence of details on the site characteristics, the actual space requirement is not optimized. It can easily be reduced by 15% if site conditions allow.

	Number of users	Volume of sewage flow KLD	Area	Area per KLD	Area per user
	PE	KLD	sqm	sqm	sqm
Phase 1	1000	108	200	1,85	0,20
Phase 2	3000	197	440	2,24	0,15
Phase 3	5000	328	680	2,07	0,14

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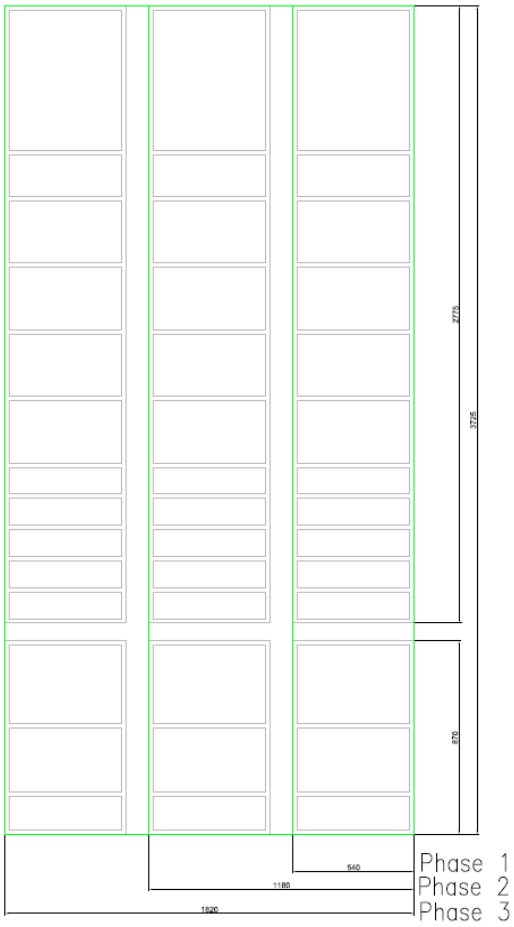

NOTE: Most of the components in the present design are underground structures; several of them will emerge above ground level: The pump house, the V-Notch box, the Repartition box. It is possible to construct the two last mentioned below ground level, but necessitating a layout revision resulting in a more complex structure.

In the absence of details on the site conditions, the design is not optimized at this stage. It is based on 3.5m deep structures.

The actual design is made of 3 systems of equal size, for the flows are more or less proportional from one phase to the other. This is allowing for an easy phasing of the STP. Once the site conditions are known, the design will be reframed in order to optimize the phasing and reduce the foot print and cost accordingly. The settler, balancing tank and vortex sumps could be modified as per the phasing, hence reducing the construction cost.

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6 POWER REQUIREMENT

	Phase 1		Phase 2		Phase 3	
Components	Installed power HP	Running power HP	Installed power HP	Running power HP	Installed power HP	Running power HP
Balancing tank transfer pump	2	1	2	1	4	2
First Vortex pump	2	1	3	1,5	4	2
Second Vortex pump	2	1	3	1,5	3	1,5
Activated Carbon Filter	2	1	3	1,5	3	1,5
TOTAL	**8**	**4**	**11**	**5,5**	**14**	**7**

NOTE:

The power requirement for the Activated Carbon Filter is indicative only. In practice, it will be integrated in the hydro pneumatic system. In the absence of definition of the recycling network, this device will be defined at a later stage.

7 BIOGAS GENERATION

The proposed Vortex DEWATS includes several anaerobic functioning components.

Considering the volume of wastewater generated, it is interesting to look at the volume of biogas generated from these components both from the point of environmental impact and potential power generation.

Phase	Biogas generation cum/d	Inbuilt energy KWh/d	Potential Power generation KWh/d
Phase 1	24	141	47
Phase 2	52	313	104
Phase 3	86	518	173

(The present concept is not addressing biogas generation and usage as such.)

It is anyhow proposed to design and give indications for the execution of the Vortex DEWATS which will allow for upgrading/retrofitting towards capturing biogas and potential usage for power generation.

The quality of execution in regard to air tight manholes, accurate levels in the hydraulic system, supply lines are of crucial importance to ensure a smooth and problem free functioning resulting in a effective biogas capture.

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8 COST ESTIMATE

8.1 Investment estimate

The present estimate is based on RCC structure of appropriate thickness and quality, including double special plastering for protection against corrosion.

Auroville Residential Zone - Sector 1 & 2					
Phase 1					
Bill of Quantity - Abstract					
Sl No	**Description**	**Quantity**	**Unit**	**Rate**	**Amount**
1	Earth work excavation	2460,16	m^3	110	270 618
2	Back filling	579,81	m^3	45	26 091
3	PCC 1:4:8 for foundation	73,04	m^3	2 950	215 468
4	RCC work	214,80	m^3	10 300	2 212 389
5	Perforated slab	6,00	Units	12 000	72 000
6	Shuttering	2652,86	m^2	220	583 629
7	Two coat Plastering inside wall & Floor	1275,90	m^2	220	280 698
8	Supplying & laying PVC pipes		LS		109 800
9	Providing filter media	429,00	m^3	1 400	600 600
10	GI manhole cover	17	No	1 500	25 500
11	Supplying & installing Vortex system	2	No	285 000	570 000
12	Special piping, valves, control & divers	1	No	150 000	150 000
13	Supplying & installing Pumps	8	No	30 000	240 000
14	Unforeseen	5%			267 840
15	Consultancy	10%			575 000
	TOTAL COST ESTIMATE				**6 200 000**

The design life of the STP is 20 years for the structure and piping. The pumps and related control valves have a design life of 3 to 5 years.

	Cost estimate Phase 1	Cost estimate Phase 2	Cost estimate Phase 3	Total
TOTAL Rs	**6 200 000**	**4 500 000**	**4 500 000**	**15 200 000**
Added Capacity KLD	108	89	131	328
Added Users EP	1 000	2 000	2 000	5 000
Rs/m3	57 497	49 676	33 749	46 974
Rs/user	6 210	2 211	2 211	3 544

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NOTE: The cost estimate include the pumps for the process and 2 vortex systems of 60cm dia/ 2 meter height as per requirement.
It does not include the required pumps for irrigation and the hydro-pneumatic systems, nor the electrical setup.

8.2 Yearly Running cost estimate

The present running cost estimate include electrical consumption, man power and desludging cost (mobile unit, disposal at dedicated sludge processing site).

	Phase 1	Phase 2	Phase 3
TOTAL Rs	148 700	265 075	317 925

The STP will need one operator half time during first phase, and one operator full time (8h/d) during following phases.
Desludging will be organised once a year.

9 SLUDGE MANAGEMENT CONCEPT

9.1 Introduction

Vortex-DEWATS technology is able to guarantee safe and odorless discharge of effluent, reaching all requirements of the effluent parameters. The sludge generated from any STP system has an unpleasant and persistent odor and contains still pathogens. It should be handled in an appropriate way to avoid pathogen propagation and odor control.

The objectives for disposing and processing sludge are:

1. Producing safe (hygienic) processed sludge for soil fertilizer of the greenery within the settlement,
2. Aiming at an odorless process,
3. Reduction of sludge volume
4. Obtaining an easy to handle end product (solid form).

These objectives are obtained through employing a desludging unit, which collect the liquid sludge in air tight containers for further disposal and treatment in a dedicated specialized compound, away from residents, or through mechanical devices (centrifuge, sludge filter press) which will reduce the high water content to a much lower value, for further treatment and disposal.

The proposal explores the possibility to integrate an onsite sludge management, including recycling, keeping in mind all the requirements for nuisance free processing and disposal, without the help of mechanical solutions.

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9.2 Sludge producing devices

Treated wastewater produces sludge which needs to be eliminated in order to ensure proper pollution removal and working conditions.

Within Vortex-DEWATS, sludge is accumulating in 3 places:

- The Settler, where sludge is physically separated by sedimentation and by floatation (scum). Scum is digested through time, and turns into sludge collapsing at the bottom of the tank. The accumulated sludge at the bottom of the chambers is removed on a yearly basis by a desludging device/unit.
- The Baffled Reactor, where sludge will accumulate naturally and is used to treat the sewage flow by forcing the wastewater to pass through the accumulated layer of sludge (up flow system). Sludge accumulating at the bottom of the chambers is removed on a yearly basis by a desludging device/unit.
- The Anaerobic Filter, where the sludge volume carried by the sewage flow becomes negligible as it is already captured in the previous treatment stages, but where a second generation occurs by the development of microorganism (film) on the surface of the filtering media (cinder). After a period it collapses naturally by its own weight when it becomes too voluminous (self cleaning mechanism) and gathers in the provided space below the filtering media by falling through a properly designed perforated slab. In order to easily desludge, each chamber is fitted with a large size desludging pipe reaching the empty space below the filtering media. Sludge accumulating at the bottom of the chambers is removed on a yearly basis by a desludging device/unit.

9.3 Yearly sludge production

According to sewage flow, the volume of sludge generated for each phase will be as follow:

	Phase 1	Phase 2	Phase 3
m^3/y	77	171	283

NOTE: the values for the sludge volume are based on actual sewage flow and not on the NBC values.

9.4 Potential for biogas generation

The sludge accumulated and stored in the various chambers of a Dewats system is, after one year, stable and will therefore hardly decompose, while becoming more compact and mineralized. Scope for extra biogas generation is negligible after such a long retention period *(see paragraph 7).*

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9.5 Sludge collection and disposal

If onsite treatment is envisaged, the end product needs to be fully odorless, harmless and hygienic safe. It should be easy to handle once processed (dry) and ready for reuse on site in the green area as a fertilizer, or marketed to outside parties.

The main issues with sludge collection and disposal, are the relatively large volumes and consequently the cost for transportation, the emitting odors and the potential health hazards.

Health hazards are related to the high density of pathogens in sludge and the attraction of health hazard carriers like flies. Pathogens are eliminated either through time or through other thermal or chemical processes. The simplest and the most ecological way to address it is by leaving the sludge to decompose by itself. Setting up an onsite sludge treatment program needs to incorporate all these facts in a practical and efficient way.

The proposed options are:

1. Collect the sludge from the STP with a desludging unit for transport and processing, to a common dumping/ treatment site.
2. Collect the sludge through a sludge pump for disposal and treatment at an onsite sludge processing plant.

The first option of using lorry transport with relatively small loading quantities (5-10 m^3 per truck) of sludge over long distances and risk of inadequate disposal is to be seen in regard to practicality and cost.

For completing the exploration for the second option, more details are required regarding the actual site conditions, space availability and prevailing surrounding conditions to determine the appropriateness of such choice and potential hazard and risks.

It is understood that a study is on going to identify a site suitable for all sludge generated from Auroville's STPs or septic tanks. This element would help in deciding the most suitable solution.

Nevertheless, it must be noted that the running cost evaluation is based on sludge disposal at a dedicated site, note attached to the STP.

The advantage of the last solution is that the entire sewage cycle is under the control of the STP in-charge.

It is possible to optimize the treatment facilities (reduced size and therefore investment cost) by properly planning and organizing the desludging operation. The proposed STP is designed on a one yearly desludging period in order to ensure proper efficiency and cost effectiveness of the STPs; however the desludging sequence periods can be planned on a rotational basis, element

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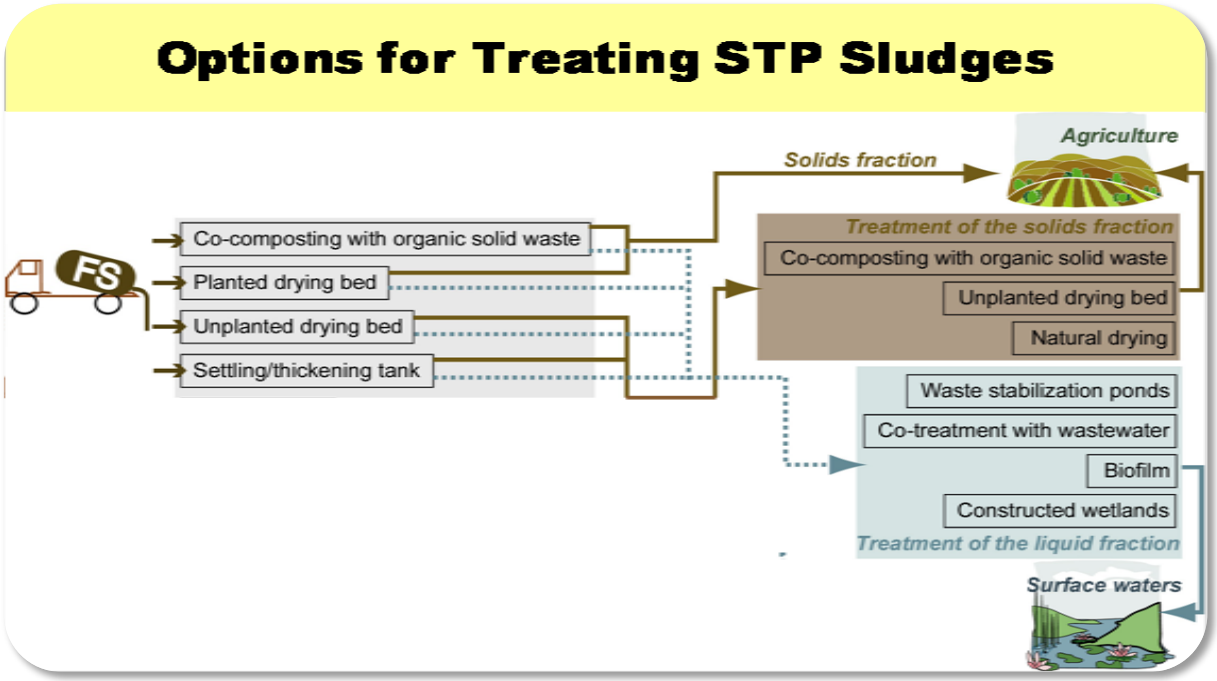
per element. This would reduce the volume to be treated while still ensuring treatment efficiency and proper end product.

