



Urban Wastewater Public-Private Partnerships

White Paper



Disclaimer, Rights and Permissions
All Rights Reserved

No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission.

This publication may contain advice, opinions and statements of various information providers and content providers. FICCI and 2030 WRG do not represent or endorse the accuracy or reliability of any advice, opinion statement or other information provided by any information provider or content provider or any user of this publication or other person or entity.

Acknowledgements

This report is the result of joint collaboration between the FICCI Water Mission and the 2030 Water Resources Group (2030 WRG), in conjunction with knowledge partner, Powertec Engineering Pvt. Ltd. We wish to acknowledge the following individuals for their contribution to the document.

FICCI Water Mission: Rita Roy Choudhury, Medhavi Sharma

2030 WRG: Bastiaan Mohrmann, Rochi Khemka, Annelieke Margreet Laninga

Powertec Engineering Pvt. Ltd: Sujatha Srikumar, Rahul Joshi



Foreword

The Ministry of Water Resources, Government of India recently formulated a policy for Public Private Partnership projects in the wastewater sector through an innovative hybrid annuity model under the Namami Gange Program. This approach seeks to ensure performance, efficiency and sustainability of the proposed wastewater investments by using long term PPP contracts, where private sector will be responsible for technological innovation, construction, operations and maintenance of assets. The Government will address the main concern of the private sector regarding timeliness of payment. Under the hybrid annuity program, up to 40% of the capital investment will be paid by the Central Government through milestones linked to construction progress, with the balance paid through annuities over the remaining life of the concession extending up to 20 years. The Government of India plans to establish a Special Purpose Vehicle (SPV) to develop and structure projects, identify private sector partners and create capacity to effectively monitor performance during the concession period. The SPV would enter into tripartite agreements with respective states and ULBs for supporting individual projects.

In this context, this white paper on urban wastewater PPPs, prepared by the FICCI Water Mission and the 2030 Water Resources Group, provides useful industry perspectives on measures to improve the investment climate and enhance project viability and sustainability through wastewater reuse markets in the long run.

Building upon industry's interest in the sewerage sector, we look forward to partnering with private sector to accelerate PPPs and establish business models for sustainable operations to transform this sector.

A handwritten signature in blue ink, appearing to read 'Shashi Shekhar', written in a cursive style.

(Shashi Shekhar)

Secretary

Ministry of Water Resources, River Development & Ganga Rejuvenation
Government of India

Preface

India has long felt the need for a policy, regulatory, and institutional framework supporting circular and economically viable wastewater management models, which encourage private sector participation and financing. These elements are crucial to improve the efficacy of sewerage services through superior delivery mechanisms and innovative technologies. Stakeholders welcome the recently announced Government of India policy championing Public-Private Partnership projects for pollution abatement in the Ganga basin.

In this context, it gives us immense pleasure to present a white paper on Urban Wastewater PPPs prepared by the FICCI Water Mission and the 2030 Water Resources Group. This paper aims to provide the industry perspective on issues affecting PPP projects in the urban wastewater sector, suggesting measures to improve the investment climate for these projects at the national, state and municipal levels and enhance reuse of treated wastewater. The FICCI Water Mission accords the highest priority to increasing private sector participation in urban & industrial water. 2030 Water Resources Group is committed to working for integrated water security solutions through public-private-civil society partnerships.

This study is the outcome of extensive stakeholder consultation with industry participants through formal interviews, consultative workshops and surveys, supplemented by desk research involving review of reports on the domestic sewerage sector as well as international and Indian PPP case studies of projects in this sector.

On behalf of the FICCI Water Mission and the 2030 Water Resources Group, we extend our appreciation to the Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India for their support in bringing this paper to fruition.

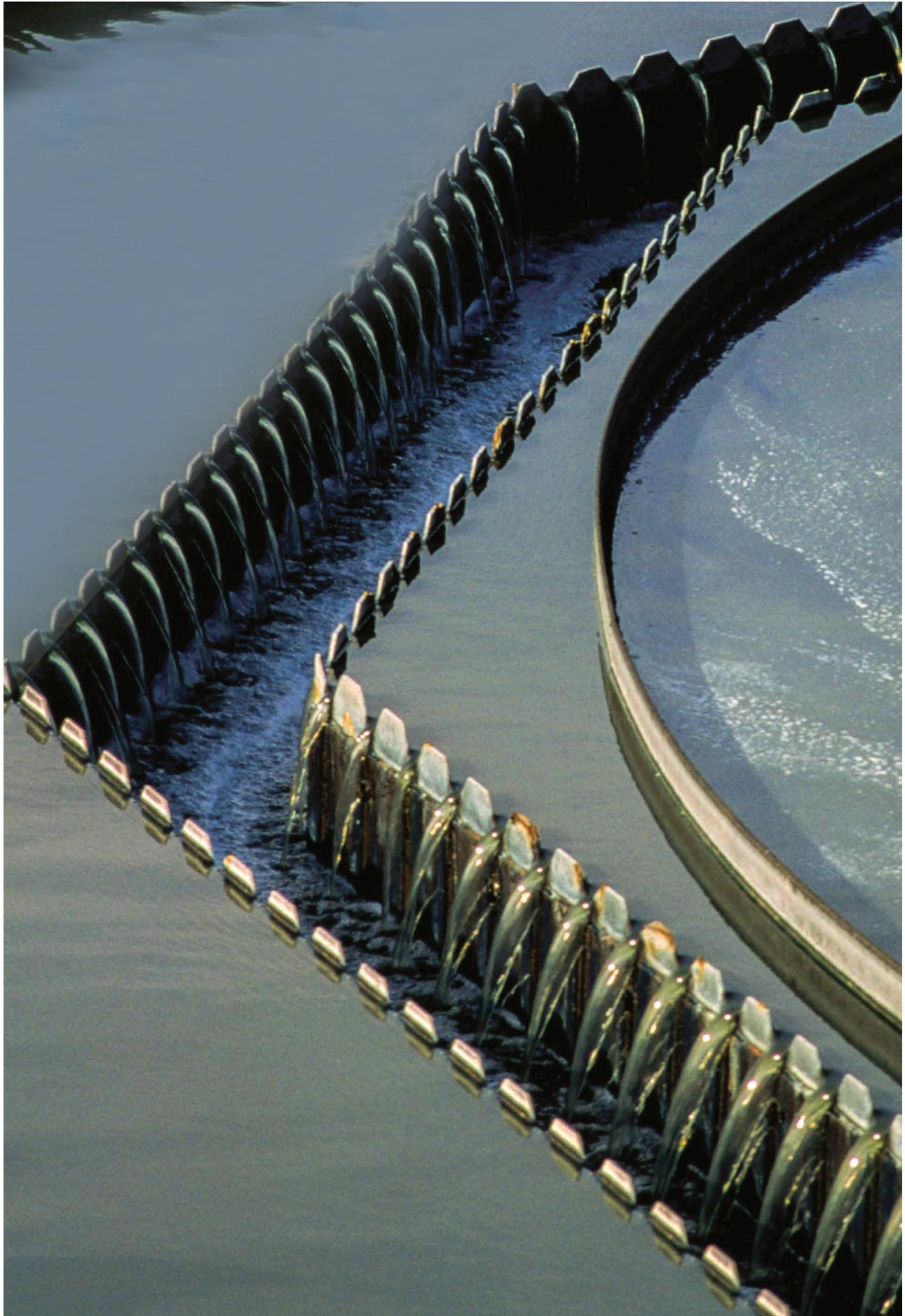
We hope that this white paper serves as a valuable resource for assessing current constraints faced by PPP projects and developing innovative ways of creating a conducive investment climate for private sector involvement in the sewerage sector.



Naina Lal Kidwai
Chairperson
FICCI Water Mission



Anders Berntell
Executive Director
2030 Water Resources Group



Contents

Acknowledgments	3
Foreword	4
Preface	5
Executive Summary	8
Introduction	12
<hr/>	
Chapter 1	15
1. Brief Overview of Urban Sewerage Sector in India	16
<hr/>	
Chapter 2	33
2. Challenges and Imperatives to Scale Up Municipal Wastewater Treatment with Private Sector Participation and Engagement with Communities	34
<hr/>	
Chapter 3	51
3. Conclusions: Potential for Private Sector Participation and Collective Action in Urban Wastewater Sector in India	52
<hr/>	
Annexures	65
<hr/>	

Executive Summary

Introduction:

This study on **Urban Wastewater PPPs**, prepared by **FICCI Water Mission** and the **2030 Water Resources Group (2030 WRG)**, with knowledge partner **Powertec Engineering**, aims to provide the industry perspective on issues affecting PPP projects in the urban wastewater sector and suggests measures to improve the investment climate for these projects and enhance reuse of treated wastewater. This study is the outcome of extensive stakeholder consultation with industry participants through formal interviews, consultative workshops and surveys supplemented by extensive desk research involving review of existing reports on the domestic sewerage sector as well as international and Indian PPP case studies of projects in this sector.

PPP Variants in Sewerage Sector:

- **Build, Operate and Transfer Model (BOT) - End User PPP** – A model in which the end user or consumer itself is the private operator, hence owns and takes responsibility for the project.
- **BOT Third Party PPP (Annuity)** – A model where a third party operator is hired by Concession Granting Authority (CGA) to provide wastewater collection, treatment and discharge/ reuse services to the end users and is paid an annuity by the CGA to cover capital and O&M costs.
- **BOT Third Party PPP (User Charge)** - A structure wherein a third party operator is hired by the CGA to provide wastewater collection, treatment and discharge/ reuse services to the end users and collects user charges in return from end-users itself to recover its capital investments, cover O&M costs and meet its return expectations.
- **Design, Build, Operate Model (DBO)** - In this model, the ULB or parastatal meets the capital costs for the project, and uses the private sector to bring in technology and managerial skills to operate and maintain the assets for a period of 5 to 10 years. The construction, technology and operating risks are borne by the private sector operator while the financing risk is borne by the government counterpart.

Successful Variants: An analysis of all the aforementioned categories of Public-Private Partnerships (PPPs) in India has revealed that the two most successful categories of PPPs were the BOT End-User PPP and the DBO model. The **DBO model** is a success provided some sort of surety on O&M payments is given to the private operators. However the **BOT End-User PPP model** is successful even without any payment guarantees as the private operator is the end user itself. The only guarantee required for the BOT End-User PPP model is that the quantity and quality of raw or secondary treated sewage assured by urban local body in the concession contract is as per the quantity and quality specified by the private operator. The limitation is that the BOT End-User PPP model cannot be replicated extensively. The success of the BOT Third-Party (User Charge) model hinges on tariff reforms based on full cost recovery and conjoint pricing of water and treated wastewater reuse. The annuity model can be a success if the payments are back stopped / made by a more credit worthy and credible counter party than the ULB or State Utility, such as the Government of India.

Principal Risk Factors:

- **Revenue Risk:** Both demand and payment emerges as the biggest challenge to PPPs according to a cross-section of developers and sector experts. The conventional BOT Third-Party PPP model, as mentioned above, is highly susceptible to both demand (off take) and payment risk. Over the years, hybrid PPP models such as the DBO, BOT Third-Party PPP (Annuity) and BOT End-User PPP have emerged to tackle this risk. Except for the BOT End-User PPP model, none of the other models have managed to mitigate both the off take and payment risk satisfactorily. For instance, while the DBO and BOT Third-Party PPP (Annuity) models successfully solve the wastewater demand or off take problem, they are still open to payment risk.
- **Other Risks:** The paper also addresses other risks at the project level such as inadequate scoping and poor quality data, hasty bid process, land availability and permitting, poor quality of municipal sewage, rigid contracts and limited public/end-user consultations.

