WASTEWATERS REUSE SCHEME UNDER THE PROJECT ON ABATEMENT OF POLLUTION IN MUSI RIVER IN HYDERABAD CITY

Dr. K.S.S.V.V.PRASAD[1], K.K.BASHA[2], V.PADMANJALI[3]
Vice President &Head Manager Assistant Manager

Environment, Water Supply & Sanitation Division
Aarvee Associates Architects Engineers Consultants Pvt. Limited, Hyderabad, India
kprasad@aarvee.net

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ABSTRACT

Continuing view that water is an infinite resource is one of the reasons for water shortage in many water deficit areas in India including Hyderabad city. Treated wastewater reuse is one important option which can be promoted as important concept of "integrated urban water management". Hyderabad is currently ranked as the fifth largest urban agglomeration in the country. The Greater Hyderabad Municipal Corporation (GHMC) consists of Municipal Corporation of Hyderabad (MCH) and 12-peripheral municipalities. The core area of MCH is divided into 50 drainage catchments under 6 sewerage zones and the 12 surrounding municipalities are divided into various catchments individually. With a total population of 81.90 Lakhs, GHMC generates domestic wastewater (sewage) of the order of 1032 MLD. This entire sewage drains into Musi River which flows through the heart of the city and therefore it has become a huge urban sewage drain.

Under National River Conversation Plan (NRCP), Hyderabad Metro Water Supply & Sewerage Board (HMWSSB) initiated the NRCP Project in two Phases for abatement of pollution in Musi River. Phase II aims at constructing additional sewage treatment facilities for which it invited Aarvee Associates Architects Engineers and Consultants Pvt. Ltd as Consultant to prepare the Detailed Project Report. The important reasons for establishing this project is to meet increasingly more stringent discharge standards in to Musi River and reuse part of the treated wastewater for different sectors of non-domestic uses.

Recycling and reuse of treated wastewater either for non-domestic municipal uses or for specific irrigation and industrial use will serve the purpose of Integrated Urban Water Management very well. As per Govt of India directives, the Benchmark for extent of reuse and recycling of sewage is 20**%.** At present 757 MLD of STPs are in operation in GHMC area maintained by HMWSSB & HMDA. The Hyderabad Metropolitan Development Authority (HMDA) proposed tertiary treatment facilities of 20MLD on Balkapur Nala adjacent to Khairatabad flyover and another is on Picket Nala having capacity of 30MLD in addition to the existing STPs under JICA funding for reuse & recycling and improvement of Hussain Sagar Lake. HMWSSB proposes two more wastewater treatment facilities at Fatehnagar & Qutubullapur (89 MLD) for recycle and reuse to meet the needs of the industrial clusters under NRCD Phase -II. It is also proposed to treat the balance sewage quantity of 521 MLD under NRCD Phase -II.

STP proposed under this project are advanced technologies like Moving Bed Bio- Reactor (MBBR), Sequencing Batch Reactor (SBR), Fixed Bed Biofilm Activated Sludge Reactor (FABS/Organica), Up flow Anaerobic Sludge Blanket with Extended Aeration System (UASB + EAS) to meet most stringent water quality standards. STP technologies are selected based on Life Cycle Cost (LCC) and Decision Support System (DSS) analysis by considering performance, energy requirement, resource requirements and associated costs ,land requirements, annualized cost etc.

The existing recycle & reuse quantity is much below the benchmark fixed by MoEF and there is huge potential to go for recycle & reuse options in GHMC area in view of drinking water scarcity and higher production cost.

I. INTRODUCTION:

Together, India's largest cities generate more than 38254 MLD. Out of this it is estimated that less than 30% of this is collected undergoes treatment before it is disposed into freshwater bodies or sea. As per Central Pollution Control Board (CPCB) Rules, a city or town's municipality or water authority is responsible for collecting and treating 100% of the sewage generated within its jurisdiction. The level to which the sewage has to be treated depends on where it will be disposed –treatment standards and higher for disposal into water bodies or rivers. Typically even where sewage treatment plants (STP) exist, sewage collection networks are inadequate so only a small portion goes for treatment. The rest flows into nallahs. Mostly these nallahs are connected to rivers as storm water drains and also carrying sewage water too.