The mixing of such processed sludge with organic waste from the settlements will ensure a good end product of processed sludge in the form of compost which offers a direct benefit for the greenery and beautification of the site.

The most feasible solution for on onsite sludge processing plant is either co-composting or a planted drying bed.



9.6 Dewatering of sludge

Dewatering of sludge is a relatively fast process (a couple of weeks), while further process of drying up together with pathogen control takes more time. WHO recommendations are for a 6 months period to destroy pathogens, including ameba, parasites, worms and worm eggs. Storing the sludge for such period will ensure a complete drying up process and a massive reduction in volume.

Sludge volume is inversely proportional to the solids content. Assuming that the dewatering process (e.g. by sludge drying beds) yields a reduction of the water content from 98 % to 75 % (equivalent to an increase of the solids content from 2 % to 25 %), the dewatered sludge volume to be transported would be 12 times smaller than the raw sludge volume.

In this case, the produced sludge volume from the STP of 283m³/y in phase 3 will reduce and produce about 23m³/y of compost.

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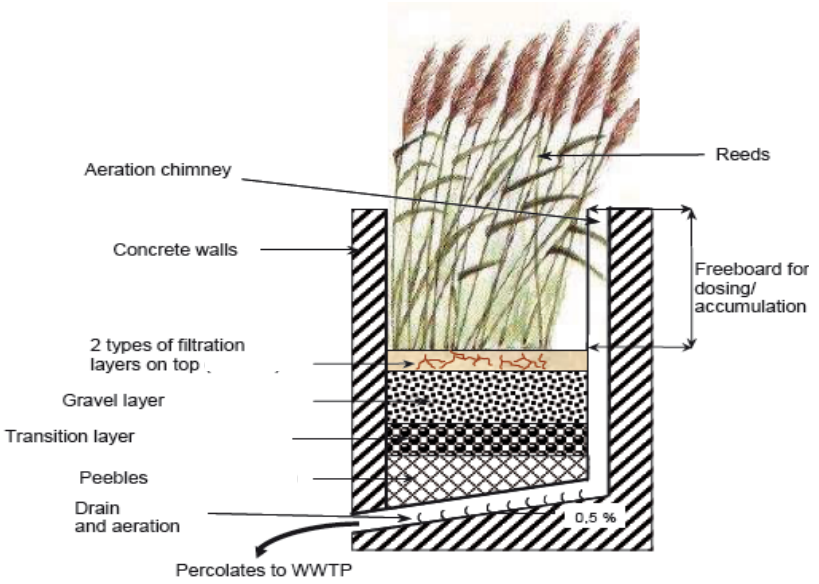
In order to maintain the pump and the sludge processing unit in optimal conditions, a one year desludging period is recommended, but conducting it on a rotational basis of one month, element per element. This would amount to a volume of about 25m³/month (more when the settlers are desludged, less for the other components).

In the context this study, the proposal could be to:

Either collect and process the sludge to a common sludge processing unit or,



- Collect the sludge from the STP with a sludge pump.
- Dispose of the sludge to a properly designed sludge processing unit close to the STP (can be integrated with solid waste processing site)
- The collected liquid from the sludge processing, which is still highly contaminated, can be treated by redirecting back to STP.
- In order to optimize the investment and treatment process, it is suggested to collect the sludge from the various elements of the STP on a rotational basis, on a 1 month interval between desludging operation, and a full rotation (back to the first element) in 1 year.

9.7 Odors control

Space availability for safe handling and processing of sludge needs to be identified.

Therefore it is essential to integrate a proper odors control system in the process.

Available options:

1. EM (Efficient Micro-organism)technology,

   EM stands for Effective Microorganisms. It is a combination of various beneficial, naturally occurring microorganisms mostly used for or found in foods. These effective microorganisms secrete beneficial substances when in contact with organic matter. The anti-oxidation effects of these microorganisms pass directly to the soil or indirectly to plants. This process increases the humus content of the soil. EM is also an effective eliminator of offensive odors.

2. a physical barrier with a plant house with compost pit control for ventilation.

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10 CSR WATER AND SANITATION

For more than thirty years CSR has developed waste water treatment methods that evolved from individual household systems to a technology applicable for large scale settlements, treating waste water volumes of 1000 KLD and above.

Milestones in this journey were the exposure to waste water dynamics by Pr. Charbonnel, H Kraft and others prior to 1995. Borda through Ludwig Sasse and Dirk Esser helped CSR to take a major leap by introducing to Auroville a large range of natural waste water treatment techniques, with the aim to test and adapt them in tropical conditions. A R&D project funded by the EU helped to develop the knowhow and to introduce and test Anaerobic Baffled Reactor, which were already implemented previously in China and Latin America.

In 2001 CPCB (Central Pollution Control Board) recognized and officially adapted Dewats technology for implementation on a national scale.

Further on, through trial and error, an appropriate natural treatment technology adapted to tropical conditions was developed, although we still had to employ the planted filter device for controlling the odor. Prior to 2008 Aquadyn and especially JF Audic experimented with a device called a vortex, first for drinking water, later on for wastewater treatment. It was this system that provided the breakthrough for substituting the planted filter with a surprisingly efficient method for oxygenating the waste water and reaching the required standards. The vortex created the possibility for implementing the technology in an urban context due to the minimized footprint required to remove the odour out of the waste water. Further R&D were conducted by CSR leading to improvements which allows today to reach flushing standards.

Tracing back the start in 1981 of exploring a way of treating and recycling individual household waste water, we observe that it took 32 years to evolve a technology researched and developed within Auroville context. It is gratifying to watch that the technology has received recognition and is being implemented within India and abroad.

We would like to thank the countless individuals and organisations which helped us to progress further.

Natural Waste Water Treatment Systems

Selected milestones

2003 Arvind Eye hospital, Puducherry – 500 KLD
2007 Surya Nepal Tobacco factory – 160 KLD & Surya Nivas Colony – 60 KLD
2008 Kalapet Jail Puducherry – prefab 75 KLD
2009 ITC Pune Tobacco factory – 160 KLD
2009 Hansa Niwas Trichy – prefab 90 KLD
2010 VBHC Bangalore – 710 and 410 KLD
2011 VBHC Chennai – prefab 80 KLD
2012 Villefranche resort – 40 KLD
2013 ITC Munger Dairy plant – 30 KLD
2013 Tollygunge Golf Club Kolkata – 200 KLD
2013 ITC Guntur settlement – 175 KLD
2013 ALEAP Industrial park (Nandigama –AP) – 1050 KLD

Gilles Boulicot, Tency Baetens, Csr
28/01/2014

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To	**From,**
Mr. Jan Imhoff **AUROVILLE** Tamil Nadu, India Mob: +91 9443263384 E: aws@auroville.org.in	**Mr. Taral Vaidya (Director)** **AKAR IMPEX PVT. LTD** E-9, Sector-6, Noida-201 301, (U.P) INDIA E-mail: akarimpex@hotmail.com; akarimpex@gmail.com Web id: http://www.akarimpex.com Tele: 0091-120-4526666, 4526630-46 Ref: AIPL/SOS/auroville-150kld-adbr-m-tn -**1312087** Date: December 24, 2013

Kind Attention: Mr. Jan Imhoff

Sub: Proposal of 150 Kld Compact Sewage Treatment Plant (ADBR) as per your requirement.

Dear Sir,

This has reference to your request for quote dated 19th December for STP for your project at Tamil Nadu. Please find enclosed our most competitive quotes for 150KLD Water Pollution Control Equipment and System as under:

This system (ADBR) has more advantages than the conventional system for sewage treatment.

- It is a compact system and occupies lesser area.
- It is a modular system; capacity may be enhanced by adding modules.
- Power requirement is much lower than conventional systems.
- Manpower requirement is less owing to it's process design and features.
- Pleasing appearance, no smell are among it's many more advantages than conventional system.
- Treated water shall be used for horticulture application as well as toilet flushing. The sludge collected shall be used as manure for the plants

Please feel free contact us for any further clarification on the subject. Looking forward to your valued order at an early date, assuring you of our best services always and every time,

Thanks and Regards

TARAL VAIDYA
Director
AKAR IMPEX PVT LTD

Encl: Proposal of 150 KLD Sewage Treatment Plant (ADBR) for your project at Tamil Nadu

Please acknowledge the receipt of this email for our records and oblige

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PROPOSAL OF 150 KLD SEWAGE TREATMENT PLANT (ADBR) FOR M/S AUROVILLE FOR THEIR PROJECT AT TAMIL NADU, INDIA

COMPACT WATER POLLUTION CONTROL EQUIPMENT & SYSTEM – ADBR (150KLD CAPACITY)

POLLUTED WATER CHARACTERISTICS

Industrial Polluted water

Raw Polluted water Generation & Characteristics for Designing of the WPCES	
Average Daily flow (Cum/day)	150
Hourly flow (Cum/Hr)	6.25
Characteristics Assumed:	
BOD (mg/l)	200
COD (mg/l)	400
Suspended solids (mg/l)	200
Oil & Grease (mg/l)	<20
Total Domestic Polluted water/day	150,000 Ltrs
Invert level of inlet pipe	2m (Assumed)

Desired Treated water Characteristics	
BOD	Less than equal to 30 mg/l
COD	Less than equal to 150 mg/l
Suspended solids	Less than equal to 30 mg/l
Oil & Grease	<10 mg/l

- **QUANTITY:**

  150 Kilo Litres per day.

- **BATTERY LIMITS:**

  The battery limits for WPCES start from inlet flange of polluted water suction pump and terminates at the outlet of outlet flange of activated carbon filter and for sludge at filter press/ Hydrocyclone/ Centrifuge.

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GENERAL DESCRIPTION OF THE WPCES-ADBR

The AIPL WATER POLLUTION CONTROL EQUIPMENT & SYSTEM (WPCES) is based on the biodegradation and sedimentation technology, which is unique due to its compactness and performance in respect of volumetric efficiency.

❖ DIMENSIONAL CRITERIA

All treatment plants i.e. WPCES shall be based on actual measurements of the waste stream to be treated in respect of hydraulic load suspended and dissolved organic material, and the applicable local effluent requirements.

❖ PRE-SEDIMENTATION SYSTEM

It is assumed that the polluted domestic water piping system ends in a customer provided pump well/tank system which shall be preceded by a screen chamber and oil and grease trap. The system shall ensure that grit, floating matter, oils and coarse particles which shall hinder the operation of the plant equipment are separated before the process.

The buffer capacity must be sufficient to level out the daily peak flows.

❖ BIOLOGICAL TREATMENT SYSTEM

The treatment plant will take suction from the pump well by its own feed pump. The pump is auto level controlled and has a capacity, which is slightly higher than the average daily flow. The plant has, therefore, an intermittent working mode in terms of hydraulic flow, while the air blower supplying air to the bioreactors is continuous. The bioreactors degrade the dissolved organic matter by oxidation into carbon dioxide, which escapes to the air, and to biomass that acts as activated sludge.

A suspended, free floating bio-film carrier medium provides a large, protected bio-film surface for the bacteria and simultaneously accumulates the active bio-sludge inside the reactors.

❖ SLUDGE SEPARATION SYSTEM

The biodegraded water flows to a clarification stage where the suspended solid settles by gravity. The water is directed to a skim well to tube settler system which provides the final clarification of the effluent.

The sludge pump is activated with suction from the clarification stage. The pump discharges through a CI sludge filter press with the overflow back to the pumping sump. When necessary, the sludge is hauled away for disposal.

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EQUIPMENT SPECIFICATION

The basic system comes with the following standard equipment:

- ADBR consisting of reaction chamber/settling chamber. The system shall be fabricated & internally painted by Epilux 555 of Berger paints and externally painted with epoxy primer followed by 2 coats of epoxy paint.
- A free floating plastic bio-film carrier medium provided inside the reaction chambers.
- A tube separator system of 60 degree inclined modular tubes in the settling tank.
- Two twin lobe roots blower (1working+1standby) with air header and air distribution system in G.I. Air filter/silencer on the blower inlet/outlet respectively. Coarse diffusers provided for air diffusion and drive to media.
- Two horizontal centrifugal feed and sludge pumps (1working + 1standby) with waste water pipes in uPVC.
- One chlorine-dosing tank for disinfection with one dosing metering pump.
- One Activated Carbon Filter and Pressure Sand filter for filtration of treated polluted domestic water for wastewater purification with two (1working + 1standby) horizontal centrifugal pump known as filter feed pump with auto level controller.
- One main electrical switchboard/control panel with start/stop push buttons, suitable safety devices for supplying power to various pumps of the system.
- One C.I. moulded hydraulically operated plate type filter press with filter cloth for sludge solids separation with water. The filter press is provided with hopper for ease of collection as well removal of sludge from the filter press.
- One bar screen to screen out suspended solids from the Sewage.