Revenue Risk Mitigation Strategy: It is recommended that a three-level payment security mechanism be adopted, which involves ring fencing of sewerage revenues at the local government/state utility level followed by funding support from the state government through a separate State Sanitation Fund, back-stopped by a guarantee facility from the Government of India. It is also recommended that the country moves to a regime where sewerage charges at least cover O&M expenses. This approach is in line with international experience with PPPs, where the revenue risk is borne by the concession granting authority (CGA) or the government counter-party which collects the sewerage charges from the end-users but pays contractually agreed amount to the private sector.

Other Risk Mitigants:

- **Data Quality And Project Scoping** can be improved considerably through extensive public consultations and detailed technical surveys and audits to determine the base line values.
- **Bidding Risks:** Further, it is important to recognize that the PPP project preparation and bidding takes time and rushing through this process leads to poor quality bids and unsatisfactory project outcomes. Therefore **adequate time** for data collection, stakeholder consultation and project preparation is **non-negotiable**.
- **Rigid Contracts:** Moreover, contracts should be flexible enough to allow revision in Key Performance Indicators (KPIs) and costs should the initial contours of the project change significantly with the passage of time. It is recommended that KPIs should be progressively tightened as the project progresses instead of stating excessively high threshold values at the time of signing the contract.

Measures at Various Levels to Improve Investment Climate for Sewerage PPP Projects:

- **Central Government Interventions:** The paper identifies measures to be taken at the Government of India level to promote private sector participation in the sector such as setting up a National PPP Fund/Guarantee Mechanism as well as a National River Management and Sewerage Treatment Corporation, which could be assigned the responsibility of constructing, operating and maintaining crucial STPs along river basins such as Ganga.
- **State Government Policies:**
 - ◆ As a first step, state governments should begin by developing an integrated water and wastewater plan along with wastewater collection, treatment and reuse policy along the lines suggested by the National Urban Sanitation Policy (NUSP).
 - ◆ Government of India guidelines should be adopted with regard to service level benchmarks particularly for wastewater recycling. Tariffs should be used not only for recovering costs, particularly O&M cost, but also to discourage raw and treated freshwater use by industry.
 - ◆ To promote reuse by industries, units requiring bulk water and located close to urban areas should be mandated to use treated wastewater for process use instead of freshwater.
 - ◆ Groundwater use in construction, public parks etc. should be banned and the ban should be strictly enforced. Also, groundwater consumption by industry should be limited and the limitations strictly enforced.
 - ◆ To promote reuse of treated municipal wastewater by domestic (non-potable), commercial and institutional users, building codes and plans for new townships and cities should make it compulsory to install dual pipe lines.
 - ◆ In order to minimize environmental risks, it is recommended that a certain percentage of treated wastewater be discharged into surface water bodies to maintain minimum environmental flow and for recharging the groundwater table.
 - ◆ Further to minimize conflict with peri-urban farmers, guidelines would need to be issued earmarking a portion of treated wastewater for agricultural use.
 - ◆ Moreover, state governments should set up a State Level Sanitation Fund to back-stop O&M and annuity payments to the private sector for PPP contracts in the sewerage sector.
- **Local Government / State Utility Measures:** The paper also proposes **ring fencing of water and sewerage service revenues** and costs, **tariff reforms** and **capacity building** at the local government/state utility level to create the enabling framework for sustainable investments in the sewerage sector. Thus, the paper proposes risk mitigation strategies at the project level supported by measures at the local, state and central government level to create a conducive environment for PPP projects in the country.

Way Forward:

It is suggested that the **BOT End-User PPP model** should be used wherever there is a large industrial unit with water-intensive operations which is constrained by lack of freshwater supplies. This model works in cases where there is inadequate freshwater availability, excessively high cost of procurement, regulatory restrictions on abstraction of groundwater for use by industry, and where the end-user is in the immediate vicinity of a large urban centre for sourcing raw or secondary treated sewage.

In cases where large end users with the above mentioned constraints are not available, it would be **prudent to adopt hybrids of the DBO structure**, with the proviso that the EPC portion is largely funded by Central Government schemes and/or multilateral and bilateral agencies, and O&M payments can be met by (a) a financially sound counter-party, (b) can be guaranteed by higher levels of government, or (c) met through an earmarked fund, till such time that the operating environment reduces the extent of revenue risk to allow extensive use of the BOT Third-Party PPP User Charge model.

In the case of Namami Gange projects, the Government of India may also consider using the hybrid annuity models, where between 30 - 40% of the capital investment may be paid by the Government through milestones linked to construction progress and the balance may be paid through annuities over the remaining life of the concession which may extend up to 20 years. This will ensure private sector has "skin in the game" and commitment over the life of the concession.

Introduction

In view of the severe infrastructure gaps in the sewerage sector with its concomitant health and environmental impacts, **FICCI Water Mission** and the **2030 Water Resources Group (2030 WRG)** have come together to prepare a white paper on the topic of Public-Private Partnerships (PPP) in the wastewater sector with the objective of assessing current constraints faced by these projects and coming up with suggestions on how to create a conducive investment climate for private sector involvement in the sewerage sector.

This white paper, supported by **Powertec Engineering**, outlines the policy framework needed to develop a more circular and economically viable wastewater management model along with a supportive institutional structure and regulatory environment which encourages private sector participation and financing in the sector. These elements are crucial to improve the efficacy of sewerage services through superior delivery mechanisms and innovative/optimal technologies brought in by the private sector. Thus, it is imperative for governments, both at the national and state levels, to focus on improvement in the quality of sewerage services in the country through Public-Private (Community) Partnerships (PP(C)P) rather than look at private sector participation as a means to bridge the investment gap. This white paper is meant for an informed audience comprising policy makers at the state and national level engaged in developing policies for wastewater treatment and reuse and encapsulates private sector's perspective on wastewater reuse potential, challenges faced by PPPs and interventions required for promoting PPPs in this sector.

Chapter 1 of the white paper analyses the current status of sewerage services in the country, the magnitude of the investment gap, available funding sources, the fragmented institutional framework, the prevailing regulations governing the sector and the technology choices made so far and their implications for sector performance. The paper thus presents the nascent PPP market in the context of these aforementioned constraints as well as the low level of community involvement in the decision making process and limited experience with generating income through sale of wastewater to industries.

The **Chapter 2** analyzes in detail the prime factors that make private sector participation in municipal wastewater and recycling project a success or a failure. For this purpose, we have analyzed twenty PPP projects in the municipal wastewater and recycling sector in India as well as eight international projects in this sector. The cases have been analyzed keeping certain parameters in mind such as implementation/contract structure; scope of work; funding pattern; revenue model; processes followed in project development and operator selection and community participation/stakeholder consultations. The prime factors responsible for success or failure of such projects have also been assessed in detail. Finally, the manner in which the risks have been allocated amongst public and private stakeholders as well as the mitigation measures employed by the stakeholders have been studied with a view to understand whether or not risks have been properly allocated to the parties best able to handle them and also to determine the appropriateness of the risk-reward balance and its bearing on project success. The chapter concludes with summary of challenges and lessons gleaned from review of PPP cases as well as expert and stakeholder consultations.

Based on the key issues and risk factors impacting PPP projects identified in Chapter 2, **Chapter 3** makes a series of recommendations to facilitate a more congenial climate for PP(C)P projects in the wastewater sector. A review of the PPP variants used in the country indicates that the most successful PPP model in India has been the **Build-Operate-Transfer (BOT) End User PPP model**, where the consumer owns and takes responsibility for the project followed by the **Design-Build-Operate (DBO)** model, which is more like a EPC contract for the construction phase followed by a management contract for operations and maintenance (O&M) post implementation of the project. Here, all payments are made by the Urban Local Body (ULB) or the state utility/parastatal awarding the contract. The more conventional BOT or Design-Build-Finance-Operate-Transfer (DBFOT) concession models, where the private sector funds the project and recovers its initial investment as well O&M charges during the concession period through annuity payments viz. BOT Third-Party PPP (Annuity) model or user charges viz., BOT Third-Party PPP (User Charge) model have been the least successful PPP structure.

Thus, it is suggested that:

- The **BOT End-User PPP model should be used** wherever there is a large industrial unit with **water-intensive operations** which is constrained by lack of freshwater supplies because of lack of availability, excessively high cost of procurement, regulatory restrictions on abstraction of groundwater for use by industry; and is in the immediate vicinity of a large urban centre from where it can source raw or secondary treated sewage.
- In cases where large end users with the above mentioned constraints are not available, it would be prudent to adopt hybrids like the **DBO and the BOT Third-Party PPP (Annuity)** structures till such time that the operating environment reduces the extent of revenue risk to allow extensive use of the BOT Third-Party PPP User Charge model.
- In the interim, the DBO model should be adopted with the proviso that the EPC portion is largely funded by Central Government schemes and/or multilateral and bilateral agencies and O&M payments can be met by a financially sound counter-party or can be guaranteed by higher levels of government or met through an earmarked fund.
- The BOT Third-Party PPP (Annuity) model too should be encouraged as an interim measure provided that the annuity payment can be assured by a financially sound counter-party or can be guaranteed by higher levels of government or met through an earmarked fund.

The key project level risks and their mitigation measures are discussed in detail in the **last chapter**. Revenue, both demand and payment, emerges as the biggest challenge to PPPs according to a cross-section of developers and sector experts. Thus, the paper recommends a three level payment security mechanism which involves ring fencing of sewerage revenues at the local government/state utility level, followed by funding support from the state government through a separate State Sanitation Fund back-stopped by a guarantee facility from the Government of India. The paper also suggests that the country

needs to move to a regime where sewerage charges at least cover O&M expenses. This approach is in line with international experience with PPPs where the revenue risk is borne by the **Concession Granting Authority (CGA)** or the government counter-party which collects the sewerage charges from the end-users but pays contractually agreed amount to the private sector.

The paper also addresses other risks at the project level such as scoping and poor quality data, bid process, land availability and permitting, quality of municipal sewage, rigid contracts and limited public/end-user consultations. The paper identifies measures to be taken at the Government of India level to promote private sector participation in the sector, such as setting up a National PPP Fund/Guarantee Mechanism as well as a National River Management and Sewerage Treatment Corporation which could be assigned the responsibility of constructing, operating and maintaining crucial STPs along river basins such as Ganga. The paper also suggests that state governments should develop their own Wastewater Collection, Treatment and Reuse Policy along the lines suggested by the National Urban Sanitation Policy (NUSP). Further, state governments should set up a State Level Sanitation Fund to back-stop O&M and annuity payments to the private sector for PPP contracts in the sewerage sector. The paper also proposes ring fencing of water and sewerage service revenues and costs, tariff reforms and capacity building at the local government/state utility level to create the enabling framework for sustainable investments in the sewerage sector. Thus, the paper proposes risk mitigation strategies at the project level supported by measures at the local, state and central government level to create a conducive environment for PP(C)P projects in the country.

Chapter I

Brief Overview of Urban Sewerage Sector in India

Brief Overview of Urban Sewerage Sector in India

Background

The following sections provide the backdrop against which sewerage sector PPPs are awarded in the country. This section deals with an analysis of current status of the sector and future investment requirements. It also covers the regulatory framework for the sector as well as the fragmented institutional roles and responsibilities which are affecting current sector performance. It also provides a brief overview of the experience with community participation in the sector and an introduction to PPPs in the sector in India.