River Musi is a tributary to River Krishna, it is originating from Ananthagiri Hills. The river travels 70 km upstream before entering Hyderabad near Rajendranagar, flowing west to east, bifurcate the old and new city on South and North of river Musi. The river traverses about 28km within the city limits and flows downstream, about 158km before joining into River Krishna, near Wazeerabad, Nalgonda District, AP.

There was a time when River Musi was considered as a life-line, a symbol of purity and virtue for countless residents of Hyderabad. But, over the past few decades, the discharge of untreated sewage and industrial effluents directly into River Musi has made the situation miserable. Once this beautiful river has been reduced to a stinking drain. Due to rapid unplanned development of the city of Hyderabad, the quantity of sewage generated is many times more than the designed capacity of the existing sewage treatment plants, resulting in high percentage of under-treated and untreated sewage entering the river. The photographs showing the view of River Musi few decades ago and now.

View of Musi river in Earlier Days

Present View of Musi River

II. EXISTING SCENARIO OF SEWAGE TREATMENT

The River Musi drainage basin in GHMC limits is about 574.54 Sq. Km covering the population of 82 Lakhs. For more than 40 years now, untreated wastewater from the Hyderabad city has been flowing into River Musi. A couple of decades ago, when the population of Hyderabad was quite small, it was not considered an issue of river pollution. However, in the last ten years (2001-2011) the population of Hyderabad has increased by 28.8% resulting in increased wastewater flows into the River Musi leading to further deterioration. Besides poor water quality status of River Musi, at present the River has no any natural inflow except the sewage water joining from various parts of the city through nullahs and ultimately joining into River Krishna. The River Musi receives fresh water from rains during June, July and August and would have remained dry.

The River Musi water quality is analysed in Hyderabad stretch for various critical parameters such as BOD, COD, TSS, DO and Fecal Coliforms. The BOD levels are in the range of 104 – 219 mg/l, COD levels are ranging from 254 – 628 mg/l, TSS levels are ranging from 88 – 276 mg/l, DO levels are absolutely NIL and the Fecal Coliforms are in the range of 0.5 – 5.8 x 10^5 MPN/100 ml. It observed

from the analysis that the wastewater / water flowing in the river is not satisfying any of the IS:2296 surface water quality criteria standards suggested by the Central Pollution Control Board (CPCB).

The sewage flows enters into River Musi, existing treatment facilities and additional STPs proposed are given in Table -1. The photographs showing the existing STPs in the GHMC area are given below:

Table -1: Details of Sewage Flows and Additional Capacities of STPs (MLD)

Horizon Year	Sewage Flows (MLD)	Existing STPs Capacity	Additional Capacity Required
2014	1079	727	352
2024	1337	727	610
2044	1827	727	1100

Photographs Showing the Existing Sewage Treatment Plants in GHMC Area

A Panoramic View of Amberpet STP (339 MLD)

Extended Aeration System in Amberpet STP

III. PROPOSALS OF NEW STPS

Under NRCD Phase -II, HMWSSB proposed 610 MLD of Sewage Treatment Plants (Upto 2024 needs) with an approximate cost of Rs. 850 Crores. Ten STPs were proposed along the River Musi including Interception & Diversion (I&D) Structures and Conveying Mains. The location map showing the proposed STPs are given in Figure -1.