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LIST OF ITEMS IN CIVIL CONSTRUCTION (CLIENT'S SCOPE)

1. Equalization Tank –

Size	:	4m x 4m x 3m + 2.3m FBD
Type	:	Underground
Material of construction	:	RCC
Quantity	:	1

2. Treated Water Tank-

Size	:	4m x 4m x 4m + 0.5m FBD
Type	:	above Ground
Material of construction	:	RCC
Quantity	:	1

3. Screen Chamber-

Size	:	1.5m x 0.5m x 0.3m + 2.1m FBD
Type	:	Under Ground
Material of construction	:	RCC
Quantity	:	1

4. Oil & Grease trap-

Size	:	2m x1.5m x 1.4m+2.2m FBD
Type	:	Under Ground
Material of construction	:	RCC
Quantity	:	1

5. Balance Tank-

Volume	:	3 cum
Type	:	above Ground
Material of construction	:	LDPE/PVC
Quantity	:	1

6. Plant Room	:	6m x 6m x 4m
Material of construction	:	Brickwork
Quantity	:	1

7. Foundation	:	14m x 5m x 0.3m h
MOC	:	RCC
Qty	:	1Lot

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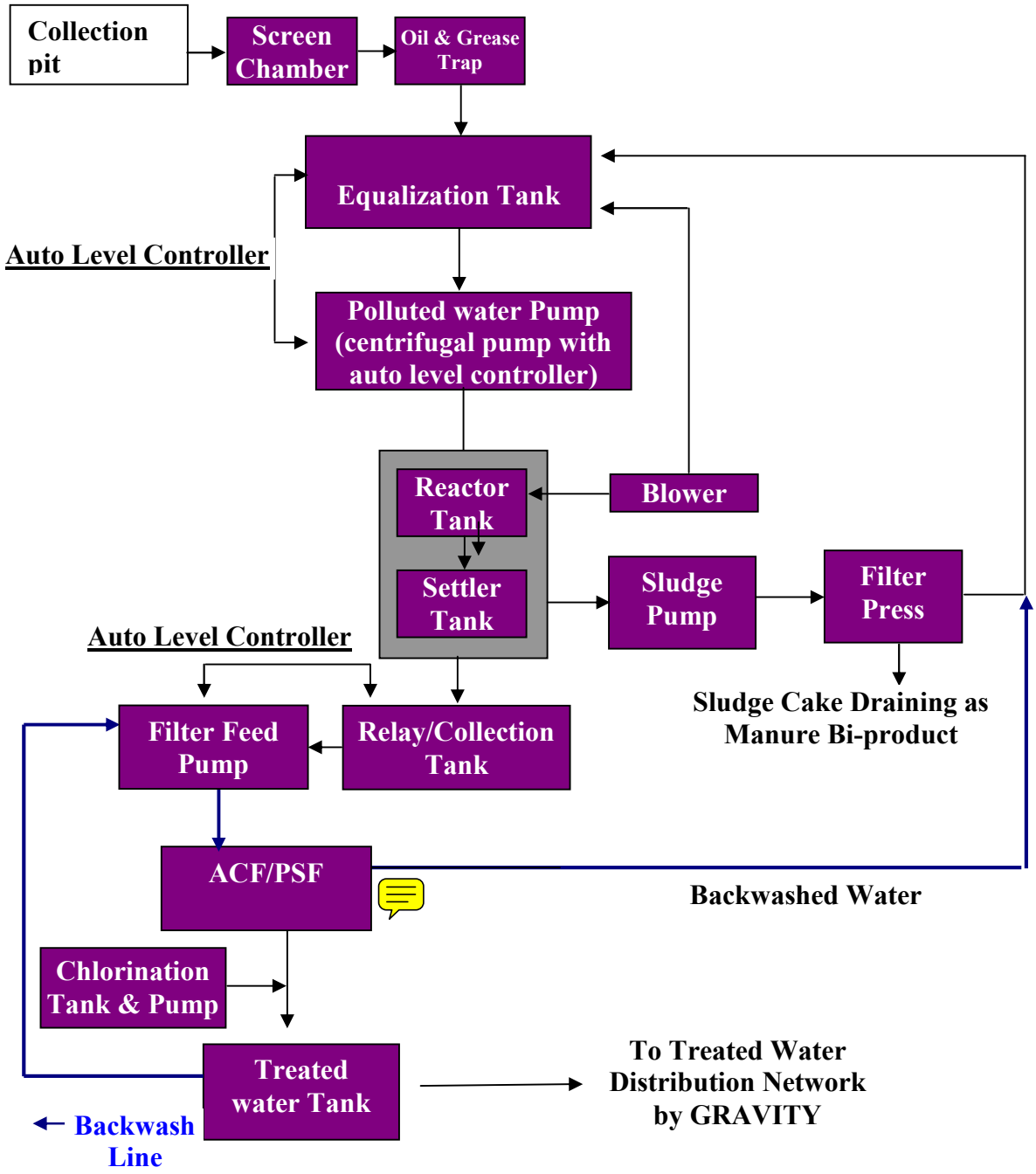
GENERIC FLOW CHART: ADBR BASED DOMESTIC POLLUTED WATER POLLUTION CONTORL EQUIPMENT AND SYSTEM



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TECHNICAL DATA AND SPECIFICATIONS

Data and Specifications are subject to change without notice. Specifically, pump and blower motor power may be altered as per manufacturer's selection chart and performance curve.

S.No.	Equipment	Specification	Unit	ADBR-WPCES 150 KLD	Quantity	Make
1	**ADBR (MSEP)**	Length	M	8.0	1	Akar
		Width	M	2.4		
		Height	M	2.6		
2	**Bar screen**	Length	M	0.4	1	Akar
		Width	M	0.4		
3	**Bio Media**	Proprietary	cum	6	1 lot	PP Aqua/Om Enviro/Equiv.
4	**Settling Media**	Tubedek	cum	3	1lot	PP Aqua/Om Enviro/Equiv.
5	**Blower**	Nominal Capacity	cum/hr	100	1w+1s	Beta/Everest
		Back Pressure	PSI	5		
		Motor rating	KW/HP	3.7/5.0		
6	**Centrifugal Pump**	Nominal Capacity	M3/hr	6.5	1w+1s	Kirloskar/Equiv.
		Head	M	8		
		Revolutions	RPM	2880		
		Motor rating	KW	0.75		
7	**Sludge Pump**	Nominal Capacity	M3/hr	3	1w+1s	Kirloskar/Equiv.
		Head	M	22		
		Revolutions	RPM	2880		
		Motor rating	KW	2.2		
8	**Filter Feed Pump**	Nominal Capacity	M3/hr	7	1w+1s	Kirloskar/Equiv.
		Head	M	24		
		Revolutions	RPM	2880		
		Motor rating	KW	2.2		
9	**Activated Carbon Filter+PSF**	Dia	M	0.7	2w	Akar

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		Height	M	1.4		
		Type	**	MSEP		
10	**Filter press With Hydraulic**	Size	Inch	18x18	1w	Akar
		M.O.C	***	C.I		
		No. of plates	No.	16		
11	**Chlorine dosing pump**	3lph@3bar	****	****	1w	Toschon/Equiv.
12	**Pipes & Valve**	Of suitable size			1lot	Supreme/Sant
13	**Control panel**	16swg body &door		M.S	1lot	Akar

- **CLIENT'S SCOPE (SPECIFIC)**

1. Access road for approach to site and site electrification and lighting.
2. Dilution water connection to battery limits.
3. Power cable to plant, Plant room Area.
4. Puddle flanges and walkway for STP tanks.
5. Bringing sewage to plant and disposal of screenings, sludge and treated water from plant.
6. Chemicals and consumables for operating the plant.
7. Peripheral drain, internal drain for rainwater passage, chain link fence etc. Walkway/Puddle Flange and other structural steel work will be in client scope.
8. Providing Crane, Hydra etc. for lifting of equipment at site in client's scope.

- **OTHER SERVICES (CLIENT'S SCOPE)**

- Structural steel works like cat ladders etc. wherever required.
- Rain protection shed for all equipment.

- **POWER REQUIREMENT**

- Supply: 3 Phase, 440 Volts A.C

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PAYMENT AND OTHER COMMERCIAL TERMS

- **Basic Price of equipment : Rs. 27, 00, 000.00**
- **Cost of civil work : Client's scope**
- **Price term** : Ex-Works, Noida
- **Taxes & Duties** : All taxes duties, packing, forwarding, Transportation, Insurance, etc. will be charged extra on basic value; ***[as applicable]***

Packing charges	5% For order value of Rs. 1.5 lacs and below. 3% For order value of Rs. 1.5 lacs to Rs. 5 Lacs. 1.5% For order value of above Rs. 5 lacs.
Excise duty including 2% Education Cess	12.36% [or as applicable at the time of dispatch]
U.P.-VAT	Presently 5%% [or as applicable at the time of dispatch]
OR	
CST-VAT	2% against form 'C' [or as applicable at the time of dispatch]
Service tax against Installation and Commissioning including 2% Education Cess	Presently 12.36% [or as applicable at the time of dispatch]

- **Transportation : Extra or Client's Scope**
- **Transit Insurance : Extra, At the rate of 1% of Order Value, Or, By Client**
- **Training of operator : Extra at Rs. 3000/- per day for 7 days in advance**

- The above price / prices are only for equipment ex. Works. They do not include the cost of erection and starting up of the equipment / plant. The buyer needs to engage their own team for site work such as piping, civil works, foundation of equipment, cabling, electrification in the plant etc. however, it is essential for the buyer to have our person for supervision of installation of equipment / plant. Without having our supervision, we shall not be able to guarantee plant performance or mechanical equipment guarantees / warranties. The charges for the supervision are not included in the prices above. They are given below. If the buyer wants us to carry out installation of the plant / equipment, we give below our prices.

- The Transportation Charges are valid for 30 days from the date of this offer. Transportation rates are subject to change without prior notice. They shall be as per the prevailing/current rates on the day of transport of goods from our works.

- **Unloading and transfer of Plant and Machinery at site is in the Client's Scope. Similarly safe storage at site is also in client's scope.**
- **Any change in the location of any of the equipment requiring additional piping and cables etc shall be charged extra.**
- **Please note that the to and fro travel expenses, accommodation & food i.e lodging and boarding, local transportation, etc. of our Supervisor/engineers etc. are in the Client's scope.**

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Charges for structural civil engineering drawings and designing.	Extra
Charges for a supervisor for supervision of installation and startup of the equipment / plant.	Rs. **3000/- per day.** We shall charge for 15 days charges in advance.
OR	
Installation of equipment, piping etc.	**Rs. 2, 00,000.00** **OR** In the client scope
Starting up of the plant / Commissioning	Rs. **25,000.00** **OR** In the client scope

- PLEASE NOTE THAT IN ANY CASE, IF OUR INSTALLATION AND COMMISSIONING TEAM IS MADE TO WAIT FOR THE PERIOD BEYOND STIPULATED DATE DUE TO WHATEVER REASONS, WE SHALL CHARGE YOU AT THE RATE AS MENTIONED IN THE "TERMS AND CONDITIONS FOR INSTALLATION AND COMMISSIONING" UNDER THE HEADING "WORKING OF OUR TEAM BEYOND STIPULATED PERIOD".

OTHER PAYMENT TERMS

- **FOR SUPPLY**

- 40% of the total value of the order as advance along with a clear and firm Purchase order.

- 60% of the total value of the order + 100% Taxes & Duties, Packing against Inspection at our works, before dispatch. Please see the scope and conditions of inspection under the heading "*Terms and conditions for sale and supply of equipment" under sub-heading* "inspection before dispatch" in the pages hereafter.

- **FOR INSTALLATION AND COMMISSIONING**

- 50% of the installation charges shall be paid in advance along with the order and the balance 50% immediately after the completion of installation but before commissioning of the plant/equipment.

- 50% of the commissioning charges shall be paid in advance along with the order and the balance 50% payable against testing of treated water sample by approved laboratory confirming the agreed parameters as per design parameters of offer. Akar shall not be responsible if adequate/requisite effluent/sewage quantity and quality is not available during commissioning and the balance amount shall be released by client immediately without delay.

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DELIVERY

- Supply: 12-14 weeks from the date of receipt of order. This period will be taken from the date of receipt of technically and commercially clear order along with the advance; whichever is later. In case where drawings / specifications have to be approved from your side, the delivery period shall be deemed to start from the date of approval of drawings / specifications.

- Installation & Commissioning : Within 4-6 weeks from the date of receipt of material at site or from the date of confirmation of readiness of the site with all requisite structures, tanks etc as required; whichever is later. Please note that our installation & commissioning team and the supervisor will visit upon confirmation by you in writing. If after the visit of our team and supervisor, it is found that site is not ready then the team and the supervisor will return back. The cost of sending the team again will be charged extra for each of the visiting person alongwith to and fro travel expenses, lodging–boarding etc. The team shall then, visit the site based on their availability.

VALIDITY:

- 30 days from the date of this offer

NOTE:

- All payments are to be made by a Crossed Demand Draft in favor of M/s. Akar Impex Pvt. Ltd. payable at the ING Vysya Bank Ltd., Sector-19, Noida, U.P., India.

- The payments against proforma Invoice must reach us within a maximum of 15 days from the date of presentation of the same.

- TIN Number must be intimated to us well in advance before invoicing.

- Any legal dispute arising out of the resultant contract will be subject to the jurisdiction of the Delhi Courts, If the same cannot be resolved by mutual consent.