1.1 Current Situation, Trends and Needs Assessment (Future Projections)

The challenges facing the urban sewerage sector are acute. According to statistics provided in the High Powered Expert Committee Report, March, 2011 (HPEC), 4861 out of the 5161 cities/towns in India do not even have a semblance of a sewerage network. Even in large metropolitan cities like Hyderabad and Bangalore, nearly 50% of the households do not have sewerage connections and have to depend on other means for sewerage disposal. Given the poor state of sewerage infrastructure across urban areas in the country, it is estimated that nearly 50 million people in urban area defecate in the open every day. This erstwhile neglect of sewerage and sanitation infrastructure requirements in urban areas has led to large scale environmental degradation and high prevalence of water-borne diseases in the country.

In the context of this white paper, the focus is on sewerage services to be provided for the management of domestic effluents, wastewater from commercial establishments and institutions etc which flow into the sewerage network and sometimes directly into storm water drains. With increased policy focus on cleaning up of rivers including the Ganga and addressing the health challenges arising from poor sewerage services, many studies have been carried out to assess the extent of the problem and possible solutions for the same. For instance, in the Ganges Basin alone, there are 223 towns and cities that generate 8250 million litres of sewage each day, of which about 2500 million litres is disposed directly into the Ganges without treatment and 4250 million litres into its tributaries^[1]. Irrespective of the numbers quoted in various studies, it is beyond doubt that most cities/towns in India do not have basic sewerage infrastructure and those cities with partial sewerage and infrastructure are operating at low efficiency levels. This has led to a situation where most of the wastewater is flowing into water bodies with hardly any treatment leading to severe environmental degradation.

While there has been significant attention given to provision of toilets to all citizens, the major gap lies in creation of networks to carry wastewater to sewerage treatment plants from where treated wastewater may be reused wherever feasible or discharged after adequate treatment. According to various studies carried out by the Ministry of Urban Development (MoUD), while 82% of all of the urban households have access to toilet facilities, only about 21% of the wastewater generated is treated and disposed in a safe manner. According to the High Powered Expert Committee (HPEC) report (March 2011) on Indian urban infrastructure services the adequacy of treatment infrastructure varied between 47%, in Class IA^[2] cities to 10%, in Class III^[3] cities. Another study carried out by the MoUD of 423 cities in 2010 showed that almost

1 Report on Indian Urban Infrastructure and Services by The High Powered Expert Committee (HPEC), March 2011.
2 Class 1A cities with population size of more than 5 million
3 Class III cities with population size of less than 0.5 million

all the cities performed very poorly with respect to sewerage services, of which 190 cities were assessed to be in a state of emergency vis-a-vis environment and public health benchmarks. Chandigarh, Mysore, Surat and New Delhi Municipal Council were the only four Urban Local Bodies (ULBs) assessed to have reasonably satisfactory level of sewerage and sanitation services.

Table 1.1: Sewerage Services Backlog in India

City Size Class	Network (%)	Treatment (%)
Class IA	53	53
Class IB	44	53
Class IC	64	77
Class II	84	88
Class III	90	96
Class IV	100	100

Source: Report on Indian Urban Infrastructure and Services by The High Powered Expert Committee (HPEC), March 2011.

The service backlog in sewerage networks and STPs as assessed by HPEC gives a perspective of the coverage level gaps and is the main reason for unsafe disposal of sewage. The service backlog in sewerage network and STPs are as presented in the table 1.1 above.

Table 1.2: Projected Capital Expenditure during 12th Plan by HPEC (Amount in Rs. Crore)

Sector	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Water Supply	5,241	5,881	6,593	7,390	8,285	33,390
Sewerage	3,931	4,411	4,945	5,543	6,213	25,042
Total	9,172	10,292	11,538	12,933	14,498	58,432

Source: Report on Indian Urban Infrastructure and Services by The High Powered Expert Committee (HPEC), March 2011.

Table 1.3: Projected Recurring Expenditure during 12th Plan by HPEC (Amount in Rs. Crore)

Sector	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Water Supply	13,392	14,085	14,861	15,732	16,708	74,778
Sewerage	4,299	4,675	5,097	5,569	6,098	25,738
Total	17,691	18,760	19,958	21,301	22,806	1,00,516

Source: Report on Indian Urban Infrastructure and Services by The High Powered Expert Committee (HPEC), March 2011.

The HPEC report on Indian urban infrastructure and services estimated the investment requirement in the sewerage sector over the 12th plan period to be Rs. 25,042 crores at 2009-10 levels. It also estimated the recurring O&M expenditure in the sewerage sector for the 12th plan period to be Rs. 25,738 crores. Thus, the assessment of the huge infrastructure backlog in the sewerage sector by the HPEC and projected

investment requirement show the extent of the under- investment in the sewerage sector in the past. These problems are compounded by low social awareness of the health risks amongst the general public, and the low level of administrative, technical and implementation skills amongst personnel in ULBs and state level agencies responsible for the delivery of sewerage services.

The poor performance of existing service providers in the sector due to a combination of lack of funds, lack of technically skilled manpower as well as the huge investment requirements foreseen in this sector has led to the exploration of Public-Private Partnership (PPP)⁴ models in the sector as a panacea for the host of problems identified above. This white paper attempts to assess the challenges facing PPPs in this sector as well as suggest measures to address the issues identified therein.

1.2 Existing Policy, Institutional, Regulatory and Financial Arrangements

1.2.1 National Urban Sanitation Policy, 2014

The main policy governing the urban sanitation and sewerage sector is the National Urban Sanitation Policy (NUSP) of 2014 which enunciates its vision as “All Indian cities and towns become totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women.”

The key goals spelt out under the NUSP include:

- **Awareness Generation and Behaviour Change**
- **Open Defecation Free Cities**
- **Integrated City-Wide Sanitation**
 - a. Re-Orienting Institutions and Mainstreaming Sanitation
 - b. Sanitary and Safe Disposal
 - c. Proper Operation & Maintenance of all Sanitary Installations

Another important feature of the policy is the emphasis on the reuse of wastewater as an important factor for conserving water and meeting environmental norms. It recommends that at least 20% of the generated wastewater must be reused. This encourages the possibility of earning revenues through sale of treated wastewater. It also acknowledges the role PPPs could play in this sector in terms of investments, cost recovery through wastewater reuse mechanisms and improving the management of sewerage treatment facilities and networks.

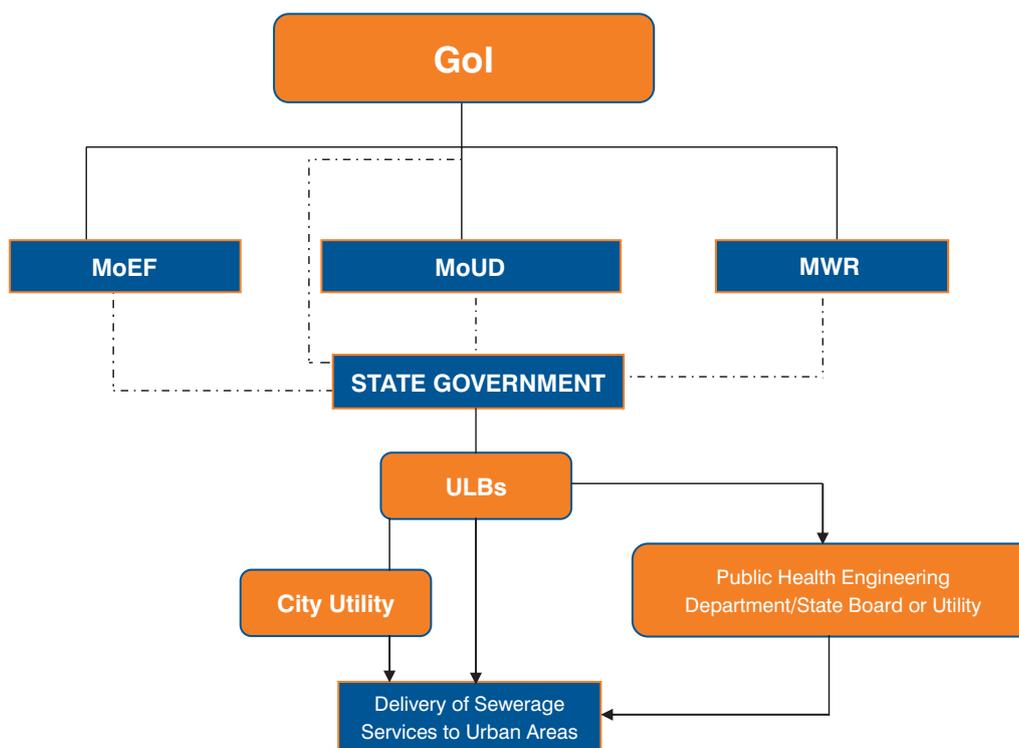
4 Department of Economic Affairs, Government of India has defined Public Private Partnership as an arrangement between a government / statutory entity / government owned entity on one side and a private sector entity on the other, for the provision of public assets and/or public services, through investments being made and/or management being undertaken by the private sector entity, for a specified period of time, where there is well defined allocation of risk between the private sector and the public entity and the private entity receives performance linked payments that conform (or are benchmarked) to specified and pre-determined performance standards, measurable by the public entity or its representative. (Source: Developing Toolkits for Improving Public Private Partnership Decision Making Process, Department of Economic Affairs, User Guide, December, 2010)

1.2.2 Institutional Arrangements and Regulatory Framework for Delivery of Sewerage Services

Institutional Arrangements at the National Level

As sanitation is a state subject, the Government of India (GoI) is mainly involved in delineating policies, providing funding for various programmes of national importance such as the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) and formulation of national service level benchmarks (SLBs). The key ministries in the GoI are the MoUD, the Ministry of Environment and Forests (MoEF) and the Ministry of Water Resources (MoWR). MoWR formulated the National Water Policy 2012. MoUD is involved in policy formulation such as the NUSP and funding programmes such as the JnNURM and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT). These programmes have provided grants linked to implementation of specific reforms for the sewerage sector such as introduction of new user charge structures in sewerage and use of wastewater recycling to optimize usage of water. The Central Public Health and Environmental Engineering Organization (CPHEEO) under MoUD formulates technical standards for the sewerage sector and also approves Detailed Project Report (DPR) for projects in the sewerage sector which are provided funding under various MoUD schemes. It is the Nodal agency which prepares guidelines for use of various technologies in the sewerage sector, and is therefore an important quasi-regulatory body for introducing new technologies in this sector. CPHEEO is also closely involved in setting SLBs for the sector such as coverage of toilets, coverage of sewerage network, collection efficiency of sewerage network, extent of reuse and recycling, extent of cost recovery and adequacy of sewerage treatment capacity. CPHEEO also sets standards for disposing sewage into inland surface water, public sewers and irrigation.

Diagram 1.1 Institutional Structure for the Sewerage Sector



The MoEF acts as the regulatory and monitoring body for environmental related outcomes and impacts of the sewerage projects. Under MoEF, the Central Pollution Control Board (CPCB) is the national regulatory authority constituted under the Water (Prevention and Control of Pollution) Act of 1974 defines performance standards for the sewerage sector in terms of quality of treated wastewater. The National River Conservation Directorate (NRCD) provides funding for many sewerage projects as part of its efforts to clean up river bodies. The MWR is responsible for policy decisions and regulation of the country's water resources. It has formulated the National Policy, 2012 which highlights the importance of reuse of wastewater.