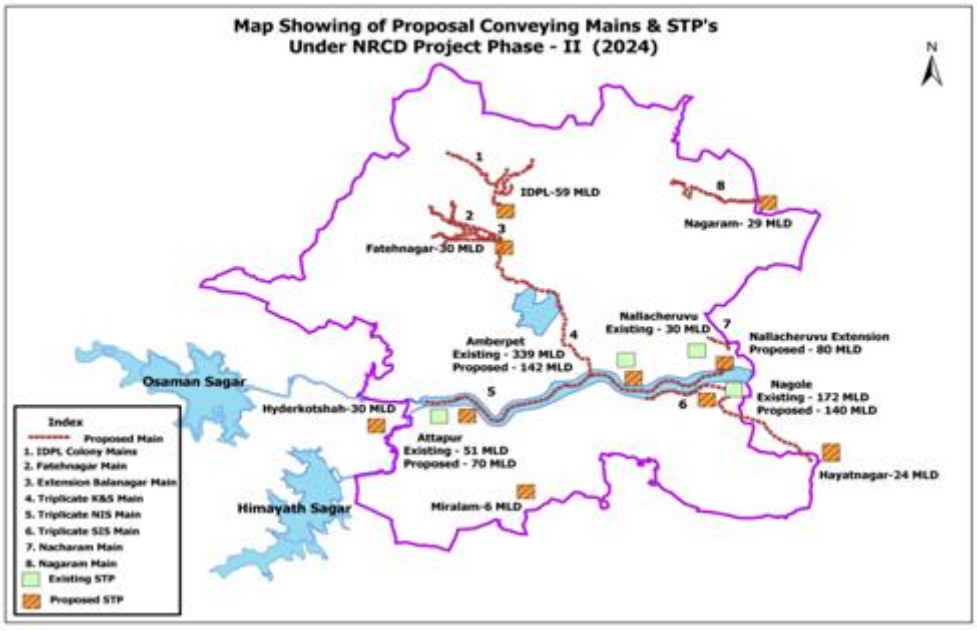


Figure -1: Location Map Showing the Proposed STPs under NRCD Phase -II

SELECTION OF TECHNOLOGIES FOR BETTER QUALITY EFFLUENT

Several processes 'technologies' to treat wastewater are in use. Recently, several new technologies have emerged, which amongst other includes Organica (Fixed Bed Film Activated Sludge (FBAS) Technology), Moving Bed Bio- Reactor (MBBR), Sequencing Batch Reactor (SBR), and Membrane Bioreactor (MBR). Every technology has its advantages and disadvantages and therefore has to be applied in accordance to the local conditions. Some of the above mentioned emerging technologies like SBR, and MBBR have already been used for sewage treatment in India. Decision Support Systems (DSS) and other tools have been developed to select the process/technology which is based on site specific approach and local conditions. The life-cycle cost (LCC) analysis is one such tool which is widely being used to identify the technology that may suit to the particular case or location. Life cycle cost analysis (LCCA) is an economic evaluation technique that determines the total cost of owning and operating a facility over period of time. Life Cycle Cost Analysis can be performed on large and small projects or on an isolated system. Policy makers, planners etc. apply the principles of life cycle cost analysis in decisions they make regarding creation an asset or any improvements to a facility. The main purpose of the computation of life cycle cost and evaluation of the various treatment options is to evolve a preferred process option. There are two most important components while evaluating LCCA. These are costs and time. Defining the exact costs of each expense category can be somewhat difficult since, at the time of the LCC evaluation, nearly some costs are unknown. However, through the use of reasonable, consistent, and well-documented assumptions, a credible LCCA can be prepared.

As per the NRCP document "*Compendium of Treatment Technologies"* published in 2009, various technologies have been evaluated on the basis of:

i. Performance
ii. Energy requirement
iii. Resource requirements and associated costs
iv. Land requirements
v. Annualized cost etc.

Due importance was given for recycle and reuse of wastewater effluent and by adopting LCCA and Decision Support System (DSS), the following technologies were considered:

- Upflow Anaerobic Sludge Blanket Reactor + Activated Sludge Process (Extended Aeration System).
- Upflow Anaerobic Sludge Blanket Reactor + Final Polishing Unit.
- Moving Bed Biological Reactors (MBBRs)
- Sequential Batch Reactors (SBRs)
- Membrane Bio-reactors (MBRs)
- Fixed Bed Film Activated Sludge (FBAS) Technology - Organica

IV. WASTEWATER RECYCLE AND REUSE APPLICATIONS IN GHMC AREA

The wastewater reuse is the most promising alternative to augment water supply and means of alleviating the anthropogenic impacts on the environment: it reduces the volume of wastewater discharged to receiving waters, and its substitution for freshwater leaves more water for the environment. Wastewater can be reused for a variety of purposes, including agricultural irrigation, heavy industry, urban and landscape irrigation, groundwater recharge, and wetland creation .The wastewater reuse schemes have the potential to extend existing water supplies, lessen the demand on sensitive water bodies, lower the cost of developing new water supplies, reduce disposal costs, lessen the discharge of pollutants to the environment, and provide water to serve a variety of beneficial uses .Wastewater, treated, partially-treated or untreated, is most widely reused for irrigation in an agricultural setting in developing countries as well as the water-scarce regions of the developed

countries. There are many ill effects of reusing untreated or partially treated wastewater for irrigation like groundwater pollution, soil contamination, and the adverse effect on farmers and consumers of wastewater products.