BATTERY LIMITS:

- The battery limit of our treatment plant starts from the inlet of flange of our equipment or plant and terminates at the outlet flange of the last of the equipment to be supplied by us. Generally the treatment terminates at the outlet of the pressure filter, activated carbon filter, etc. and at the outlet of the filter press. However, this may vary from proposal to proposal.

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TERMS AND CONDITIONS FOR SALE AND SUPPLY OF EQUIPMENT

DELIVERY:

The equipment will be supplied to the buyer within the stipulated period. This period will be taken from the date when the technically and commercially clear order along with the advance payment whichever is later. However, in cases where drawing approval is to be taken from the buyer, the delivery period shall commence from the date of approval of the drawing or specifications as the case may be even if the advance along with the order is received earlier. Fabrication of the equipment will start only after receipt of the advance payment at our end. The same is required for procurement of raw materials; therefore on non-receipt of the advance, the project cannot start.

ORDER CANCELLATION:

Order received and acknowledged by the seller shall not be subject to cancellation either wholly or partly for any reason whatsoever without the seller's written consent.

The amount already paid as advance shall be forfeited and will not be returned in case the order is cancelled in whole or in part.

In all such cases,

- The material manufactured or fully or partly shall be disposed-off by us without any reference to the buyer.
- No Claim in this regard shall be entertained.

ACCEPTANCE OF GOODS:

Goods once sold cannot be returned unless accepted by Akar's proper authorized person through written document. If the buyer returns the goods delivered to them, then the buyer is bound to return the same to Akar Impex Pvt. Ltd. immediately at his cost. In such a case, Akar Impex Pvt. Ltd. Is at liberty to accept it back or not and to divert these goods to some other buyer and allot a fresh delivery schedule to the original buyer under the same terms and conditions.

MANUFACTURING OF EQUIPMENT:

Fabrication of the equipment will start only after receipt of the advance payment at our end. The same is required for procurement of raw materials, therefore on non-payment of the advance the project cannot start.

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NON PAYMENT OF DUE AMOUNTS WITHIN THE SPECIFIED DATE:

If there is any default from the buyer for payment of the payable amounts within the respective due dates, then the buyer will have to pay interest on the particular amount at a rate of 1.5% per month on the amount due on that date; calculated on monthly basis and taken from the day subsequent to the day when the due date gets over. This amount will be in addition to the total price of the equipment.

FAILURE OF THE BUYER TO COLLECT THE GOODS IN SPECIFIED TIME:

If the buyer fails to pick up the material from our works after an intimation to him to collect the same, Akar shall charge warehouse charges @ 0.50% of invoice value per day after the first 15 days from the date of intimation and after that at the rate of 2% of the invoice value per day for the next 15 days. Even then if the buyer fails to collect the material within the next 2 months, we shall dispose off the material without any reference to the buyer and any amount paid by the buyer shall be forfeited and the buyer shall have no right whatsoever over the ordered materials after the expiry of this 2 months period.

INSPECTION OF MATERIALS BEFORE DESPATCH:

If you desire to have the ordered materials inspected before shipment, you may appoint any suitable agency of your choice. If you like, we may refer any one of the reputed inspecting agency for you. The charges for such an inspection in any of the cases shall be borne by you. The inspection shall be visual and will not include any performance or operating tests. We shall provide test certificates from the manufacturers (of important equipment only), if you like. For producing goods for inspection, we shall intimate to you when the goods are ready for shipment. You will have to get the inspection done within 4 days of our notice. If the inspecting agency fails to show up during this period, we shall presume that you have waived off the inspection clause and we shall under intimation to you ship the consignment without inspection. We shall not be penalized or faulted for this, in such an event. It would then take us three to four working days to pack and transport the shipment to nearest transport location.

CONSEQUENTIAL LOSSES:

There shall be no liability for either party towards the other party for loss of production, loss of profit, loss of use, loss of contracts or for any other consequential or indirect loss whatsoever.

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Certified ISO 9001 : 2008 Company
E-9, Sector-6, NOIDA - 201 301 (U.P.) INDIA
Ph.: 0091-120-4526666
Fax : 0091-120-4526632

GUARANTEE:

Process Performance Guarantee: We guarantee the performance of the process as per our commitment at the time of finalization of the order. This is however, subject to the condition that the treatment plant supplied is operated as per the instructions given by us during commissioning period and/or as given in our "Operation and Maintenance Manual" supplied with the plant or equipment. After the treatment plant is handed over to the buyer, the buyer needs to operate the same as per the instructions given by us during commissioning period. There may be usual glitches like clogging of the filters, pumps and some other such routine problems, which need to be attended by you on day-to-day basis.

Manufacturing: We undertake the responsibility to rectify any defect in equipment supplied by us due to bad workmanship or defective material, provided the defects are brought to our notice within 15 (Fifteen) calendar months from the date of supply or 12 months from the date of commissioning whichever is earlier. However, we are not responsible for any electrical faults or failures such as motor burn outs, switches not working etc. these are expressly excluded from warranty / Guarantee.

For any defects brought to our notice after the guarantee period, we will not be held responsible and if we are called upon to rectify those defects, extra charges will be payable to us. However, our guarantee does not extend to electrical items including instruments, motors, cables, etc.

SAFE STORAGE OF THE EQUIPMENT AND OTHER COMPONENTS:

The buyer shall provide safe storage facilities for the machineries and components till the equipment is installed and commissioned. In case of failure, AIPL will not be held responsible for such damages.

FORCE MAJEURE:

Our offer is subject to Force Majeure clause. We shall not be held responsible for any delay in execution of the work for causes beyond our control such as war, terrorist attack, bandh, revolution, and strike, epidemic, accidental fire, flood or any other act of God.

JURISDICTION:

Any legal dispute arising of the resultant contract will be subject to the jurisdiction of Delhi courts in case the same is not settled mutually.

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TERMS AND CONDITIONS FOR INSTALLATION AND COMMISSIONING

The client has to provide the following to AIPL, free of cost:

- Uninterrupted Power Supply at the site during the installation and commissioning period for lighting, welding, grinding or for any such operation that may require the use of electrical power.
- Free supply of water or any such service required for starting the operation on the plant.
- Chemicals and consumables during commissioning period.
- Water testing from time to time either in your own laboratory (if you have one) or from outside agencies. Charges for the same are not included in the price.
- Earth pit for earthing of electrical installations of electrical equipment.
- Akar shall not be responsible if adequate/requisite effluent/sewage quantity and quality is not available during commissioning and the balance amount shall be released by client immediately without delay.
- If you desire to have the ordered materials inspected before shipment, you may appoint any suitable agency of your choice. If you like, we may refer any one of the reputed inspecting agency for you. The charges for such an inspection in any of the cases shall be borne by you. The inspection shall be visual and will not include any performance or operating tests. We shall provide test certificates from the manufacturers (of important equipment only), if you like. For producing goods for inspection, we shall intimate to you when the goods are ready for shipment. You will have to get the inspection done within 4 days of our notice. If the inspecting agency fails to show up during this period, we shall presume that you have waived off the inspection clause and we shall under intimation to you ship the consignment without inspection. We shall not be penalized or faulted for this, in such an event. It would then take us three to four working days to pack and transport the shipment to nearest dry port for further transport to the designated sea port.

LOADING AND UNLOADING:

Our proposal excludes site unloading and shifting of material to site from unloading place.

CIVIL WORKS:

Our proposal excludes all civil works such as pump room, masonry, foundation works for structures, excavation, refilling, grouting, making holes, providing trenches etc.

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FOUNDATIONS:

The building and foundations must be ready in all respects for installation before the installation and commissioning crew reaches at the site.

WALKWAY AND OTHER STRUCTURES AND FACILITIES:

Steel structures such as walkways, shades, pipe supports, drains etc. are excluded from our scope. Any facilities for operating staff such as fans, table, chairs, lighting, roads etc. are expressly excluded.

DELIVERY OF SEWAGE / EFFLUENT WATER:

Arrangement for delivery of sewage, effluent or un treated water at site is not in our scope. The same has to be arranged by you. Similarly, disposal of treated sewage, effluent, screenings, oil, grit, grease and sludge from plant shall be in your scope.

STATUTORY CLEARANCES:

All statutory clearances such as NOC from Pollution Control Board or any other permissions and clearances are not in our scope. The client will arrange for all these.

EASY ACCESS TO SITE:

It may be necessary to obtain necessary permissions or entry passes. You shall arrange for these at your cost. It may be necessary for our persons to stay at site during night. Permission for same has to be given.

IDLING OF OUR PERSONS:

If the crew has to sit idle to the lack of infrastructure and facilities, to be provided by the buyer for the installation and commissioning purposes, these will be included in the total number of days required to complete the job.

WORKING OF OUR TEAM BEYOND STIPULATED PERIOD:

If the crew has to work beyond the stipulated period to complete the job, because of the above reason, then the buyer becomes liable to pay extra charges, as applicable.

Charges per day basis:

- Engineers/Supervisors : Rs. 5,000.00 per day.
- Technicians : Rs. 1,000.00 per day

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LOCKABLE STORAGE FACILITIES:

Lockable must be provided to the installation and commissioning crew for them to keep their tools, tackles, spare parts, etc.

SUB-CONTRACTING:

AIPL reserves the right to allot the installation and commissioning job to a sub-contractor.

TAKING OVER:

The buyer is expected to take over the plant from AIPL, once its installation and commissioning is completed, but only after the payment of the necessary amount is made.

LOG SHEET:

At the time of commissioning log sheet will be made by our commissioning Engineer, which should be signed by your Engineer / Operator for operation of the plant on every day during initial trial. In case of non-compliance, AIPL will have the right to withdraw the commissioning personnel.

FREE ACCOMMODATION:

Free accommodation has to be provided to the installation and commissioning crew during the period of the installation and commissioning.

INITIAL OPERATION:

AIPL will perform operation of treatment plant continuously 24 hours run per day for 3-4 days to prove performance of plant. During this performance run uninterrupted supply of services to be provided by buyer. After these runs joint report is required to be made and plant is to be taken over by buyer after issuing a commissioning certificate.

TRAINING:

AIPL's crew will impart the necessary training to personnel from the buyer's side. However, these persons selected by the buyer for the training should be technically adequate for the same. The training charges shall be extra at Rs. 3000/- per day.

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ACCEPTANCE OF GOODS:

If the buyer refuses to accept the goods delivered to them, then they are bound to return the same to AIPL immediately. In such a case, AIPL has the liberty to divert these goods to some other buyer and allot a fresh delivery schedule to the original buyer under the same terms and conditions.

PUMP MODELS AND POWER CONSUMPTION:

This may vary as per manufacturer's selection chart and after detailed designing.

CONSIGNMENT OF GOODS:

AIPL will dispatch the goods in part or in full, as is convenient, within the stipulated delivery period. Under no circumstances will the part consignment of goods give the buyer a valid reason to refrain from paying the due amount.

FORCE MAJEURE:

Our contract is subject to the Force Majeure clause and as such we will not be responsible for delay in the delivery of equipment due to war, emergency, revolution, accidental fire, floods or any such natural calamities which are beyond our control.

EXCLUSION:

Any other items and services not specifically mentioned in the above offer are excluded from our (AIPL) scope.

##############################

JOB
SEWAGE TREATMENT PLANT (STP)

Contact Person for this offer
Team Indus: 850-100-6000
O. Jebaraj @ 0-9444 278 715

Volume:
175 KLD or 1,75,000 lts per day
No. of hours run: 24 hours per day

Raw / Treated Sewage Quality:
Our offer is based on the influent parameters:

#	Parameter	Effluent / Feed	Treated / Desired
1	pH	6.0 - 8.5	5.5-9.0
2	TSS	1000	< 30
3	Oil & grease	50	< 10
4	BOD5	250-300	< 25
5	COD	600-700	< 125

Treated water confirms to discharge standards of central pollution control board.

This offer contains:

1. Savings Calculator
2. Remote Monitoring- Features Advantages
3. Design Philosophy & Treatment Scheme
4. Proposed System — Technology & Engineering
5. Proposed System — Scope of Supply
6. Technical Specifications
7. Details of Civil Work & Exclusions
8. Power Consumption Data
9. Terms & Conditions — General
10. Price & Delivery Schedule

CHAPTER-1

SAVINGS CALCULATOR

CAPITAL SAVINGS WITH INDUS STP

- ✓ 40% Smaller foot print
- ✓ 30% Lesser Civil works (as compared to conventional ASP)
- ✓ 30% reduced expenditure on equipment cost

OPERATING COST SAVINGS WITH INDUS STP

- ✓ 90% Savings on manpower
- ✓ 30% Lesser power consumption by using highly efficient DAB Pumps
- ✓ Fresh water procurement cost by recycling for gardening / flushing

Example:
Savings on manpower
Operators required for conventional (Non- Indus) STP: 4
Manpower cost for 4 operators @ Rs. 8000/- per month= 8000 * 4 = 32000
Operators required for INDUS STP: One Operator
Manpower cost for INDUS STP one operator @ 8000 PM = 8000
Monthly Savings on manpower cost: 32000 – 8000 = 24000
Annual Savings on Manpower cost = 24000 *12 = **288000**
Payback period = 1675000 / 288000 = 5.8 years

WHY INDUS STP?

INDUS STPs are designed by professionals with more than 15 years hands on experience.