Institutional Arrangement at the State Level

Under the Indian constitution, sanitation is a state subject and the key to ensuring success of any sewerage service investment, in terms of public health and environmental outcomes, hinges on strong ULBs which are backed by their respective state government in terms of policy and fiscal support. Also, under the 74th Constitutional Amendment, the responsibility for providing urban civic services such as sewerage services should be devolved to the ULBs. Many states have variants of this hierarchy with the presence of para-statal such as Water Supply and Sewerage Boards as well as Public Health Engineering Departments (PHED) whose responsibilities vary from just construction of water supply and sewerage assets to complete provision of water supply and sewerage services. The NUSP recognizes that whether or not the ULBs have partial or incomplete control over sewerage services, states need to devise policies to devolve powers, responsibilities and funding to ULBs for this service. ULBs also need to be empowered whereby they can enter into contractual relationships with agencies, both public and private providing sewerage services within their geographical jurisdiction. Under the current scheme of things, most para-statal and PHEDs are not accountable to the ULBs for the quality of water and sewerage services provided by them. The key constraint with the ULBs is the lack of capacity to operate and manage sewerage treatment plants and networks both in terms of adequate technical manpower as well as availability of financial resources. Typically in a state, the environmental outcomes of sewerage service investments are monitored by the State Pollution Control Board, the public health outcomes by the state health department and service standards are defined and monitored by the Urban Development Department. This fragmentation of roles and responsibilities and multiplicity of agencies and departments at the state level who are involved in this sector affects the efficient and effective delivery of sewerage services. Some of the models for managing sewerage services in various states are depicted below:

1) Sewerage Functions Carried Out by State Government Department

In this model, the Public Health Engineering Department (PHED) performs all functions relating to the sewerage sector such as planning for new investments, construction and operations and maintenance of the sewerage assets. In this model, the ULB rarely has any say in planning or asset creation in the sewerage sector. Public Private Partnership (PPP) contracts, if any in this sector need to be then contracted out by the state government itself through the PHED.

2) Sewerage Functions Provided by Parastatals/State Level Utilities

Many states have created separate state level agencies (Parastatals/State Level Utilities) for water supply and sewerage services such as the State Water Supply and Sewerage/Drainage Boards. Some states have split these boards into separate ones for urban sector the rural sector. The reporting relationships of these boards may vest with separate departments other than the state urban development/municipal administration department which looks after the ULBs in the state. In this case too, ULBs have very little say in the performance of sewerage functions.

3) Sewerage Functions Split Between State/Parastatal and ULBs

In this model, the PHED or the water supply and sewerage board would be responsible for planning and construction of sewerage assets but these assets would be transferred to the ULBs for operations and maintenance post construction. In this model too, ULBs have little say in planning and asset creation and could end up holding assets for which they neither have the financial resources or technical capabilities to perform O&M functions satisfactorily. This partially explains why many sewerage treatment plants do not function properly after commissioning.

4) All Sewerage Functions with ULB or City Level Utility

In some states like Gujarat and Maharashtra, the sewerage functions vests completely with the ULBs in accordance with the governing Municipal Act (The Bombay Provincial Municipal Corporation Act, 1949). There are city level water supply and sewerage boards (eg; Chennai Metropolitan Water Supply and Sewerage Board) in some states performing the entire gamut of sewerage functions. In this model some states have provided representation to the ULBs on the board of the city level utility which has ensured that ULBs have a say in the sewerage services being provided within the municipal limits. These arrangements are also in line with the 74th Constitutional Amendment which envisages ULBs being responsible for the provision of urban civic services such as sewerage.

1.2.3 Regulatory Framework Governing the Sewerage Sector

There are several legislations at both the National and State Levels which govern the performance of the sewerage sector. As sanitation services including sewerage are a state subject, the National legislation relating to the performance of this sector are primarily related to environment protection and larger public health interests.

At the National Level

The **Water (Prevention and Control of Pollution) Act, 1974**, and the subsequent **Water (Prevention and Control of Pollution) Cess Act, 1977**, were enacted to prevent water pollution due to discharge of untreated/inadequately treated domestic sewage in urban areas and untreated industrial effluents. The Central and State Pollution Control Boards, set up under these Acts, have been given the authority to regulate pollution of water bodies by establishing standards for acceptable qualities of treated municipal sewage which can be discharged into water bodies and monitoring and controlling

pollution levels through various interventions. The main function of the Central Pollution Control Board (CPCB) is to promote cleanliness of water bodies in the country by performing certain functions in the nature of advice, planning, co-ordination, publications, education and programmes for preventing, controlling and abating water pollution. The State Pollution Control Boards (SPCB) are required to prepare comprehensive plans for the prevention and control of water pollution by laying down standards for effluent treatment of both municipal and industrial wastewaters and quality of discharged water. They also have powers to inspect sewage or trade effluents and their treatment facilities to ensure compliance with state pollution control norms and levy penalties and punishment for non-compliance of the orders given by the SPCB.

Environment Protection Act, 1986 was formulated to cover various areas of environment including water pollution. The water resources in coastal areas and their pollution due to disposal of sewerage received due attention and prevention framework under this act. The Act empowers the Central Government to take all appropriate measures to prevent and control environmental pollution and to establish effective machinery for the purpose of protecting and improving the quality of the environment. The Central Government is empowered to collect the samples of air, water, soil or other substances as evidence of the offences under the Environment (Protection) Act, 1986. The Act prescribes a special procedure for handling hazardous substances. This Act also empowers and authorizes the Central Government to issue directions for the operation or process, prohibition, closure, or regulation of any industry. The Central Government is also authorized to stop, regulate the supply of electricity or water or any other service directly without obtaining the order of the Court in this regard.

At the State Level

Many States have promulgated municipal acts and other acts relating to creation of separate boards/ entities for providing water supply and sewerage services. It is on the basis of these Acts that the institutional structure for provision of sewerage services has evolved. Many of these Acts also specify the basis for levying user charges in the form of sewerage taxes and user charges if any and how and by whom they can be revised. Some states have also enacted separate legislation for PPPs which include the sewerage sector as well. From the perspective of structuring and awarding a PPP project the provisions under all these acts need to be taken into account before structuring the contractual framework for the PPP project.

1.2.4 Financial Arrangements for Sewerage Sector

In the Indian context, most sewerage projects are not financially viable as the current level of user charges does not cover O&M expenses, leave alone capital costs. Therefore commercial financing of these projects through the bank loan market or the bond markets is not really a feasible option. Most sewerage projects in the country have been financed through a mix of grants from higher levels of government and multilateral/bilateral loans which are guaranteed by the GoI. The main sources for financing sewerage projects in the Government sector are depicted below:

Table 1.4: Sources for Financing Sewerage Projects in the Government Sector

Source of Financing	Type of Financing	Schemes	Costs Covered
Government of India (GoI)	Grants	Jawaharlal Nehru National Urban Renewal Mission (JnNURM) and other Schemes of MoUD, National River Conservation Plan (NRCP) under MoEF, Central Devolution under 13 th Finance Commission	Portion of Capital Costs. O&M costs to be met by the ULB or the parastatal providing sewerage services
State Government	Grants and loans	As part of co-financing for GoI schemes such as JnNURM, other state plan schemes, Devolution under State Finance Commission	Capital Costs- Partially or fully
Multilateral/ Bilateral Agencies	Loans for Projects and grants for Capacity Building and Technical Assistance	Under External borrowings by GoI	Capital Costs- Either Partially or fully O&M costs, Few recent project in the Ganga Basin have funding for O&M as well
Urban Local Bodies (ULBs)	Own taxes and user charges including one time connection fees		Capital costs- small portion met through internal accruals or borrowings O&M costs to be met by ULB – this is a problem because only a small portion recovered through sewerage taxes and sewerage charges (full cost recovery of O&M a rare phenomenon)

A few projects in the sewerage sector have been developed under PPP models. As discussed in detail in subsequent sections of the report, most of these projects involve an element of government funding either in the form of Viability Gap Funding (VGF) or grants through schemes such as JnNURM and NRCP or annuity payments from government agencies to cover Capital and O&M costs. Very few PPP projects have managed to recover Capital and O&M costs from charging domestic consumers. Recovery of Capital and O&M costs seem more feasible when there are large industrial off-takers for treated sewerage. The evolution of PPP projects in this sector is discussed in detail in subsequent sections of this paper

1.3 Technology in Wastewater

The technologies in vogue in India range from pond-based systems to Activated Sludge Process (ASP) and its variants to advanced or tertiary treatment technologies such as Membrane Bio-Reactor (MBR), reverse osmosis systems, carbon adsorption etc. As far as secondary treatment technologies are concerned pond-based systems are generally used for smaller capacities of 20 mld or less, while for larger capacity treatment plants the preference is for ASP or its variants and equivalent systems such as Upflow Anaerobic Sludge Blanket (UASB), Fluidized Aerated Bed (FAB), Moving Bed Bio-Reactor (MBBR) and Sequential Bed Reactor (SBR). For very large plants of capacity greater than 50 mld, the preference today is to use either SBR or ASP with methane power generation facility. Details regarding costs associated with different technologies are given in Annex 3.

The main issues associated with technology in urban wastewater treatment in India revolve around: (i) contract conditions which prevent entry of newer technologies because of the need to satisfy conditions requiring the technology to have been successfully tested elsewhere in India; (ii) the bid conditions are quite often not technology neutral particularly where there is no involvement of multilateral/bilateral agencies; (iii) focus on selection based solely on lowest capital cost (L1) rather than on the quality of output performance parameters and lifecycle cost. It is felt by a cross section of industry players is that since most of the projects are awarded by government bodies there is a fear of introducing new technologies because of the risk involved as well as a lack of knowledge about the latest technologies combined with an inability to think of out-of-the-box solutions.

The consequences of the aforementioned bid conditions is that: not only do old technologies get perpetuated but also quite often proprietary technologies gain advantage in the bidding process resulting in higher costs and inefficiencies in operations. Secondly, the emphasis on least capital cost technology often results in inappropriate technological solutions being selected. Therefore the emphasis in government bids should be to be technology neutral and encourage evaluation based on lifecycle cost and quality of output parameters achieved by a particular technology given the influent conditions. Thus, it will become easier to resolve questions such as whether to use ASP or ASP with methane power generation or SBR technology given influent conditions for say a 100 mld treatment capacity plant? Please refer to Annex 3: Technology & Costs for details regarding costs of different commonly used technologies in India.

1.4 Approaches Taken in India to Engage the Community in Wastewater Sector

Over the past few decades, water resources in India have been affected in terms of deteriorating quality in terms of pollution levels, reducing availability leading to difficulty in catering to demand from all users and social inequity in terms of the costs that poor people have to bear to access safe drinking water. Most interventions in the water and wastewater sector in the country are characterized by a top-down approach in which end user communities rarely have a say in the type of service they want and what they are willing to pay for the same. As discussed earlier in the section on institutional framework governing the wastewater sector, the highly fragmented nature of the institutional structures has led to very low levels of co-ordination amongst various agencies and very little citizen involvement in the planning and design of sewerage services. While most projects are theoretically supposed to be finalized in consultation with the public, the actual level of public involvement in project planning is quite low leading to situations where investments in the sewerage treatment plant and networks have been made without ensuring that households are willing to get connected to the network. This often leads to situation where the quantity of sewage supplied to the STP is much lower than estimated leading to operating inefficiencies at the plant. This is a major factor for problem faced by some of the PPP projects in the country.