The reuse of treated wastewater may be applied in agriculture, industry, ground water recharge, and urban usage including lanscape irrigation and fire protection. Wastewater reuse can be adopted to meet the water demand in different fields and contribute to the conservation of freshwater resources. The categories of treated wastewater reuse applications in GHMC area are given in Table -2.

Table -2: Categories of Treated Wastewater Reuse in GHMC Area

S.No.	Category of Reuse	Application in GHMC Area	Status
1.	Urban use unrestricted	Landscape of parks present and proposed along the River Musi in Hyderabad Stretch.	Partially
	Restricted others	Fire protection & massive Construction Activity in the City.	Not yet
2.	Agricultural Food crops	As of now along the River Musi leafy vegetables are being grown with partially treated wastewater and the same can be allowed after treatment with lot more secured way.	Partially
	Non-Food crops	Irrigation for fodder is also under practice along the River Musi and the same can be extended in secured manner.	Not yet
3.	Recreational use un-restricted	There are 176 lakes present in GHMC Area among them around 57 are prime and can be filled this water to improve the tourism activities and also improves the eco-system.	Partially By HMDA
	Restricted	Fishing and Boating can be allowed in these lakes.	Not yet
4.	Environmental Enhancement	By augmenting the existing lakes and wetlands in the GHMC Area.	Partially
5.	Groundwater Recharge	As of now the Groundwater in the City premises is varying from 90 to 150 m BGL. The treated water can be an option to increase the groundwater table in the region.	Not yet
6.	Industrial Resuse	There is a huge demand of water for industrial clusters such as Uppal IDA, Bollaram IDA, Nacharam IDA, Jeedimetla IDA, Kattedan IDA, BHEL Area, Patancheruvu IDA Etc. in GHMC area and the same can be used for various industrial applications to minimise the treated water supply to the industries.	Not yet
7.	Residential Use	The major townships, appartments etc present in GHMC can have a fair chance utilise the treated wastewater for flushing toilets and gardening and floor cleaning etc.	Not yet

V. STATUS OF REUSE & RECYCLE UNITS

Hussainsagar lake is 450-year-old water body in the heart of the city, a series of Interception & Diversion (I&D) structures and Sewage Treatment Plants (STP) commissioned recently have come to help improve the quality of water that flows into it. The Hyderabad Metropolitan Development Authority (HMDA) which has taken up the project to clean the water body with Rs.**370 crore** JICA assistance.

Under the Hussainsagar Lake and Catchment area Improvement project the existing STP of 20 MLD at Khairatabad has been upgraded to tertiary level (Membrane Filtration) with biological nutrient removal process to address the issues of nitrates and phosphates and the treated water then undergoes ultra-filtration by membranes procured from Australia. These membranes were being put to

use for the first time in the country. After the ultra-filtration, the water is disinfected of pathogenic bacteria which make the treated water discharged into the lake fit for reuse for non-potable purposes. Setting up an additional RO Unit (reverse osmosis) could also enhance the quality to potable purposes, it was suggested.

Photos of Upgraded 20 MLD STP with Membrane Filtration at Balkapur Nala.

The Tertiary treatment plant of 30 MLD capacity at Picket Nalla opposite to KIMS hospital is under construction stage. The new STPs of 89 MLD at Fatch nagar and Qutubullapur are under proposal stage.

VI. RIVER FRONT DEVELOPMENT ACTIVITIES

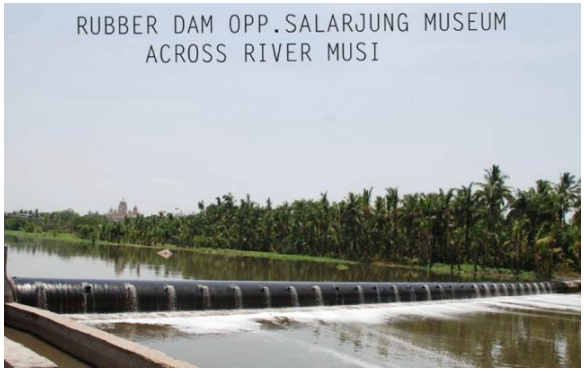
After treatment of 1079MLD wastewater, the effluent will be discharged into River musi. There is huge scope for River front development activities. River River front development is mainly to address specific management issues and objectives related to economic development in areas of forestry, agriculture, tourism fisheries habitat, sensitive species, water resources, recreational and cultural activities along the river front areas available for development. Some of the key focus areas of RFD can be:

- To clean the River
- To develop the river front areas as a major tourist attraction.
- Facilitate economic development and social integration.
- Create city level recreational and green spaces.
- Maintain water pools at strategic location.