- ✓ Superior designs save on foot print and reduce civil works
- ✓ First time in India- Complete STP Automation reduces manpower by 90%
- ✓ Complete automation reduces the chances of human error
- ✓ Remote data reporting helps supplier & client understand the plant operating status
- ✓ We have dedicated teams for installation and service
- ✓ Our prices are customer friendly

100% savings on headache with 100% peace of mind

CHAPTER-2

Indus STP Remote Monitoring

Indus the Pioneer in Wastewater Treatment offers "**Remote Monitoring Systems**" specially designed for Sewage treatment plants. The objective is to enhance the operational efficiency of the STPs and reduce operational/service costs. Real time status parameters of any INDUS STP anywhere in India can be obtained from a single location. Working on a custom designed software application, provides central supervisory 'control and monitoring' sewage treatment plant. Software communicates to Local Control Unit (LCU) on the site for control operations using any GSM SIM.

Why Remote Monitoring?

Problems with the Current Systems:

- Plant operators are not well versed with the technical aspects of the STP and cannot interpret instrument values such as flow, pressure etc.
- A site complaint is received only when the flow reduces drastically (or) the plant completely breaks down.
- Site Operators do not backwash sand/carbon filters timely nor do they change cartridges when required.
- Site Operators may be pumping too little or too much sewage into bio-reactor.
- Site Operators may not ensure dosing chemical & pumps operation
- Dosing pump may not be pumping / chemical tank may be empty
- Log books are rarely maintained at site.
- Service calls are always an emergency. The cost of providing the service has to borne by the supplier providing the service or any material consumed.
- Prevention is better than cure- This rarely happens on site. Operators do NOT read & analyze symptoms to avoid potential problems. With remote monitoring this function is attended by skilled supervisors at office.

Automation specifications

1. **Feed Tank Level**: Float level switch control feed pump operation. If the level is below a set point (lowest level), feed pump will switch off. If the level is too high, an emergency drain pump will switch on and critical alert will be generated to draw operator attention.

2. **Feed Pump**: Motor control circuit will be provided to prevent pump from burning due to
   - Low voltage
   - High voltage
   - Phase imbalance (single / two phase supply)
   - Low / high frequency
   - Dry pump running (due to suction blockage etc)

   Feed pump interchange: working & standby pump duty cycle interchanges every 4 hours (or as programmed by us / user). In the event of one pump failure, the second pump will be switched on automatically and a critical alert will be generated. This will continue till the problem is rectified.
   Treat lesser sewage more effectively: By increasing the starting time delay between working to standby pumps, we can effectively treat lesser volume of sewage (30% to 100% of plant capacity).
3. **Flow Measurement & reporting**: Custom designed digital flow meters to measure and record data of flow per hour & per day. This will be reported daily or on demand.

4. **Blower Operation**: Working & standby air blower duty cycle interchanges every 4 hours (or as programmed). When the working blower fails, the stand bye blower will be switched on automatically and a critical alert will be generated. This will continue till the problem is rectified.
   Motor control circuit will be provided to prevent blower motor from burning due to
   - Low voltage
   - High voltage
   - Phase imbalance (single / two phase supply)
   - Low / high frequency

   Lower sewage generation: By increasing the starting time delay between working to standby blowers, we can effectively treat lesser volume of sewage (30% to 100% of plant capacity). This will save energy.

5. **Sludge Pump Operation**: Sludge pump on & off time can be programmed to make it fully automatic. Working stand by interchange is similar to that of feed

pumps with critical alert in case of failure. Sludge pump is fully protected from burning due to

- Low voltage
- High voltage
- Phase imbalance (single / two phase supply)
- Low / high frequency
- Dry pump running (due to suction blockage etc)

6. **Chlorine Dosing**: Dosing pumps not dosing chemical will be detected by a dosing switch and an SMS alert will be sent.

7. **Filter Feed Pumps**: These pumps operation will be controlled by float level switches in the filter feed tank. If the tank is empty, pumps will switch off. Working stand by interchange is similar to that of feed pumps with critical alert in case of failure. Pumps are fully protected from burning due to
   - Low voltage
   - High voltage
   - Phase imbalance (single / two phase supply)
   - Low / high frequency
   - Dry pump running (due to suction blockage etc)

   Filter feed pump will switch off when the level in the treated water tank is full (as determined by a float level switch)

8. **Multiport Valves**: Automatic multiport valves will go into backwash mode when
   - After flow of programmed volume of water
   - After operation of number of hours of filter feed pumps
   - On demand from the site or from remote central computer.
   - Service, backwash & rinse will happen as per program without any operator

9. **Power consumption data**: If an energy meter with RS-485 port is available on site, data such as power consumption in units, voltage, frequency etc will be recorded in log.

10. Unauthorized tampering of local control unit on site: Any modification of operating parameters on site will be intimated to the central computer and by SMS to pre-determined numbers. Even a manual switch off will generate an alert.

11. The local control unit is pass word protected to prevent un-authorized modification.

Log will be maintained for

1. Critical alerts generated
2. Flow rate & total volume treated
3. Electrical data: voltage, current, Kwh, frequency, power factor etc
4. Status of various pumps and tank levels
5. Cumulative plant operation time

Control from central computer

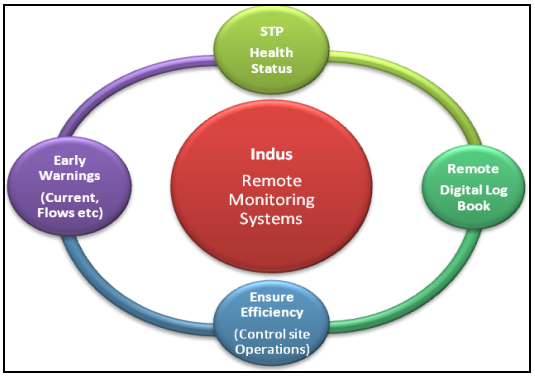
1. Start & stop the plant
2. Switch on / switch off any pump or blower
3. Start backwash / rinse sand filter and carbon filter
4. Modify & set / reset all pump / blower timers
5. Get status SMS on command
6. Change SMS transmission frequency

Critical Alerts

To two GSM mobile numbers viz., to the central server, user / operator.

SMS will be sent to the three numbers in case of

- High level in collection tank
- Feed pump stoppage due to level in collection tank
- Any pump failure
- Dosing pump failure or non-dosing of chemical
- Any blower failure
- Manual plant switch off
- Modifications on the local control unit



Data Export: System will send all operational parameters every month in excel format.

CHAPTER- 3

DESIGN PHILOSOPHY & TREATMENT SCHEME

OBJECTIVE: Treatment of wastewater generated from Kitchen, Washrooms, Bathrooms, Floor Wash and general domestic activities, to make it suitable for re-use in gardening and cooling tower or discharge to sewer

EFFLUENT: Wastewater consists of oil (free & emulsified), Suspended matters, Edible contents, Soaps- detergent & general washing chemicals generated from general domestic activities.

EFLUENT GENERATION & TREATMENT

Average Feed Flow	-	175 KL per Day
Average Treatment Flow	-	7290 Liters per Hour

PROPOSED TREATMENT SCHEME

Preliminary Treatment: Bar Screen → Multi-chamber Oil- trap cum Preliminary Settling Chambers → Equalization cum Collection Tank →.

Secondary Treatment: MBBR → Clarifier → Clarified water to Chlorine Contact Tank→ Sludge to collection tank

Tertiary Treatment
Chlorine Dosing Unit → Filter Feed Pump → Sand Media Filter → Activated Carbon Unit → Storage for re-use / discharge

Sludge
Secondary Clarifier → Sludge Drying Beds → Cake for disposal as manure and effluent back to collection tank

CHAPTER- 4

PROPOSED SYSTEM — Technology & Engineering

Moving Bed Bio Reactor (MBBR) also known as **Fluidized Biobed Reactor** technology the positive traits of two fundamental biological treatment processes namely Fixed film technology (SAFF) and Suspended Growth (conventional Activated Sludge) technology together into one hybrid system.

By combining high biomass quantities typical of fixed-film technologies with fluidization typical of a conventional activated sludge (CAS), the MBBR technology achieves high removal rates in a small volume.

In MBBR systems all the biomass is supported on the bio-film carrier with no recycled activated sludge.

MBBR systems were designed to optimize mass transfer, biomass density and contaminant removal rates through intensive research world over

A 22 mm diameter carrier offers the ability to utilize a larger screen mesh size, thereby minimizing head loss across the screen and the tendency to foul

Highly resilient process for flow and contaminant loading variations. This system offers the following unique advantages:

- 10 Times more loading in less than 20% time compared to conventional system
- Ultra-compact needs less space than any other sewage treatment process
- Easy start up, Fully automatic operation; Reliable and robust once started
- Less maintenance- Low capital and operating costs
- No need to add any micro-organism
- No chemicals are added for the process
- Clog free air distribution system and bio-media with 10 year guarantee
- Lower Power consumption due to higher oxygen transfer efficiency

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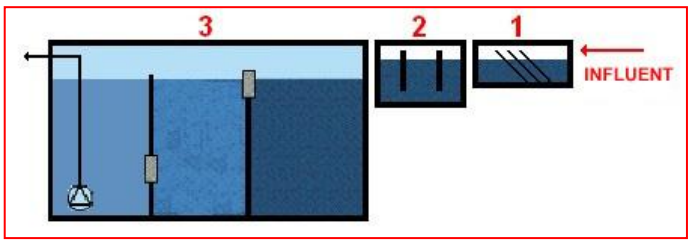
MBBR- PROCESS DESCRIPTION

PRELIMENARY TREATMENT – Customer Scope

It is assumed that the sewage pipeline ends in a customer provided three -chamber combined settling / buffer / equalization tank. It is properly equipped to separate paper, plastic covers and sanitary binds. This capacity should be ideally about 30% to 50% of the total daily flow.



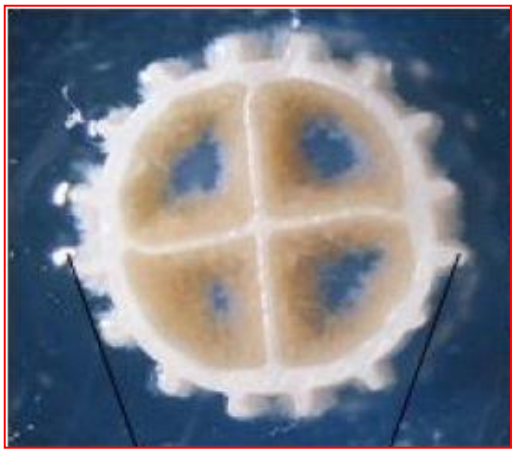
Collection tank

The above schematic is the preferred process of primary treatment. Customer can also opt for providing coarse bubble aeration system in the collection tank to mix and agitate the effluent continuously.

BIOLOGICAL TREATMENT SYSTEM

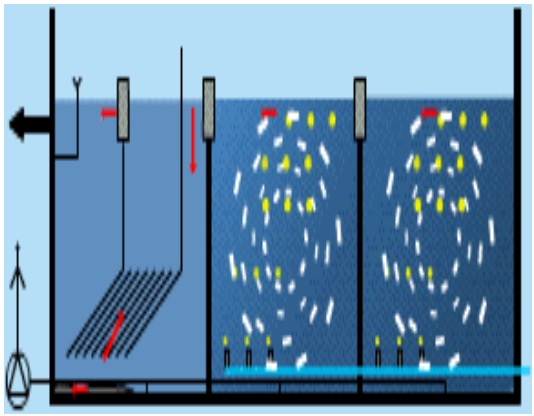
Feed pump provided with the plant will take the required quantity of sewage for treatment from the collection tank. Pump operation is controlled by timers and contactors.

A Twin Lobe Rotary Air Blower provides the required quantum of air into the two bio-reactors. Bio-reactor is divided into two stages with a combined efficiency of about 90% BOD removal. Dissolved organic matter is digested into carbon-di-oxide and biomass. This biomass acts as activated sludge. A suspended free floating bio-film carrier medium provides a large bio-film surface area for the bacteria to attach and grow.

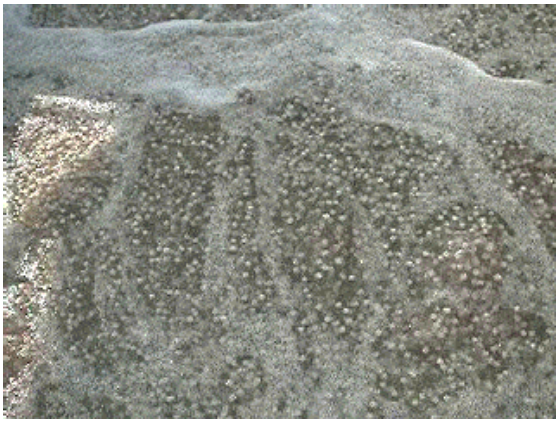


Bio Media with film growth

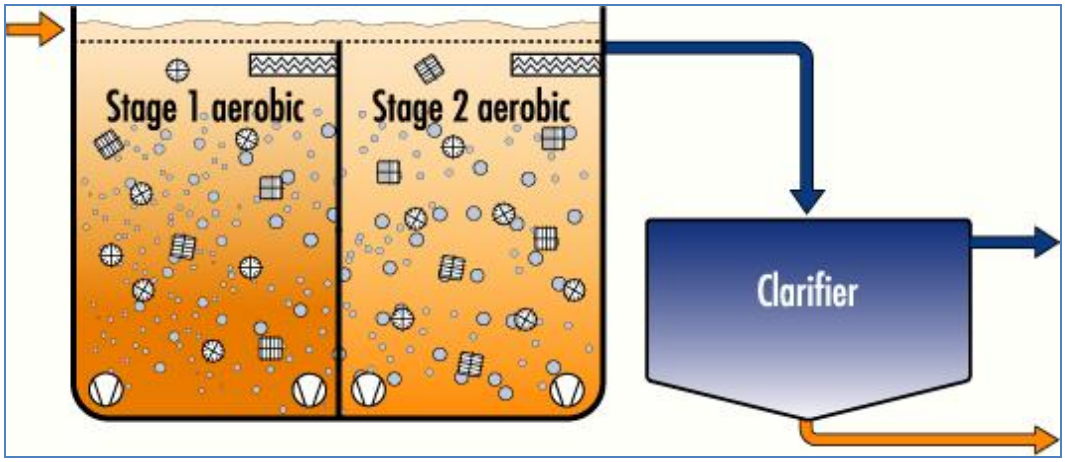
Bio Media



Bioreactors & clarifier



Bio reactor with aeration



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SLUDGE SEPARATION SYSTEM

Biologically de-graded water is flowing into a clarifier where suspended solids settle by gravity. This water is directed into a plate settler system for faster and better settling of solids. Clarifier has a hopper shaped (conical) bottom to enable the accumulation of solids in the bottom.