One of the few instances where community participation in the project preparation stage is the Alandur sewerage project where the Mayor along with other municipal officials conducted a public campaign to promote the project and seek citizen feedback. The one time connection charges were fixed in consultation with the public which ensured that part of the capital costs for the network were met by the citizens and also encouraged them to connect to the network once it was operational. The level of O&M charges for the service was also finalized through willingness to pay surveys as well as consultation meetings with the public.

1.5 Status of Private Sector Participation in Municipal Water Treatment

Impetus for Private Sector Participation

The Ministry of Urban Development conducted rating of class I cities on sanitation and sewerage performance and found that only four cities had a reasonably satisfactory performance. No city achieved the distinction of being in the highest category. This study reflects the poor condition of publicly maintained sewerage assets where paucity of resources, both financial and human, with the government sector has led to inadequate levels of investments in collection, conveyance, treatment of sewage waste and extremely poor maintenance of the same. Thus, the paucity of finances at all levels of government and the lack of capacity with most ULBs to operate and maintain sewerage assets has led to the policy impetus to encourage private sector participation in the sewerage sector through PPPs.

Definition of PPPs

“PPP means an arrangement between a government or statutory entity or government owned entity on one side and a private sector entity on the other, for the provision of public assets and/ or related services for public benefit, through investments being made by and/or management undertaken by the private sector entity for a specified time period, where there is a substantial risk sharing with the private sector and the private sector receives performance linked payments that conform (or are benchmarked) to specified, pre-determined and measurable performance standards.”^[5]

Evolution of PPPs in the Sewerage Sector

Alandur in Tamil Nadu was the first ULB to attempt a PPP project in this sector. In the period between 2000-2005, about six projects were attempted on a PPP basis including Alandur, Tirupur and four projects in Chennai. In the period between 2006-2011, the number of PPP projects attempted in the sector increased significantly because of the availability of grant funding from JnNURM and NRCD and the overarching policy thrust on PPPs in the infrastructure sector at the national level which percolated down to the states as well. We have covered around 20 PPP projects in the country which represent a significant portion of PPP projects attempted in the sector. The list of PPP projects in the sewerage sector are represented below:

Table 1.5 : Projects undertaken/planned on DBO/DB/O&M basis

Sr. No	Location	Scope	Type	Year of Planning	Current Status
1	Kodungaiyur, Chennai, Tamil Nadu	STP	DBO	2002	Commissioned in 2006, O&M to end in 2016
2	Perungudi, Chennai, Tamil Nadu	STP	DBO	2002	Commissioned in 2006, O&M to end in 2016
3	Koyambedu, Chennai, Tamil Nadu	STP	DBO	2002	Commissioned in 2005
4	Nesapakkam, Chennai, Tamil Nadu	STP	DB	2002	Commissioned in 2005
5	Allahabad, Uttar Pradesh	STP	DBO	2010	Commissioned in 2013
6	Moradabad, Uttar Pradesh	STP	DBO	2011	Not Known
7	Keshopur, Delhi	STP	DBO	2008	Commissioned in 2011
8	Khundli, Delhi	STP	DBO	2008	Commissioned in 2011

Source: CRISIL INFRASTRUCTURE ADVISORY, CPCB, Delhi Jal Board, UP Jal Nigam, Chennai Metro Water

5 The definition of PPPs according to the Department of Economic Affairs, Ministry of Finance, Government of India

Table 1.6: Projects undertaken/planned on DBFOT/BOT basis

Sr. No	Location	Scope	Type	Year of Planning / Award	Current Status
1	Alandur, Tamil Nadu	STP	BOT- Third Party PPP Annuity	2000	In Operation since 2003. Contract to terminate in 2017
2	Salt Lake, Kolkata, West Bengal	Network and STP	BOT- Third Party PPP User Charge (DBFOT)	2007	Commissioned in 2010 and currently in operation till 2040
3	Rajkot, Gujarat	STP	BOT- Third Party PPP User Charge (DBFOT)	2009	Under construction
4	Vishakhapatnam, Andhra Pradesh	STP	BOT- Third Party PPP User Charge (DBFOT)	2011	Approval from GoAP for Concession Agreement still awaited.
5	Surat, Gujarat	STP	BOT- Third Party PPP User Charge (DBFOT)	2010	Concession Agreement canceled prior to signing in July 2010. Later contract awarded on EPC basis in 2012 & in operation.
6	Kolhapur, Maharashtra	STP	BOT- Third Party PPP Annuity	2010	In operation, commissioned in 2015.
7	Ghatkopkar, Mumbai, Maharashtra	STP	BOT- Third Party PPP User Charge (DBFOT)	2011	Project on indefinite hold.

Source: CRISIL INFRASTRUCTURE ADVISORY, Central Pollution Control Board, Chennai Metro Water, Powertec Research, DEA, Ministry of Finance Infrastructure Database

Table 1.7: Projects undertaken/planned on JV basis

Sr. No	Location	Scope	Type	Year of Award	Current Status
1	Tirupur, Tamil Nadu	Integrated	Joint Venture-BOT- Third Party PPP User Charge	2002	In operation since 2005. However operator in financial trouble since high court order on closure of polluting units.
2	Nagpur, Maharashtra	Integrated	Joint Venture-BOT-End User PPP	2008-JV; 2011-Construction Contract to private contractor	Expected to be commissioned by late 2015.

Source: CRISIL INFRASTRUCTURE ADVISORY, Central Pollution Control Board, Chennai Metro Water, Powertec Research, DEA, Ministry of Finance Infrastructure Database

Table 1.8: Projects undertaken by end-user

Sr. No	Location	Scope	Type	Year	Current Status
1	Chennai	STP, Treated Water Conveyance, Tertiary Treatment Plant	BOT - End User PPP	1992	In operation
2	Mumbai	STP, Treated Water Conveyance, Tertiary Treatment Plant	BOT - End User PPP	2000	In operation
3	New Delhi	STP, Treated Water Conveyance, Tertiary Treatment Plant	BOT - End User PPP	2004	In operation

Source: Powertec Research

PPP Models Followed in this Sector:

Design, Build, Operate Model (DBO): In this model, ULB or parastatal meets the capital costs for the project, and uses the private sector to bring in technology and managerial skills to operate and maintain the assets. In most contracts, an EPC contract is awarded to the selected operator for construction of the sewerage assets linked to milestones and a separate fee is paid for operations and maintenance of the asset. Early contracts in this sector had O&M contracts for a period of 5 years, though some recent contracts have extended the tenure to upto 10 years. In this model, the construction, technology and operating risks are borne by the private sector operator while the financing risk is borne by the government counterpart.

Build, Operate, and Transfer Models (BOT): These models are primarily concessions, where the private sector designs, constructs, finances capital expenditure, operates and maintains the assets and at the end of concession period returns it to the Concession Granting Authority (CGA). In practice there are three variants of the BOT model followed in India:

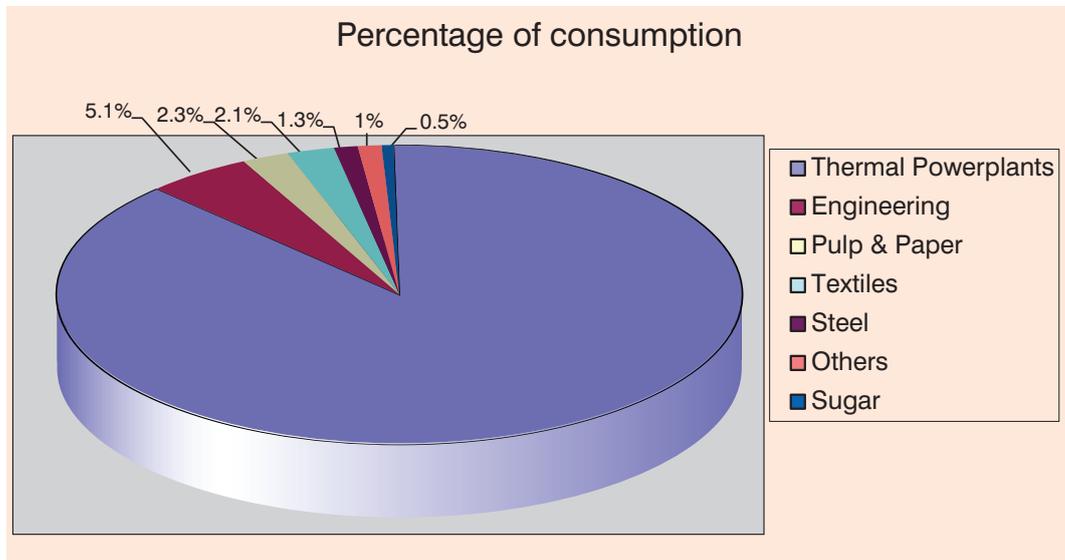
- **BOT End User PPP** – in this case the end user is an industrial firm or power plant which is a bulk consumer of water. The end user or consumer itself is the private operator, hence owns and takes responsibility for the project. The end user purchases either treated or raw sewage from the ULB / Water Utility from its STPs/discharge points through a long term wastewater supply or purchase contract; conveys it to its facility; and treats it to a level required by it for its internal process and other non-potable uses. The end user is responsible for financing all the capital and operating expenditures required for the conveyance infrastructure and additional treatment facilities. In certain cases, the end user undertakes to operate the municipal STPs for the ULB / Water Utility at its own cost as well, in return for free treated sewage supplies from the STPs through a long term agreement. The benefit is the cost savings emanating from a stable source of water of the requisite quality for own use at a cost which is lower than the cost of alternative sources of treated water.
- **BOT Third Party PPP(Annuity)** – in this case, a third party operator is hired by the CGA to provide wastewater collection, treatment and discharge/ reuse services to the end users and is paid an annuity by the CGA to cover capital and O&M costs.
- **BOT Third Party PPP (User Charge)** – in this case, a third party operator is hired by the CGA to provide wastewater collection, treatment and discharge/ reuse services to the end users and collects user charges in return from end-users itself to recover its capital investments, cover O&M costs and meet its return expectations. These Models are also known as Design, Build, Finance, Operate, Transfer (DBFOT).

All these models are discussed in detail in the next chapter.