Reuse of treated wastewater can be effectively utilised in River Front Development Activities in urban areas. GHMC has already made such provision to develop the River Musi with a provision of Rs. 450.00 Crores. The DPR for the very purpose is already prepared and sent for the approval of the National River Coservation Directorate (NRCD) under Ministry of Environment & Forests, GoI. The

photographs showing the River Front Activities already taken place and proposed in GHMC Area are given below:

Photographs Showing the RFD Activities Already Taken Place in GHMC Area



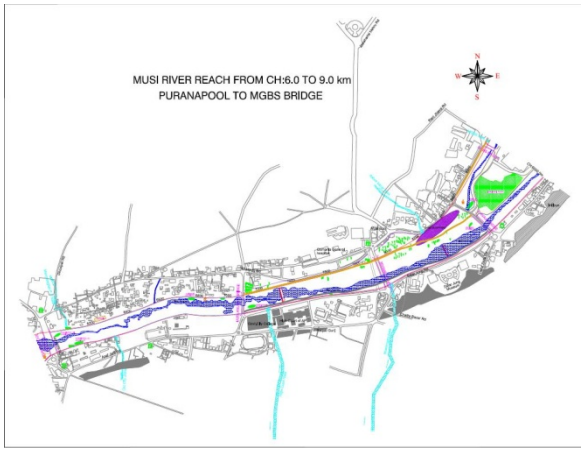
Rubber Dam near Salarjung Museum

Park Development in front of High Court

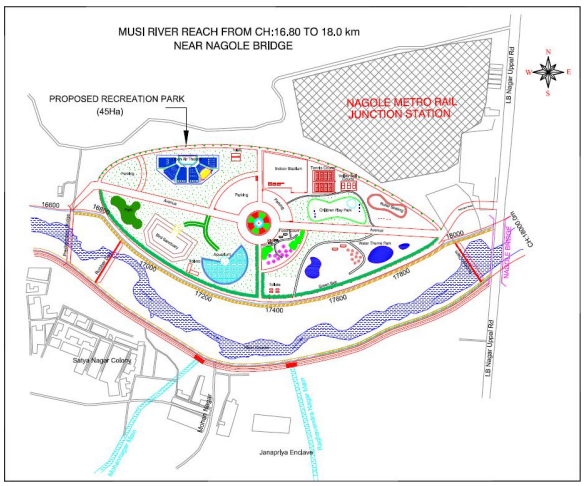
Photographs Showing the Proposed RFD Activities Proposed in GHMC Area

Proposed Typical view of Promenades

Proposed layout around musi river



Proposed RFD work from Puranapool to MGBS



Recreational Park near Nagole Bridge

If all the above treatment facilities are in operation only 139 MLD wastewater wil be recycled out of 1079 MLD, which is less than 20% norms fixed by GOI. The overall wastewater treatment quantities are given in Fig No 2