Sludge pump connected to the conical bottom of the clarifier. Sludge pump is controlled through a timer which will switch on periodically as desired. Normally the pump is configured to run for 5 minutes every 4 hours. Electrically operated solenoid valve will prevent flow of water when the pump is in off mode.

Typically this pump is pumped onto sludge drying beds (provided by customer) or a filter press. Dry sludge can be disposed off suitably or used as manure in garden.

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TERTIARY TREATMENT

The tertiary treatment involves addition of Sodium Hypochlorite for COD reduction and pathogen kill and removal suspended solids completely along with chlorine-removal.

Sodium Hypochlorite (chlorine) is added using a dosing pump (up to 5 PPM) into a storage tank. Contact time of 30 minutes is provided. Chlorinated water is pumped into a dual media filter containing anthracite and sylex for removal of suspended solids. This water will then pass though an activated carbon filter for removal of residual chlorine and any trace organics and color, smell etc.

Treated water will be clear, odor free and good for gardening.

PRILIMANARY TREATMENT— We recommend civil construction/ structure for this section i.e. Collection Channel with Bar Screen Placement option **—** Oil Separation Pit **—** Multi-chambered preliminary settler **—** Collection cum Equalization Tank, by client.

***BIOLOGICAL TREATMENT* —** Biological treatment tanks are to be constructed in RCC.

TERTIARY TREATMENT: Dual media Filter and activated filter are pre-fabricated in FRP for longer life..

***SLUDGE HANDLING* —** We have provided bag filter for sludge dewatering.

CHAPTER- 5

SCOPE OF SUPPLY

S.No.	Description	Make	Quantity
1.	Submersible Effluent Transfer pumps	Grundfos	2 No
2.	Bio Media- PVC	Eco-tec	1 Lot
3.	Air Blowers	Everest / Kay	2 No
4.	Motors for air blowers	CG / ABB/ Eq	2 No
5.	Fine Bubble Membrane Diffusers	Cogen	24 Nos
6.	Corse Bubble Diffusers	Cogen	20 Nos
7.	Sludge Transfer pump	Kirloskar	2 No
8.	Tertiary Treatment Pumps	Kirloskar / Eq	2 No
9.	Dual Media Filter in FRP	Aventura / Eq	1 No
10.	Activated Carbon Filters	Aventura / Eq	1 No
11.	Dosing Pumps	i-dose	1 No
12.	Electrical Control Panel	Eco	1 No
13.	Pipes / Valves / Fittings U- PVC	Prince / Eq	1 set

CHAPTER- 6

SPECIFICATIONS OF ELECTRO-MECHANICAL UNITS

UNITS	Bar Screens
Duty	To retain coarse matter in wastewater
No. of units	Two (coarse followed by fine screen in each chamber)
Size	To suit drain size; with 15 mm and 6 mm opening.
Type	Bar screen made of MS 25 X 3 mm
HRT	5 Minutes
MOC	FRP

UNIT	AERATION GRID FOR EQUALISATION TANK
DUTY	to avoid solids from settling & septicty of water
No. of units	One
Size	To suit size of equalization tank.
Type	Coarse Bubble Diffusers
MOC	EPDM
Quantity	16
Air discharge / diffuser	1-2 M^3/hour
Air Requirement	40 M^3/hour

UNIT	EFFLUENT FEED PUMPS
Duty	To pump wastewater for treatment.
No. of units	Two (1 working + 1 stand-by)
Capacity (M^3/Hour)	10
Head	10-12 m.
Type	Non clog submersible pumps.
Make	DAB from Grundfos
Impeller	Open type
Rating	1 Kw 415 V
MOC	Cast Iron

UNIT	AERATION GRID IN BIO REACTOR
Duty	To supply air from blower to diffusers.
Number of Units	One lot
Header Size	150 MM- 6”
MOC	MS
Control Valve	NRV for each blower
Branch size	100 MM- 4”
MOC	MS
Diffuser inlet	Hose Pipe
Size	30 mm- 1”
Make	PVC Braided
Control valves	Independently provided for each section
Control valve size	One each for a set of two diffusers

UNIT	AIR DIFFUSERS
Duty	To provide oxygen in bio-reactor for bio-chemical oxidation.
No. of units	**20**
Type	Fine bubble diffusers
MOC	EPDM.
Size (mm)	96 X 900
Type	Tubular- Non buyont
Capacity	8 – 9 m^3/hr
Total air requirement	160 M^3/hour

UNIT	BLOWERS
Duty	To provide air / oxygen into bio reactor
No. of units	Two (1 working + 1 stand-by)
Capacity	250 cum/hr @0.4 kg/cm^2
Type	Twin lobe rotary type.
Make	Everest / Equivalent
MOC	CI
Power	5 Kw 415
Motor	Kirloskar / Crompton / Eq

unit	BIOPACK MEDIA
Duty	High surface area to volume ratio of media shall be provided in the aeration tank for immobilizing the microbes.
Volume (M^3)	15
MOC	Poly Propelene
Shape	Circular
Surface Area	450 m^2/m^3

UNIT	SLUDGE TRANSFER PUMPS
Duty	To pump sludge to drying beds
No. of units	Two (1 working + 1 stand-by)
Capacity (M^3/Hour)	3.5 cum/hr.
Head (Mts)	20
Type	Non clog, self priming centrifugal pumps.
Particle size (mm)	8
Rating	0.8 kw 415 V

UNIT	HYPOCHLORITE TANK
Duty	To hold hypochlorite solution
No. of units	One
Volume	100 liters
MOC	HDPE

UNIT	CHLORINE DOSING PUMP
Duty	To dose chlorine solution in a regulated manner
Number of Units	Two (1 working +1 standby)

Capacity (LPH)	0-12 @ 5Kg/cm^2
Type	Electronic variable dosing
Make	i-dose / Ecotech / Eq
Special feature	Noise free- Silent

UNIT	PRESSURE SAND FILTER
Duty	To remove fine suspended particles.
No. of units	One
Size (mm)	D 900 X 1800 H
MOC	FRP
Volume (lts)	990
Media	Anthracite and river sand, pebbles

UNIT	ACTIVATED CARBON FILTER
Duty	To remove smell and color
No. of units	One
Size (mm)	D 900 X 1800 H
MOC	FRP
Volume (lts)	990
Media	Pebbles and granular activated carbon (GAC)

UNIT	AERATION GRID IN TREATED WATER TANK
Duty	To avoid odour in treated water & maintain DO
Number of Units	One lot
Type	Fine Bubble diffusers
MOC	EPDM
Control Valve	PP
Diffuser inlet pipe	PVC Braided Hose
Size	30 mm
No. Of diffusers	10
Air volume / diffuser	1-2 M^3/hour
Total air requirement	20 M^3/hour

Instrumentation:

1. Level switches in collection tank for feed pumps- Provided along with pump
2. Level switches in chlorination tank- Provided

Flow Meters:

Electronic Flow meter are part of the automatic multiport valves in Dual Media Filter and Activated Carbon Filter.

Pressure Gauges:
Glycerin filled pressure gauges of D-2.5" provided at the inlet and outlet of all pipes

Unit	*Electric Panel Box*
Duty	*For operation and protection of all electrical items*
Incoming	*MCCB of adequate rating, ammeter, voltmeter, aluminium bus bar and phase indicating lamps.*
Out going	Contactors of suitable rating of DOL type for motor rating up to 10 HP and Star-Delta type for motor ratings above 10 HP
Make	All electrical items shall be of L&T, English Electric, GEC, Crompton, IMP, MECO or Siemens.
Electrical cabling	All interconnecting cabling within STP shall be in PVC insulated, armored /unarmored, aluminum conductor of standard make. Cabling, as far as practicable, shall be underground.

UNIT	INTERCONNECTING PIPING AND VALVES
Duty	Interconnection between the various units of the STP.
Type	a) Piping : Generally all piping shall be in HDPE/PVC/GI/CI and of suitable size & pressure rating. b) All valves shall be of polypropylene/CI/GM

CHAPTER-7

CIVIL WORKS IN CUSTOMER SCOPE

As per attached drawing

EXCLUSIONS
(CLIENT'S SCOPE)

The following are the exclusions from the scope of our work and the client's scope:

a. All required civil works for tanks
b. Drains up to and beyond the STP
c. Electrical cable of required rating up to control panel
d. Chemicals, electricity and man power during trial run and commissioning.
e. Disposal of residuals.
f. Crane if required.
g. Plant illumination, painting and ventilation.
h. All statutory and regulatory approvals from government authorities.
i. All foundations for the equipments and tanks.

CHAPTER- 8

POWER CONSUMPTION DETAILS

#	Description	Connected load- Kw	Operating load- Kw
1.	Feed Pump	0.8 X 2 = 1.6	0.8 X 24 = 25
2.	Air Blower	5 X 2 = 10	5.0 X 24 = 120
3.	Sludge Transfer Pumps	0.8 X 2.0 = 1.6	0.8 X 1 = 0.8
4.	DMF feed pumps	1.25 X 2.0 = 2.5	1.2 X 20 = 25
5.	Total	7.4	171

Power Consumption per day = 171

Power Consumption / KL = 171/ 170 = 1.0 Kw / KL

Manpower Details of Operation & Maintenance

Our STP needs operator for one shift every day

CHAPTER- 9

TERMS & CONDITIONS - GENERAL

TERMINATION POINTS

i. Inlet: Flanged connection into the bar screen chamber.
ii. Over- flow/ drain points of all units at their respective end connection.
iii. Final waste as sludge — at Sludge transfer pump outlet
iv. Processed water: At activated carbon filter outlet.

JOB COMPLETION

Since system installation & commissioning entirely depends over site's working atmosphere & clients' cooperation, as supplier needs a number of inputs like *Civil Construction, Electrical Power, Feed Water/ Effluent inlet* connection to system, *Processed Effluent outlet* connection, *Water Drainage* etc., commitment of job completion can't be valid without active support / commitment from client. However the projected / avenge period for system supply & installation will be six to eight weeks & commissioning period will be further three to four weeks only.

SYSTEM WARRANTY

The system is guaranteed **for Fifteen months from the date of dispatch (major lot of equipment, in** case of part supplies) or **Twelve months** from the date of commissioning / testing against inherent manufacturing defects only and not cover Electrical items & instruments, moving parts, gasket & seals, consumables

INDUS ECOWATER
Innovative & Affordable Sewage Solutions

CHAPTER-10

PRICE & DELIVERY SCHEDULE

Our price for Design, Engineering, Manufacture, Supply, erection and commissioning of 175 KLD Sewage Treatment Plant as detailed in this offer shall be INR Rs. **16,75,000/-** (Rupees Sixteen Lakhs and Seventy Five Thousands) only.

PAYMENT TERMS

50%	Advance along with confirmed Purchase Order.
40%	Against pro-forma prior to dispatch of material from factory
10%	Against completion of work

DELIVERY

6-8 Weeks after the receipt of purchase order

INSTALLATION CHARGES

10% of the final price extra. Service tax extra as applicable on this amount.