1.6 Current Practices for Reuse by Industries

According to estimates, industries account for only about 8% of the water consumption in the country and drinking water consumption accounts for just 5%^[6]. The agriculture sector is the major consumer of water and accounts for almost 87% of the total consumption. Despite consuming just 8% of the water used in the country, industries are vulnerable to water scarcity as they are given the last preference in water allocation by the National Water Policy (NWP). Apart from being the key raw material in many industries, water plays a significant role in energy generation through various sources. From an industrial unit's perspective, water is an important input for its own production but also an important resource used by its vendors supplying inputs to the industrial unit. Further, discharge of used water poses a major regulatory risk and therefore wastewater treatment and recycling has assumed importance. The breakup of water consumption across industries is given below:

6 Source: L& T Study for Chemical Engineer World, July, 2011 (<http://www.chemtech-online.com/WAT/online/Ajay/index.html>)



Source: L & T Study for Chemical Engineer World, July, 2011 (<http://www.chemtech-online.com/WAT/online/Ajay/index.html>)

It is evident from the above table that thermal power plants are major consumers of water and policies encouraging thermal power plants to reuse treated municipal wastewater facilitate creation of a market for treated municipal wastewater viz., Pragati Power Corporation Ltd, New Delhi

Examples of Wastewater Reuse:

a) Reuse of Municipal Wastewater

S.No	Project	Description
1	Chennai Petroleum Corporation Limited, Chennai	CPCL has 2.5 (Million Gallons Per Day) MGD (475 KL/hr) reclamation of untreated city sewage plant through tertiary treatment and reverse osmosis. CPCL is executing an additional 2.5 MGD (475 KL/ hr) city sewage reclamation plant as well as a 5.8 MGD sea water desalination plant. CPCL is the first company in India to go for a reverse osmosis rejects recovery plant of 80 KL/hr
2	Madras Fertilizers Limited, Chennai	In 1992, the Madras Fertilizer Ltd. constructed a 16 MLD tertiary treatment and reverse osmosis (TTRO) producing 16 MLD of recycled water. Based on these tertiary treatment plants (TTPs), the Chennai Metro Water and Sewerage Board (CMWSB) supplies 12 MLD of secondary treated sewage (with BOD 120 mg/L even after secondary treatment) and 3 MLD of treated freshwater and the MFL provides the required further treatment depending on its end uses. The TTP infrastructure at Madras Fertilizer Ltd. consists of following: a. MFL constructed their 16 MLD TTRO plant in 1992 at a cost of Rs. 30 crores. b. A 1.6 km Pipeline from STP to TTRO plant. c. 5 km pipeline and pumping machinery from TTRO to Fertiliser Plant.

S.No	Project	Description
3	Rashtriya Chemicals and Fertilizers, Mumbai	<p>The RCF Plant commissioned a 23 MLD capacity sewage reclamation plant involving reverse osmosis to treat complex wastewater comprising municipal sewage heavily contaminated with various industrial wastes. RCF's STP, which is located in the heart of Mumbai, came on line in 2000. RCF constructed a 5 km pipeline to receive raw sewage from Brihan Mumbai Corporation's (BMC) Ghatkopar pumping station. They also buy 11 MLD of freshwater from BMC.</p> <p>The sewage reclamation plant at the RCF consists of following treatment units: Screening → Grit Removal → Activated Sludge System → Clarifier → Sand Filter → Pressure Filter → Cartridge Filters → Reverse Osmosis → Degasser to remove CO₂ → Reuse in Industry.</p>
4	Pragati Power Corporation Limited (PPCL), New Delhi	<p>Gas based Power Plants use over 90% of their water for cooling requiring only slightly higher than secondary or in some cases tertiary and only a fraction of water, 5 percent, is required at the high-end level which requires de-mineralization. The STPs that PPCL was given to operate and use, were two of nine Activated Sludge Process (ASP) plants built along the Yamuna River under JICA funding as a pilot project for the Delhi Jal Board (DJB) in 2002. The STPs used by PPCL treat only 5-10 percent of the sewage that flows through the nallahs and the rest is discharged untreated into the Yamuna.</p> <p>The STP treats water to the secondary level with output parameters of BOD < 10, COD < 25-30 and TSS < 15. After that 19 MLD of STW is pumped to the PPCL power plant where it undergoes lime-softening treatment. The bulk of the water is utilized within the PPCL plant at this level of treatment. Only 1-1.5 percent of lime-softened water is sent for DM so it can be used in boilers. While DM is an expensive process that adds to the cost of production, this step is required even if freshwater were used. Lime-softening and DM take place within the power plant and utilize electricity generated by the plant itself. Moreover, both processes are required regardless of water source.</p>
5	JV between NMC and MAHAGENCO	<p>Sewerage network, treatment and disposal, collection of revenue from reuse wastewater. Strong project ownership by MAHAGENCO and NMC. Feasibility undertaken at the beginning. Contracts ring fencing commercial risks.</p> <p>However contracts had loopholes, allowing for significant change in scope post signing. There was no bidding as the operator approached NMC itself. Thus selection was on a nomination (sole source) basis. MAHAGENCO selected an operator through competitive tendering on least project cost basis. Detailed USAID funded feasibility study undertaken on water reuse opportunities. MoU with NMC akin to a concession and a concession agreement between MAHAGENCO and SMS-GSJ Enviro Ltd spelled out the PPP structure and project components clearly.</p>

Source: 'Review of Wastewater Reuse Projects Worldwide', Consortium of IITs,

IDFC Quarterly research Note No. 12, on 'Sewage wastewater recycling for industrial use', June 2011

Report on PPP in Urban Sewerage Sector in India, March 2013, CRISIL Infrastructure Advisory

Table above reveals that where the end user of the treated wastewater is itself responsible for implementing the PPP project for wastewater reuse (BOT – End user model) such projects have higher degree of success than model where the wastewater is sold by the project SPV to third party users (BOT – Third Party User Charge).

Chapter 2

Challenges and Imperatives to Scale Up Municipal Wastewater Treatment with Private Sector Participation and Engagement with Communities

Challenges and Imperatives to Scale Up Municipal Wastewater Treatment with Private Sector Participation and Engagement with Communities

2.1 Introduction

This Chapter analyses in detail the prime factors that make private sector participation in Municipal wastewater and recycling project a success or a failure. For this purpose, we have analyzed twenty PPP projects in the municipal wastewater and recycling sector in India as well as eight international projects in this sector. The twenty projects assessed in this study represent a significant percentage of the universe of PPP projects in this sector in India. Eight of the twenty PPP projects are of the Design, Build and Operate (DBO) variety. In addition, information has been solicited from experts as well as public and private sector market participants on issues and risks as well as their perspective on PPPs in this sector through in-person interviews and responses to questionnaires.

The cases have been analyzed keeping certain parameters in mind such as implementation/ contract structure; scope of work; funding pattern; revenue model; processes followed in project development and operator selection; community participation/stakeholder consultation. The prime factors responsible for success or failure of such projects have also been assessed in detail. Finally the manner in which the risks have been allocated amongst public and private stakeholders as well as the mitigation measures employed by the stakeholders have been reviewed with a view to understand whether or not risks have been properly allocated to the parties best able to handle them and also to determine the appropriateness of the risk-reward balance and its bearing on project success.

The Chapter presents the result of the aforementioned analysis in the subsequent section.

2.2 Examination and Structured Overview of Domestic PPP Projects in India

2.2.1 Classification of PPPs

There exist two major categories of PPPs, viz., EPC plus O&M undertaken for five to ten years known as design, build and operate contracts (DBO); and concessions, where the private sector designs, constructs, finances capital expenditure, operates and maintains the assets and at the end of the concession period returns it to the Concession Granting Authority (CGA). Concessions are also known as Design, Build, Finance, Operate, Transfer (DBFOT) or Build, Operate, Transfer (BOT) projects. Therefore, in this white paper, the terms DBFOT, BOT and concession will be used interchangeably.

BOT projects can be further sub-divided into those in which the end user is itself the private operator (BOT End-User PPP) and those in which a third party operator is hired by the CGA to provide wastewater collection, treatment and discharge/re-use services to the end user (BOT Third- Party PPP). Another sub-classification of BOT projects is by type of payment method, that is, annuity or user charge (tariff). Finally BOT projects can also be categorized by ownership structure, namely, with part

government/CGA ownership or entirely privately owned. The former BOT projects are called joint ventures (JV). Thus, a BOT project can be classified as Third-Party PPP/ End-User PPP with a payment mechanism that is either in the form of an annuity or user-charge and housed in an SPV which is either a JV with government or entirely privately owned.

2.2.2 Success Factors

An analysis of all the aforementioned categories of PPPs in India has revealed that the two most successful categories of PPPs were the BOT End-User PPP and the DBO model. The DBO Model is a success provided some sort of surety on O&M payments is given to the private operators. However the BOT End-User PPP model is successful even without any payment guarantees as the private operator is the end user itself. The only guarantee required for the BOT End-User PPP model is that the quantity and quality of raw or secondary treated sewage assured by urban local body in the concession contract is as per the quantity and quality specified by the private operator. The BOT Third-Party PPP projects, both annuity as well as user-charge based, are the least successful with a high failure rate. The key success factors for the various PPP categories are given below.

- **DBO** – For DBOs to be successful it is essential to:
 1. scope the project well, provide extensive and up to date technical and financial information to the bidders;
 2. have a clear bid selection parameter; and
 3. provide O&M/Management Fee guarantees to the operator.
 4. Another essential factor is the public sector's source of funding capital expenditures. Financing in the form of grants and term loans by Government of India and multi-lateral and bi-lateral donor agencies assures timely and full payment of capital expenditure dues of the private contractor as per the payment schedule.
- **BOT End-User PPP** – They are successful because there is:
 1. Strong ownership of the project by the end-user as well as the ULB (which earns royalty revenue on recycled sewage and sometimes savings in O&M expenditure on its secondary treatment STPs); and
 2. The project is driven by end-user needs underpinned by economic factors such as cost of procuring water from alternative sources as determined by the end-user itself.

The consequent high level of commitment as well as an intimate understanding of user requirements ensures that the project is designed according to the specifications of the end-user and is able to withstand the delays and increases in cost caused by, among others, land acquisition problems, change in scope due to inadequate project preparation and contract limitations as was the case in Nagpur.

- **BOT Third-Party PPP (Annuity)** – The success factors associated with this category of PPP are:
 1. Presence of detailed studies to assess need, scope the project and collect up to date technical and financial information for bid purposes;
 2. Majority (70% to 90%) of the project cost is funded by grants from Centre and States as well as low-cost, long tenor loans from multi-lateral and bilateral agencies ensuring low fixed capital investment costs for the private operator hence low annuity payment requirements;
 3. Contractual assurances regarding full and timely annuity payments by the ULB and/or the State Government;

4. In case of operator non-performance due to inadequate quantity or poor quality of sewage supplied by the ULB, contractual assurance by ULB and/or State Government to the operator of payment of its annuity without penalty; and
 5. Strong political will or commitment shown by the ULB and the State Government to champion and steer the project through difficulties as well as facilitate permits and land acquisition. The abovementioned parameters are exemplified by the Kohlapur wastewater treatment and disposal project.
- **BOT Third-Party PPP (User Charge)** – The main success factors for this category of PPPs are:
 1. Authenticity of detailed, up to date and reliable data on sewerage system, quantity and quality;
 2. Extensive stakeholder consultations including their end-users to:
 - ◆ determine need, define scope including STP sites and network alignment,
 - ◆ arrive at a mutually acceptable tariff;
 - ◆ generate public support for the project, which in turn reduces socio-political risk considerably;
 3. Enshrine the right of the private operator to:
 - ◆ request from end-users minimum off take or a fixed cost coverage guarantee,
 - ◆ disconnect reuse water supply in case of non-payment of dues and/or request security deposits/financial guarantees equivalent to X months' revenues.
 4. Political will, which is essential to facilitate the permitting and land availability process as well as to ensure government support in steering the project around unforeseen hurdles in implementation and operation.