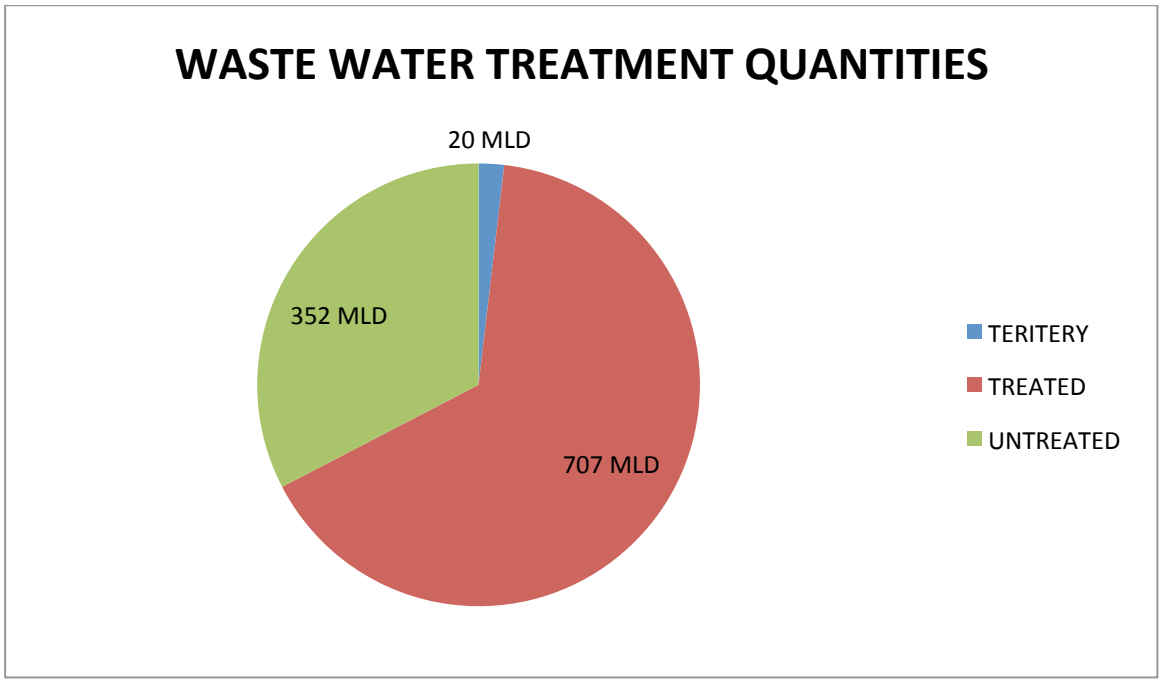


Figure -2: Chart showing the waste water treatment quantities

VII. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use. Water recycling projects have been developed to meet non-potable water demands, a number of projects use recycled water indirectly for potable purposes. These projects include recharging ground water aquifers, augmenting surface water reservoirs with recycled water, meeting Industrial demand also. Under the NRCD phase –II, to abatement the pollution in river Musi with financial assistance from NRCD not only improving the water quality of river and It also beneficial to compensate the industrial demand at two locations Fatehnagar and Qutubullapur STPs (located close to industrial cluster) by proposing advanced treatment technologies.
2. HMWWSB considered the proposal for using treated effluent after tertiary treatment from Fatehpur and Qutbullapur STPs, and also treated effluent from rest of the 8 STPs at Amberpet (142MLD), Nagaram (29MLD), Nallacheruvu (80MLD), Nagole (140MLD), Hayatnagar (24MLD), Hyderkot Shah 30MLD, Attapur(70MLD), Miralam(6MLD) is discharged into the river Musi flows downwards to compensate the agricultural water Demand and Hyderabad Metropolitan Development Authority (HMDA) proposed sewage treatment plants (STPs) for the Hussain Sagar cleaning include one with 30 MLD capacity at Picket Nala opposite KIMS Hospital for tertiary treatment which is under construction stage and 20 MLD on Balkapur nala adjacent to Khairatabad flyover which is upgraded for tertiary level with membrane treatment under reuse scheme which is currently in operation.

3. Under lake improvement project HMDA is proposing STPs at 9 locations of total 48 MLD capacity. Apart from this HMWS&SB is planning to develop the " Wastewater Recycling Units" to supply water for non –domestic requirements by considering decentralized concepts particular at group housing locations, independent drainage catchment units.

RECOMMENDATIONS

1. Lifting of 200 MLD treated water from River Musi at Nallacheruvu location to the downstream sides of River Manjeera / Singur Dam so that the downstream villages can irrigate their lands. At present more than 400 MLD water is being drawn from these locations to Hyderabad City. As HMWSSB is incurring huge expenditure on lifting the water from River Krishna, they can reduce their lifting cost by drawing additional quantity of 200 MLD.
2. HMWSSB can go for decentralisation of the sewage treatment facilities at various locations so that the recycled water can be used for non-domestic purposes like gardening, industrial use, and recharge of the groundwater at important locations.
3. HMWSSB can impose a rule for new townships, new apartment complex for utilisation of 30 – 50 % sewage and construct treatment facilities along with the recyclable options.
4. Incentives can be given for zero discharge concepts.
5. Water Cess can be collected from the bottling units / packaged drinking water companies and this fund can be utilised for the operations of the sewage treatment plants.
6. HMDA / GHMC can use treated wastewater in various lakes / water bodies in order to improve the eco-system of the existing lakes. Revenue can be generated through tourism.

VIII. ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to HMWS&SB & HMDA officials for their cooperation and encouragement towards submission of technical paper to India Water Week 2013.

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