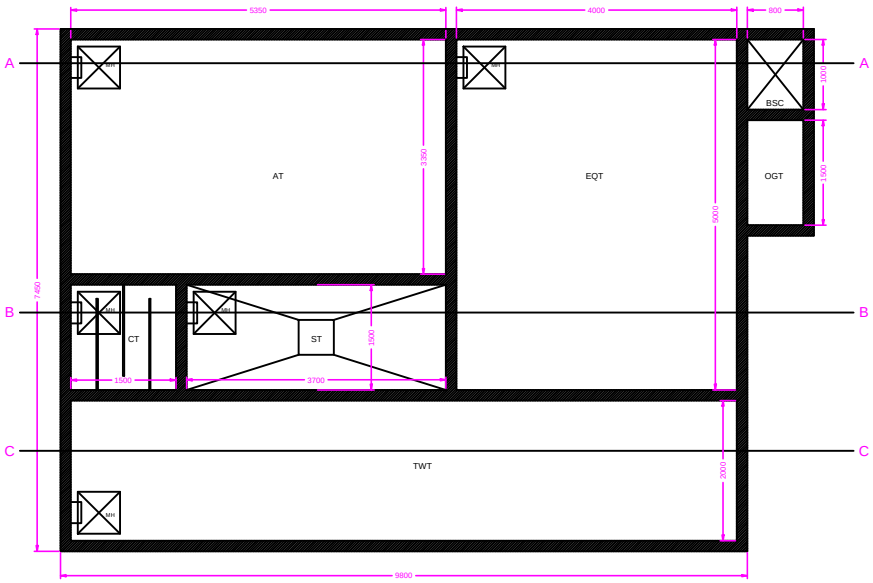
TERMS & CONDITIONS

Price	Ex- Works Hyderabad.
C.E.D.	Extra as applicable at the time of dispatch, Nil at present.
VAT	@ 5% extra
Service Tax	10.32% extra on services
Freight	In our scope
Insurance	To your account
Validity	60 Days from the date of offer

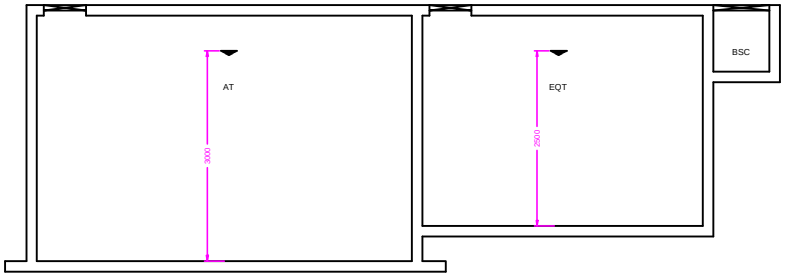
For **Indus Ecowater Pvt Ltd**

Suresh Kumar
Director

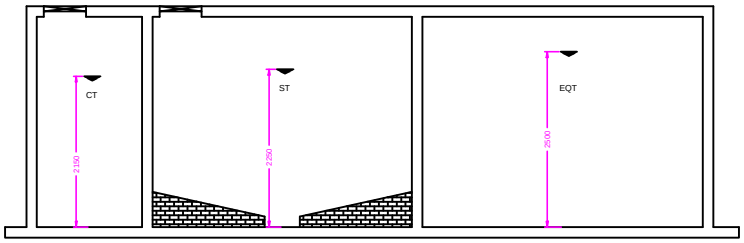
28-12-2013



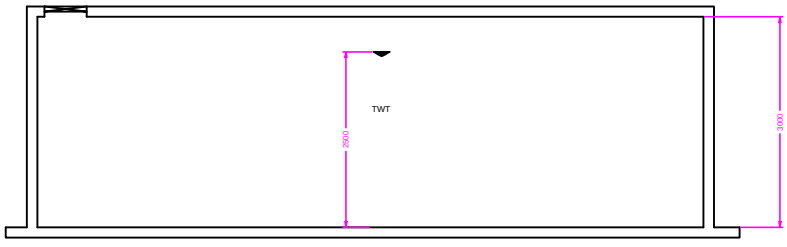
B-STP PLAN



SECTION A-A



SECTION B-B



SECTION C-C

MBBR STP CIVIL UNIT DETAILS

LEGEND	DESCRIPTION	LENGTH	WIDTH	DEPTH	WC	FB	VOLUME
BSC	BAR SCREEN CHAMBER	1000	800	800	NAC	NA	NA
OGT	OIL AND GREASE TANK	1500	800	800	NAC	NA	NA
EQT	EQUALIZATION TANK	5000	4000	3000	2500	500	50
AT	AERATION TANK	5350	3350	3500	3000	500	53
ST	SETTLING TANK	3700	1500	3000	2250	750	12.48
CT	CHLORINATION TANK	1500	1500	3000	2150	850	4.84
TWT	TREATED WATER TANK	9500	2000	3000	2500	500	49.5

FOOT PRINT IS 73M^2

TREATED WATER TANK IS REQUIRED
ONLY IF RE-USE IS PLANNED

INDUS ECOWATER PVT. LTD.
INNOVATIVE & AFFORDABLE SEWAGE TREATMENT

PLOT NO : 201/7 PHASE - II
IDA CHERLAPALLY
HYDERABAD - 51.
Ph : 850-100-6000
e-mail: design@modernstp.com

SEWAGE TREATMENT PLANT-175KLD

PROJECT CODE :

CLIENT : PROPOSAL

FILE NAME : E:\ Drawings\CD175KLD

REV. NO :		

DRAWING NO : 05	CHECKED BY : SK	DRAWN BY : VIJAY
	APPROVAL BY : SK	DATE : 07-03-2013

SHARPENN

REVISED

PROPOSAL FOR SEWAGE TREATMENT PLANT

PREPARED FOR : **Residential Complex**
Auroville
Pondicherry.

PREPARED BY : **Sharpenn Industries**
D-56, Shanmugananda, MIDC
NERUL, NAVI MUMBAI – 400 706

CONTACT PERSONS : **K.V.JAYA PRASAD / S.C. MENON**

Mobile : **9821550602 / 9820051244**

FAX : **91-22-27613871**
TELEPHONES : **91-22-65167202 / 65167203**

DATE : **15 - 02 - 2014**

E-MAIL : wtd@sharpennindia.com
Sharpenn2@gmail.com

SHARPENN

SEWAGE TREATMENT PLANT FOR RESIDENTIAL COMPLEX

AVERAGE SEWAGE GENERATION : **LITRES/DAY**

FOR PRIMARY TREATMENT **175,000=00**
FOR SECONDARY TREATMENT

Peak Flow **13 Cu mts/hr**
Minimum Flow **5 Cu mts/hr**
Average flow **7.5 cu mts/hr**

Inlet parameters:

pH : 6.5-8.5
BOD : 250-300 mg/lit.
COD : 400-500 mg/lit.
Suspended Solids : 200-250 mg/lit.
Oil & Grease : 10-15 mg/lit.

PARAMETERS CONSIDERED FOR DESIGN:

FLOW : 175 CU MTS/DAY

pH : 6 -8
COD : 600 PPM
BOD : 350 PPM
TSS : 300 PPM
O & G : 15 PPM
TEMP : 35 – 40 deg C

PARAMETERS AFTER FINAL TREATMENT:

FLOW : 175 CU MTS/DAY
pH : 7 - 8
COD : < 125 PPM
BOD : < 25 PPM
TSS : < 30 PPM
O & G : <5 PPM
TEMP : Ambient

THE TREATMENT PROCESS:

It is assumed that the waste water coming in to STP shall be domestic sewage only. No Industrial sewages will be treated in the proposed sewage treatment plant. The wastewater shall also be free of any substance toxic or inhibitory to the biological treatment process.

The proposed sewage treatment scheme is based on pretreatment method followed by the Conventional Activated Sludge process, pressure sand filtration, activated carbon filtration and disinfection to achieve the stringent final parameters. The plant operations are for capacity of 1,75,000 litres/day for primary treatment and secondary treatment as per given details. The unit operations for the Treatment are :

1. Screening
2. Oil and grit removal
3. Equalisation
4. Pre-aeration
5. Coagulation
6. Primary settling
7. Sludge Removal/ drying
8. Biological Oxidation by Activated Sludge
9. Clarification
10. Sludge removal/Sludge recycle
11. Pressure Sand Filtration
12. Activated Carbon Filtration
13.Disinfection
14.Reuse options.

The segregated sewage streams from the different residential sections will be screened using bar screens to remove the coarse floating materials, rags and other materials and will overflow in to an Oil and Grit removal chamber. The floating scum along with the free floating oil will be raked out periodically from the top of the chamber. The screened oil free sewage flows in to the equalisation tank having adequate retention time. A steady stream of air will be blown in to the equalization tank through a sparger from the air blower for thorough mixing. The sewage is received in the equalisation tank to check and stabilise the variations in pH and other polluting impurities. The aeration also improves the Dissolved oxygen level in the water. By these steps differences in temperature, rate of flow of various streams balances out and acquire homogeneity so as to facilitate optimum treatment conditions.

The pre- treated sewage from the equalization tank will be pumped at the required rate in to a specially designed flocculator and pre determined quantity of PAC solution and Poly electrolyte solution will be dosed to coagulate and flocculate the suspended and other impurities. The flocculated mass is piped down in to the primary settling tank. The flocs are settled by gravity to the bottom of the tank and are drawn off and further treated in sludge digester. The clear water overflows in to the aeration tank for biological purification.

The Primary Treated Water will be treated further by the Conventional Activated sludge Process to bring down the parameters within the prescribed limits.

The Primary treated effluent is aerated in the aeration tank by surface aerators by providing enough micro organisms and nutrients. The general biological reaction that takes place is a predator prey reaction. The waste water supplies the organic matter (Biological Food) and aeration furnishes the dissolved oxygen. The primary reaction is the metabolism of the organic matter and uptake of the dissolved oxygen by bacteria, releasing C02 and producing substantial increase in the bacterial population. The secondary reaction results from the Oxygen used by the Protozoa consuming bacteria releasing carbon dioxide and protozoal cells. About 85-90% reduction is envisaged by this process.

The sewage after the biological treatment enters the clarifier tank and the biological sludge is allowed to settle out. The sludge is drawn off and recycled back in to the aeration tank to maintain the MLSS concentration and the excess sludge is taken in to the sludge digester.

The treated water flows into a storage tank and is filtered in a pressure sand filter and activated carbon filter to trap suspended solids and adsorb other impurities and the filtered water is almost colorless and odorless. The final treated water is disinfected by the UV system and the final treated water shall be taken back for indirect cooling and general washing, agricultural and gardening purposes.

SPECIFICATIONS FOR THE PLANT AND MACHINERY:

No	Equipment	Qty	HP	Manufacturer
201	**Bar Screen** Size : 3mm square bar	**1**		**Sharpenn**
202	**Raw sewage Pump** Capacity- 8cu mts/Hr Head – 6 mts MOC – CI Body & Wetted parts Driver- suitable TEFC motor. Accessories: Base frame, coupling & guard	**2**	**2.0**	**Kirloskar/ equi**
203	**Flash Mixer-Flocculator** Size (1000 mm W x 3000 mm l x 1000 H mts) MOC: MS.IS.2062, 5mm thk Lining – Epoxy lined Flash mixer agitator 1 (Speed- 100 RPM) Floc – mix Agitators 2 (Speed 40 / 20 RPM)	**1**	**1 x 3 nos**	**Sharpenn**
204	**PAC Tank** Size 1000 mm D x 1250 mm H Mtrs Capacity (1000 Litres) Stirrer Type – Paddle Stirrer Speed – 40RPM MOC :MS.IS.2062, 5mm thk	**1**	**1.0**	**Sharpenn**
205	**Poly / lime Feed Tank** Size 1000 mm D x 1250 mm H Mtrs Capacity (1000 Litres) MOC:MS IS 2062, 5mm thk Lining : Rubber lined Stirrer Type – Paddle Stirrer Speed – 40RPM	**1**	**1.0**	**Sharpenn**
206	**Mechanical Aerator** Type – fixed surface Oxygenation Capacity – 1.2/Kgs/hr Aerator Plate, Safety lock, Aerator Bolts And accessories. Motor-5.0 HP/1440, gearbox 4" ,20:1	1	5.0	**Sharpenn**

207	**Pipe lines, valves and fittings and Accessories**	**LOT**		**PVC/CPVC**
	Working plat form & catwalk			
208	**Sludge Pump** Capacity – 5000 LPH Head – 10 MTS Type – Self priming/ Process Pump	**3**	**2x2**	**Kirloskar/Johnson**
209	**Filter Pump** Capacity – 8000 LPH Head – 25 MTS Type – High Head Process Pump	**1**	**3**	**Kirloskar/Johnson**
210	**Pressure Sand Filter - Unit** MOC- Moulded FRP Size – 950 D x 1500 H Filter media : Crushed Gavel (Different varities) Distribution pipe, Nozzles, Backwash Sample cock and accessories.			**Sharpenn**
211	**Activated Carbon Filter - Unit** MOC.Moulded FRP Size – 750 D x 1250 H Filter media : Activated carbon granules Distribution pipe, Nozzles, Backwash Sample cock and accessories.			**Sharpenn**
212	**Electrical Installation: UNIT** Industrial, Indoor, Totally enclosed from allsides MCC, front operated, dust proof, non drawout type With interlocking door design and fabricated from 14 G CRC sheet. Suitable for AC 433/415 + 6%, 50 Hz, 3-phase and neutral supply suitably painted as per IS 5 shade 631. Electrolytic copper bus bars of suitable rating and accessories. Cabling, earthing etc will be done with in the battery limit of the treatment plant.			