Exhibit 1: Reuse Wastewater Supply Revenue Security for Less Than Minimum Off take/Non-Payment of Dues by an Industrial Unit

Assumption: One month billing cycle with a 20 to 25 day grace period for payment

Quantum & Tenor: The Industrial Unit (End User) shall deposit an amount as an interest-free security deposit or furnish an irrevocable bank guarantee from a scheduled bank for the said amount to the BOT Third Party Operator. The value of the deposit/bank guarantee shall be **equal to the value of the monthly fixed cost of treated reuse wastewater supply for three/ four months** as increased from time to time at all times during the tenor of the reuse treated wastewater supply agreement. The security deposit or bank guarantee shall be paid/submitted at the time of execution of reuse treated wastewater supply agreement.

Or

The Industrial Unit shall deposit with the BOT Third Party Operator an amount **equivalent to one/two months' revenues** as increased from time to time, at all times during the tenor of the reuse treated wastewater supply agreement, from the supply of treated reuse wastewater in the form of an interest-free security deposit or an irrevocable bank guarantee from a scheduled bank. The security deposit or bank guarantee shall be paid/submitted at the time of execution of reuse treated wastewater supply agreement.

Enhancement of Quantum: Due to the annual revisions in the value of the fixed cost of treated reuse wastewater supply or the sale price of treated reuse wastewater supply, the Industrial Unit shall pay to the BOT Third Party Operator any additional required amount as a security deposit/bank guarantee computed as equivalent to three/four months' monthly fixed cost of treated reuse wastewater supply or one/two months' revenues and such amount shall be included in the invoice amount for the month of April every year.

Renewal-Natural Expiry: The security deposit shall be replenished within a period of one month immediately before it expires. The replenishment amount shall be the prevailing value of the monthly fixed cost of treated reuse wastewater supply for three months or one month's revenues. In the event that a bank guarantee is furnished the same shall be renewed/replaced one month prior to the expiry of the same.

Renewal-Post Encashment: In the event that the security deposit/bank guarantee has been drawn down or encashed the same shall be replenished within a period of seven days.

Termination of Agreement: The amount deposited as an interest free security deposit/bank guarantee will be refunded without any interest subject to deductions, if any on the expiry of the reuse treated wastewater supply agreement or its premature termination.

2.3 Challenges to Success

- **Project Scoping, Data Quality & Bid Process:** Projects often get designed poorly and end up with high capital and O&M costs because the data on sewage assets, sewage quantity and sewage quality is sketchy and outdated, the DPRs are prepared hastily hence do not pay enough attention to the requirements of the project on hand. For instance, the high prevalence of shock pollution loads is not incorporated in design specifications given in the DPR. This has been experienced in a number of projects such as Nagpur (MAHAGENCO), Vishakapatnam, Kolkata (Salt Lake City), Varanasi etc. Further, the private sector firms bidding for such projects should be given adequate time to prepare bids as they have to, inter alia, carry out site visits to understand scope and ground realities, conduct feasibility studies to assess project viability. Information paucity and rushed bidding are a greater problem for long term concession contracts than shorter term DBOs. Further the bid parameter is least cost rather than lifecycle cost.
- **Quality of Municipal Sewage:** In a number of cities municipal wastewater gets mixed up with industrial effluents, which foul up the sewage treatment works, resulting in avoidable repairs and maintenance of plant and machinery as well as downtime. This creates unforeseen increases in operating cost and results in penalties for the operator for not meeting treated effluent quality and availability standards spelt out in the contract.
- **Quantity of Municipal Sewage:** In a number of cities, the municipal sewerage network is either underdeveloped or non-existent, while the city corporations embark on an ambitious plan to establish STPs. The STP design capacities are based on assumptions about the future network capacity which often does not materialise on time. This results in lower than expected raw sewage flows hence underutilization of installed capacity for the period of delay. Lately, cities have tried to solve this problem by building interceptors to trap sewage flow in open drains and natural water channels and divert them to the STPs. This is an expensive solution and adds to the cost of the project.

- **Limited Revenue Potential from Recycled Water:** Despite significant potential for reuse of treated wastewater, BOT Third-Party PPPs (User Charge) depending on volumetric tariff based revenues from end-users purchasing treated wastewater are extremely few because: (i) there is no policy encouraging reuse at the state or ULB level nor is there a water and wastewater management plan at the ULB level, which has reuse as one of its main components. Hence, BOT Third-Party PPPs (User Charge) get limited to a few cities which have large water intensive industries in the vicinity and there is limited availability of cheap water from alternate sources.
- **Limited Revenue Generation from Sale of Sludge:** in case of pond based technologies sludge is removed once every five to ten years particularly with aeration as sludge production is low. In case of ASP, ASP variants and SBR sludge is generated continually and has to be removed daily. However there are not many takers for dried sludge to be used as manure, particularly at rates demanded by ULBs.
- **Non-Existent User Charge Regime:** Most cities in India do not have any history of levying user charges for sewerage collection, treatment and discharge whether as a percentage of water tariff revenues or as a specific volumetric rate (Rs/KL), this makes it all the more difficult for private operators to levy and collect wastewater user charges without triggering social and political opposition to the BOT Third-Party PPP (User Charge) projects. Some cities in Gujarat and Maharashtra collect sewerage taxes as a portion of property tax. Moreover, user charges acceptable to the end-users are quite often barely enough to cover O&M costs leaving capital costs uncovered necessitating grants including viability gap funding to make the BOT Third-Party PPPs (User Charge) financially viable. Please refer to Annex 6 for the MoUD's recommended sewerage tariffs, where they have advised that the best sewerage tariff model should be to levy charges (cess or surcharge) expressed as a percentage of water tariffs. The ideal range has been defined as 50% to 75% of water charges.
- **High Revenue/Payment Risk:** All PPP categories ranging from DBOs to BOT Third-Party PPPs except BOT End-User PPPs carry significant payment or revenue risks.

 - ◆ **DBOs:** Non-payment or delayed payment of O&M fees including power bills by the counterpart ULB or state government agency is a big risk factor for the private operator in such contracts. Further, in those DBO projects where there is no financing by international donor agencies or the Central government, sometimes there is significant delay in payment even for the EPC component of the DBO contract. A typical example of this risk is the STP at Indirapuram / Ghaziabad.
 - ◆ **BOT End-User PPP:** There is no payment risk as the consumer is the operator of the plant as well. The risk is primarily an unexpected increase in costs causing an unexpected loss of profit to the consumer. This is due to not being able to construct the plant and associated infrastructure to cost and/or not being able to operate the plant as efficiently as expected at the time of entering into the contract. Another risk is inadequate supply of raw or secondary treated sewage by the ULB in terms of both agreed upon quantity and quality, which can affect the operations of the End User causing a loss in its profits.
 - ◆ **BOT Third-Party PPP (Annuity):** Suffer from frequent non-payment, partial payment or delay in payment of contractually agreed annuity amounts, particularly, if the public sector

counterparty is a non-metro city or a financially weak water supply and drainage board of the state government. Even in Alandur, VA Tech. Wabag faced payment delays and non-payment of certain dues in the later stages of the contract term.

- ◆ **BOT Third-Party PPP (User Charge):** The revenue risk arising from non-payment, partial payment or delayed payment of dues by consumers based on volume of treated wastewater consumed and a volumetric user charge is quite high particularly in non-metro cities. In a majority of such cities payment for sewage collection and treatment is through the property tax and is not even adequate to cover O&M costs of such systems. Even in those cities where a sewage tariff/cess exists it is levied as a percentage of water charges and is quite often insufficient to recover O&M expenses. Further, in certain parts of India such as the Indo-Gangetic plain, the water table is relatively high and the state governments are prone to subsidizing water consumption by industry and households. Thus, the cost of treated freshwater is quite nominal compared to the cost of treated freshwater from ground or surface sources. In this scenario, it is difficult for a private operator to levy and collect tariffs from end-users which are much higher (as the tariffs are calibrated to recover both O&M and capital investment costs) than the prevailing sewage charges or the unit cost of treated freshwater from ground and surface sources.
- **High Wastewater Off-Take or Demand Risk:** In case of BOT Third-Party PPP (User Charge), there is quite a significant risk of revenue loss due to lower than expected demand for reuse wastewater from the consumers (end users). This acts as a deterrent to private sector firms seeking to undertake wastewater projects under the BOT Third-Party PPP (User Charge) implementation model. In “Availability” based contract structures such as BOT Third-Party PPP (Annuity) or DBO this risk is transferred to the public sector counterparty in the PPP framework such as the ULB or State Government Utility or Board, which has to pay the private operator the agreed upon O&M fees or annuities as long as it provides a certain agreed upon quantity and quality of treated wastewater at the agreed upon discharge points over the O&M or annuity period.
- **Rigid and Unbalanced Contracts:** Excessive expectations, lack of trust between the government and the private sector and bureaucrats’ fear of being prosecuted for deviation from the procurement policy in force implies that contracts in India are very rigid and biased in favour of the government and not easily bankable. More specifically, some of the key issues plaguing contracts in the sewerage sector are:
 - ◆ **Unrealistic Key Performance Indicators (KPI):** Too many KPIs which are unrealistic to boot both in terms of target values and the timeframe required for their achievement given ground realities. Further, the more stringent the KPIs and time frames the greater will be the capital expenditure requirements which directly reduce the affordability of the project;
 - ◆ **Frequent Change in Scope:** Change in scope occurs frequently due to, among others, mid-course revision of unrealistic KPI and capex targets or changes in city or state government plans, which are not paid for;

- ◆ **No Rebasing Clause:** There is no provision in the contract which allows a relook at certain provisions like scope, performance standards, capex and opex requirements, adjustment for inflation, adjustment for change in law and taxes etc., which can change over a 20-30 year period as underlying assumptions regarding population levels, spatial distribution, consumption norms, taxes, inflation etc. can be quite different from forecasts;
- ◆ **Weak Penalties for Non-Payment of Dues:** Often the contracts do not have clauses with strong disincentives for non-payment of dues such as: allowing for the right to disconnect or exit from service provision; requirement of maintenance of substantial security deposits or financial guarantees which can be utilized to recover dues;
- ◆ **High Penalties on Operator:** Penalties are high and biased in favour of the ULB/ state government/state government water and wastewater utility. There are no caps on penalties and LDs and no indemnity from liabilities arising from consequential damages;
- ◆ **Specified Technology:** Often in non- donor agency funded projects the technology to be used for STPs is specified in the contract, which restricts treatment options and raises costs, particularly in case of proprietary technologies. Also pre-conditions in the bid parameters requiring the technology to have been tried and tested in the last few years or there be at least 3-4 projects using the technology which are operating successfully in India act as a deterrent to the introduction of new technology.
- ◆ **Weak Clauses:** Dispute resolution mechanisms, consequential damages and indemnity clauses are weak. For reuse projects potential consequential liabilities to end-users in terms of profits or livelihoods foregone could be quite large for which the current consequential damages and indemnity clauses are inadequate.
- ◆ **Bankability of Contract;** lenders are wary of financing sewage sector PPP projects as the contracts have no premature termination clauses, step-in provisions for lenders nor indemnity from consequential damages or caps on LDs etc. in the contract.
- **Limited Public/End-User Consultations:** Limited consultations and advocacy about project scope, benefits and costs with the intended beneficiaries (end-users) during the project development or formulation stage, particularly in BOT Third-Party PPP (User Charge) projects, results in political opposition and litigation causing needless delay and cost escalation during the project construction phase as well as non-payment of dues and financial losses during the operations phase. Financing of cost overruns and operating losses becomes a huge problem. In extreme cases, the project may have to be abandoned. In cases where the project survives, the beneficiaries end-up paying for facilities they do not need or which satisfy their needs only partially.
- **Private Capital Mobilization Main Motive for Government:** State governments and ULBs often see PPPs primarily as means to mobilize extra-budgetary resources for financing capital expenditure as well as a source of future budgetary revenue rather than a way to induct private sector efficiency in operations. This perception quite often leads to: (i) inappropriate selection of the PPP model as the implementation framework of choice over public sector implementation models or limited private sector outsourcing structures; and (ii) flawed design of project structure. As a consequence, it generates indifference on the part of the private

operator as well as frequent disputes during construction and operation, quite often to the detriment of the project's sustainability.