213 UV TREATMENT SYSTEM : 1 SET

214 **Working Platforms, ladders, supports etc : QS**

215 Air Blower : 1No
(For equalization)
Capacity : 80 M3/hr
Motor : 2HP

DETAILS OF THE CIVIL WORKS
[**EXCLUDED FROM OUR SCOPE OF SUPPLY**]

1. **Bar Screen Chamber** : 1 No
   MOC : RCC M200 or suitable
   Lining : Suitable
   Size : 5000 L x 1000 W x 1000 H mm

2. **Oil & Grease Chamber** : 1 No
   MOC : M200 or suitable
   Lining : Suitable
   Size : 3000L x 1000 W x 2000 D + FB

3. **Equalisation Tank** : 1 No.
   MOC : M200 or suitable
   Lining : Suitable
   Size : 6000L x 6000 W x 2500 D + FB

4. **Primary Settling Tank:** 1 No.
   MOC : M200 or suitable
   Size : 4000 L x 4000 W x 2000 D+ HB+FB
   Type : Hopper Bottom- 45 DEGREE

5. **Sec: Settling Tank:** 1 No.
   MOC : M200 or suitable
   Size : 4000 L x4000 W x 2000 D+ HB +FB
   Type : Hopper Bottom-45 DEGREE

6. **Aeration Tank** : 1 No
   MOC : M200 or suitable
   Size : 6000 L x 6000 W x 2500 D + FB
   Central Platform
   Baffle & Overflowing
   Launder

7. **Sludge Digester** : Unit
   Size : 2000 dia x 3000 H
   MOC : 40000 x 4000 x 2000

8. **Holding Tank** : 1 No
   MOC : M200 or suitable
   Size : 40000 x 4000 x 2000 D+ FB

9. **Chemical house** : 1 No
   Area : 36 sq mts
   Type : Open/ semi closed.

10. **Miscellaneous drains, pits, foundations etc**: Lot

We shall give you all the civil dimensional and detailed drawings, the RCC details are to be done by you.

UTILITIES :

A. **MAXIMUM CHEMICAL CONSUMPTION** :

1.	Poly Aluminium Chloride	0.2 kg/cu.mt.
2.	Poly electrolyte	0.05 kg/cu.mt.
3.	Lime	0.2 kg/cu.mts

B. **POWER** :

1.	Connected Load (MAXIMUM)	24 HP
2.	Average Running	1.50 KWH/cu.mt.

C. **SPACE REQUIREMENT**

1.	For Primary Treatment(Approx)	250sq.mt. (**Total**)
2.	For Secondary Treatment	
2.	Internal Clearance, Approach, etc.	nil sq.mt.

SCOPE OF WORK :

This proposal is for process knowhow, process design, basic engineering, detailed engineering, procurement of mechanical and electrical equipments and supply of the Sewage Treatment plant for **Residentail Complex, Auroville, Pondicherry.**

EXCLUSIONS :

- Segregation of sewages and Raw sewage supply lines to the sewage treatment plant.
- Internal permanent water supply system.
- All items and instruments other than those specified in this proposal.
- PAC/Lime/ other chemical supply or storage system.
- Fire fighting equipment.
- Three phase electrical supply.
- Internal lighting and area lighting.

BATTERY LIMITS :

- Outlet from the equalisation tank.
- Outlet flange of the final filter.
- Incoming cable for MCC.

GENERAL :

The scope will cover generally all the points as mentioned in the specifications. GA drawings with hydraulic flow will be provided for civil works, complete loads of individual equipments will be provided with foundation drawings, however structural/architectural details are beyond the scope of this offer. All documentation and drawings with requisite number of copies will be provided.

LIST OF ENCLOSURES :

S.NO.	**DESCRIPTION**
01.	Process Flow Diagram
02.	Typical Lay out

SHARPENN

SCHEDULE OF PRICE :

JOB : SEWAGE TREATMENT PLANT
FOR : Residential Complex, Auroville, Pondicherry.

S.NO.	DESCRIPTION	PRICE (Rs.)
A.	Basic and detailed engg. procurement, supply fabrication, testing, pipings, as per our scope enclosed, ex-works, Shahapur.	**Rs.33,04,500=00**

(**Lump Sum Rupees Thirty Three lakhs and Four thousand Five Hundred only)**

B Taxes and duties extra at actual.

PAYMENT TERMS

A. 30% of the order value as advance along with your written purchase order.
B. 60% of the order value against proforma invoice on progressive delivery of plant and equipment.
C. Balance on commissioning of the plant.

for **Sharpenn Industries**

EXCLUDED FROM THE SCOPE OF OUR SERVICES :

1. We will provide all details regarding the civil works which are beyond the scope of our supply.

2. You will provide free electricity, water and make living arrangements for all our personnel visiting the site for the erection and commissioning of the treatment plant machinery under our scope.

3. We will offer our services for technical discussion with the State Pollution Board to obtain all the necessary approvals and NOC as required. All miscellaneous and incidental expenses for this however, will be to your account.

4. Shed for housing the packaged unit to be provided by the client.

5. Transportation of sewages from various sections to the equalisation tank.

6. Transportation of filtrate from the filter press to wherever necessary.

7. Transportation of treated water from the outlet of the Activated carbon filter to wherever necessary.

8. Internal lighting and area lighting.

9. Transportation of the plant and machinery from our works to site.

DELIVERY : 16 - 20 weeks from the date of confirmed order.

VALIDITY : Our offer is valid for thirty days from the date of this offer.

GENERAL NOTES

1. All pumps will be of Kirloskar / Johnson/equivalent make.
2. All motors will be of Crompton make.
3. All pipelines will be PVC/CPC. All process valves will be one piece design ball valves

SCHEDULE OF PRICE: (FOR TECHNICAL SERVICES)

JOB: PROPOSAL FOR SEWAGE TREATMENT PLANT
FOR: Residential Complex, Auroville, Pondicherry

S.NO.	DESCRIPTION	PRICE(Rs.)
A	Basic and detailed engg. Preparation of feasibility report, details of civil works and drawings, supervision of erection and commissioning. Lumpsum.	**Rs. 3,00,000=00**
	(Rupees Three lakhs only)	
B	Taxes and duties extra at actuals	

PAYMENT TERMS:

Rs. **60,000=00** as advance along with your written purchase order.

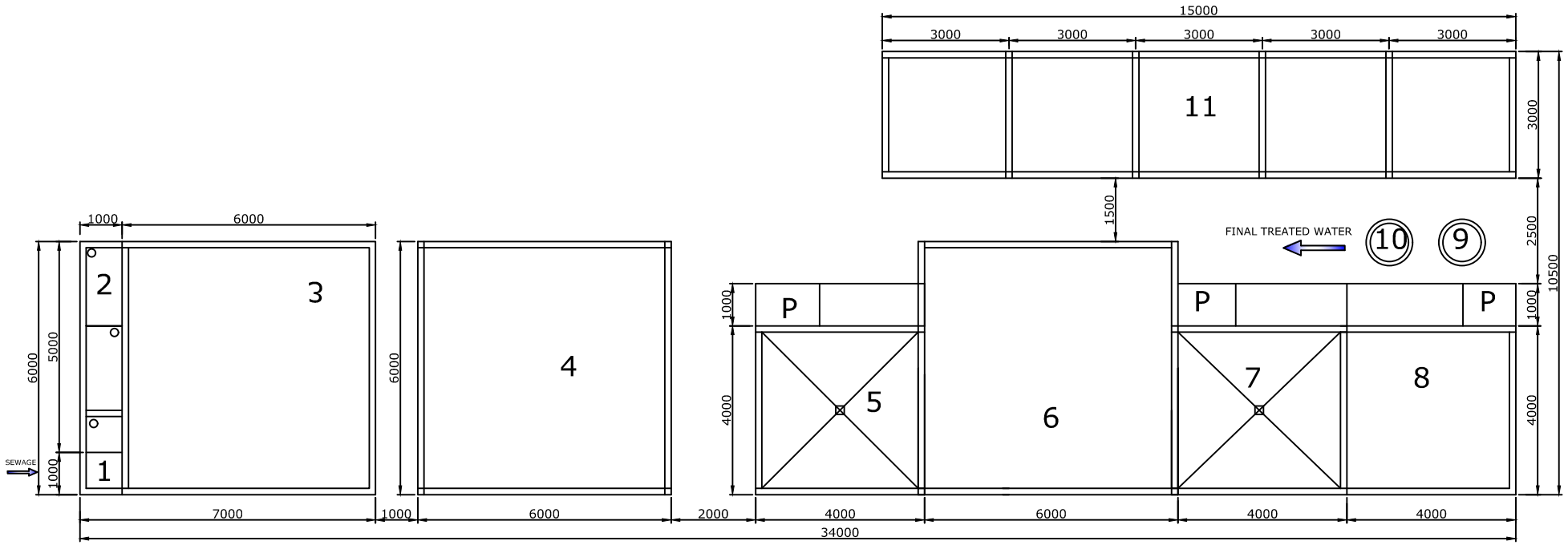
Rs. **60,000=00** against release of drawings.

Rs. **60,000=00** on completion of plant and equipments on foundation.

Rs. **60,000=00** on completion of erection of plant and equipments.

Rs. **60,000=00** on commissioning of the plant.

FOR Sharpenn Technologies Pvt Ltd



11	SLUDGE DRYING BEDS
10	ACTIVATED CARBON FILTER
09	PRESSURE SAND FILTER
08	HOLDING TANK
07	SECONDARY SETTLING TANK
06	MBBR TANK

05	PRIMARY SETTLING TANK
04	SHED / EQUIPMENTS
03	EQUALISATION TANK
02	OIL TRAP
01	BAR SCREEN CHAMBER
SR. NO.	DESCRIPTION

SHARPENN

DRN	NS
CHK	MS
APPD	MS
SCALE	NTS
DATE	12/02/14

TITLE : LAYOUT PLAN

CLIENT : AUROVILLE

CONSULTANTS :

INSPECTION :

P.O.NO. :

CAD FILE NAME LAYOUT PLANT

DRG NO : -- SI /STP / 14 / AU /04

QTY.

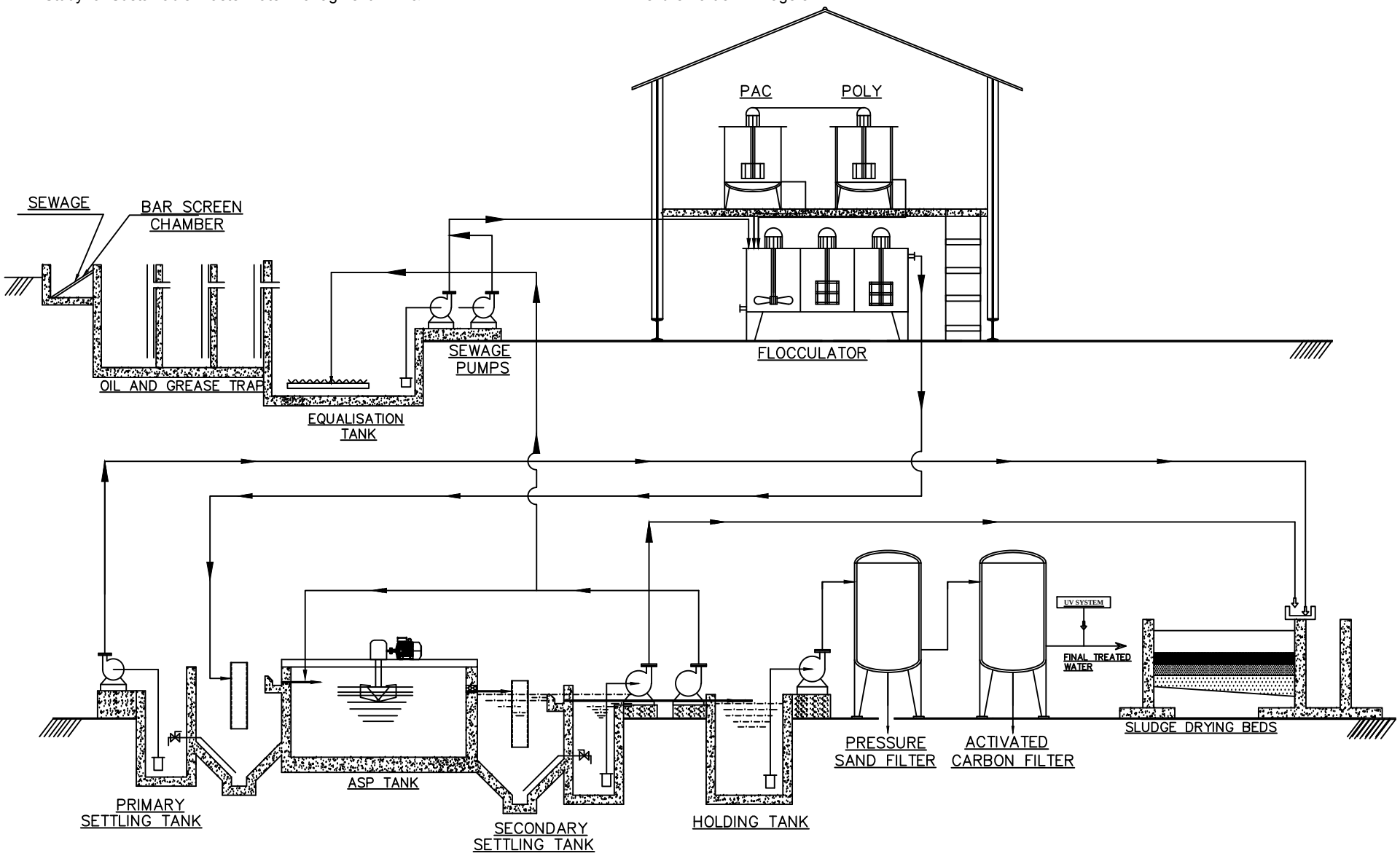
EQPT. NO.

OUR JOB NO.

CAP. (ACT) -

SHEET NO. 1 OF 1

REV NO. 0



SHARPENN	TITLE: STP FLOW DIAGRAM	DATE	12/02/14	DRG. NO. SI/STP/14/AU/03
		DRN	NS	
		CHD.	MS	
	CLIENT: AUROVILLE	APPD.	MS	SHEET 1 OF 1

FILE NAME : ------