- **Limited ULB/State Utility or Board or PHED Capacity:** Most project authorities in India i.e. ULBs and/or state water & sewerage boards, utilities or the PHED are deficient in skills related to defining project scope, drafting contracts, conducting due diligence of legal and financing documents, monitoring performance of the private operators or PPPs; and in their ability to measure wastewater flows and test influent and effluent discharge quality across the wastewater system. This leads to delays in implementation and cost overruns during implementation as well as payment disputes during operations. For instance in Nagpur, Mahagenco's wastewater treatment and reuse project suffered delays due to tardy handing over of municipal assets.
- **Land Availability:** land for location of STPs. is an issue only in metros, for example land was an issue for the STP located opposite the Delhi Secretariat. However availability of landfills for disposal of sludge and brine in case of R.O. plants is an issue all over India.
- **PPP Risk-Reward Expectations:** Discussions with a cross-section of Industry participants indicates that they expect a Project IRR equivalent to 2% to 3% above their weighted average cost of capital and an equity return ranging from 18% to 24 % for safe to moderately risky projects. A safe project is defined as:
 - ◆ A project which is well structured and viable on a standalone basis;
 - ◆ The project authority or government counterparty is good implying that the contract is clear and balanced and the authority has sufficient funds to make good its payment obligations.

For super unsafe or risky projects, return is not the criterion for bidding. The real reason is strategic, namely, to improve credentials for participating in future bids. Expected equity returns in such cases will necessarily be higher than for safe or moderately risky projects.

DBO projects are popular even though there is an element of risk in recovering O&M payments because O&M excluding power costs is a relatively small component of total cost. Thus companies are driven to bid for these contracts in order to earn the upfront returns from construction. Some firms mentioned that a gross profit margin of 15% to 18% for works contracts was normal.

2.4 Conclusion

A review of the various PPP variants indicates that the most successful PPP model in India has been the BOT End User PPP model followed by the DBO model. The more conventional BOT or concession models known as BOT Third-Party (Annuity) and BOT Third-Party (User Charge) models in this paper have been the least successful PPP structures used so far primarily on account of uncertainty regarding revenue streams. The success of the BOT Third-Party (User Charge) model hinges on tariff reforms based on full cost recovery and conjoint pricing of water and treated wastewater reuse. The annuity model can be a success if the payments are back stopped / made by a more credit worthy and credible counter party than the ULB or State Utility such as the Government of India.

- **BOT End-User:** The primary reason for the success of the BOT End-User model is the fact that the consumer owns and takes responsibility for the project and has a significant stake in the success of the project on account of the criticality of reliable supply of treated wastewater in

its operations. The only hitch in such projects is the reliability of the quantity and quality of sewage supplied by the ULB. The quality can be assured if the end user also undertakes the O&M of the ULB's STP leaving the quantity of raw sewage as the only unaddressed risk factor in their operations. Many end-user operators consulted during the course of this study mentioned that they tried to economize on the use of wastewater during the months where supply of raw sewage was lower than originally envisaged.

- **DBO:** The DBO model has succeeded wherever the EPC payments are largely funded by central government schemes and bilateral/multilateral loans. This ensures full and timely payment during the construction phase based on achievement of milestones as scheduled. The other factor determining success is surety of payment of O&M charges over the duration of the O&M contract. This is a function of the financial strength of the CGA and a well-structured contract protecting interests of both parties equally. For example, Tamil Nadu also has implemented a number of projects in the sewerage sector on a Design-Build-Operate (DBO) model where the land is provided upfront by the government to bidders, choice of technology is left open to the bidders and the revenue risk is borne completely by the government.
- **BOT Third-Party (Annuity):** This model is less preferred by private sector bidders because the capital investments are recovered over the duration of the concession in the form of annuities rather than upfront in the case of the DBO model. Further like the DBO model, it also suffers from lack of surety of payment of annuities in full and on time as per the schedules agreed on in the contracts. Even in the case of Alandur, delays in payment of the 'annuity'^[7] (lease payment) as well as non-payment of the minimum guaranteed revenue in the later stages of the concession led to VA Tech Wabag not adhering to its original contractual obligations of expanding STP treatment capacity. However, the private firms are open to bidding for annuity contracts where the annuity payments come from a more creditworthy counter party such as the Central Government. Further, if the Central Government is willing to finance a portion (30% - 40%) of the capital costs during construction stage itself, the capital expenditure value at risk reduces significantly for the private operator and also becomes more bankable. Hence with the appropriate Government counter party the annuity model could become the preferred BOT model amongst private sectors operators.
- **BOT Third-Party (User Charge):** These models are generally failures because of revenue risk emanating from both a refusal to pay dues in full and on time and the probability that consumption by end users will be much lower than originally envisaged. The probability of revenue losses materializing in such projects are high because there is a psychological barrier for paying high amounts for recycled wastewater due to a culture of not paying for sewage services and secondly, availability of low cost freshwater sources both ground and surface. This model only works in situations where water supplies are scarce and availability of treated water is critical to the operations of the end users. Thus, this model works better in water scarce regions such as the South and West rather than North and East of India.

7 The contract is a fourteen year lease and hence the payments are technically lease payments but since they are specifically for treating raw sewage supplied by Alandur Municipality, they are technically in the nature of annuity payments.

Thus it is suggested that:

- ◆ The BOT End-User PPP model should be used wherever there is a large water intensive industrial unit which is constrained by lack of freshwater supplies because of lack of availability, excessively high cost of procurement, regulatory restrictions on abstraction of groundwater for use by industry; and is in the immediate vicinity of a large urban centre from where it can source raw or secondary treated sewage.
- ◆ In cases where large end users with the above mentioned constraints are not available, the ideal solution would be to establish BOT Third-Party PPP (User Charge) structures. However, since the environment in India at present is not conducive for large scale adoption of this structure it would be prudent to adopt hybrids like the DBO and the BOT Third-Party PPP (Annuity) structures till such time that the operating environment reduces the extent of revenue risk to allow extensive use of the BOT Third-Party PPP User Charge model.
- ◆ In the interim, the DBO model should be adopted with the proviso that the EPC portion is largely funded by Central Government schemes and/or multilateral and bilateral agencies and O&M payments can be met by a financially sound counter-party or can be guaranteed by higher levels of government or met through an earmarked fund.
- ◆ The BOT Third-Party PPP (Annuity) model too should be encouraged as an interim measure provided that the annuity payment can be assured by a financially sound counter-party or can be guaranteed by higher levels of government or met through an earmarked fund as discussed later in this chapter on payment security mechanisms.

The Chinese experience too shows that the move to BOT Third-Party PPP (User Charge) model was a gradual one beginning with tariff reforms then allowing private participation by both domestic and international water companies. Even in the mid-2000s, more than a decade after the deregulation began, the pure BOT Third-Party PPP (User Charge) model was not universally used in China with quite a few projects based on negotiated payments or annuities rather than user fee/charge⁸. International Water companies are allowed to participate in the form of joint ventures with local partners (both public and private) where they can hold a majority stake. Further in order to keep tariffs affordable.

Chinese local governments provide land and bear a portion of the capital investments. Finally, China encouraged public sector enterprises to actively participate in privatization of water and wastewater services.

8 Article published in Journal of US-China Public Administration, Volume 7, No. 8 (Serial No. 58), August, 2010 on Public-Private Partnerships in China: A Responsive Participation by LooSee Beh

2.5 Overview of International PPPs in Sewage Treatment and Reuse

2.5.1 The China Experience

China has made considerable progress in use of PPPs in the water and wastewater sectors since the early 1990s. A recent study carried out by Asian Development Bank estimated that there are around 400 water and wastewater PPPs in the People's Republic of China (PRC)^[9]. Companies operating in the water sector include trans-national water companies, privatized local water companies and domestic operators. PRC began to deregulate the water sector in the 1990s, allowing private and foreign investment in the water and wastewater sectors. China has gone in for both complete privatization as well as PPPs and allowed majority foreign ownership in joint venture companies in this sector. The most common model for wastewater projects is the Build-Operate-Transfer (BOT) model, unlike in India where the BOT model has met with limited success because of the high revenue risk associated with such projects. BOT models work in China because the country went in for tariff reforms ahead of private sector participation in this sector. However, even now, China provides support to PPP projects in the form of land, portion of capital costs and in a number of projects payment of O&M charges in the form of annuity. Therefore, the government support provides comfort to private sector bidders and ensures that assured revenue streams to the private operator from the local government results in relatively low annuity bids. This allows the local government to keep tariffs at an affordable level for the end users.

Tariffs ^{[10][11]}: The pricing for wastewater treatment services in China is based primarily on the principles of affordability and the need to maintain industrial growth and profitability. Hence full cost recovery and bringing home the cost of water pollution to the end user (polluter pays principle) are secondary concerns. This is revealed by an examination of the two successful examples cited below.

At present there are four categories of water tariffs in China:

- Water Resource Fee;
- Tap Water Fee;
- Wastewater Treatment Fee; and
- Wastewater Discharge Fee.

Governments at the central, provincial and municipal levels, as well as departments responsible for pricing, finance, water resources, urban development, environmental protection, provide the necessary inputs for determining price. Revenues collected from Water Resource Fees and Wastewater Discharge Fees are shared between the central and local governments in the ratio 1:9, whilst revenues from water fees and wastewater treatment fees are exclusively for use by the local governments. Please refer to table below for further details:

9 ADB article on Sustainable Urban Development in the People's Republic of China, November, 2010. (www.adb.org/urbandev)

10 Source: Transition from Environmental Charges to Taxes in China: an Application of Polluter-Pays Principle by; Yazong MAI, Xue TAN, Zhe LI, Lei SHI and Zhong MA.

11 Source: Fundamental Issues: Industrial Wastewater Interview with Ma Zhong for China Water Risk, March 12, 2014

Fee	Fee Setting	Fee Collection	Target user	Fee Use
Water Resource Fee	Provincial government	Water resource departments at/ above county level	Organizations and individuals who use water directly from rivers, lakes and groundwater	Distributed by 1:9 between central and local treasuries
Tap Water Fee	Municipal government, pricing and water resource departments	Civil construction or water resource departments at/ above county level	Organizations and individuals who use water from public water services	To be distributed and used by local water supply companies
Wastewater Treatment Fee	Municipal government, pricing and water resource department	Civil construction or water resource departments at/ above county level	Organizations and individuals who discharge wastewater to the urban wastewater centralized treatment facilities	Cover construction and operation costs of urban wastewater centralized treatment facilities
Wastewater Discharge Fee	Central government, pricing, finance, environmental protection and economic & commerce departments	Environmental protection departments at/ above county level	Organizations and individuals who directly discharge wastewater to the environment	Distributed by 1:9 between central and local treasuries

Source: *Fundamental Issues: Industrial Wastewater Interview with Ma Zhong for China Water Risk, March 12, 2014*

Discharge fees are a function of treatment cost which in turn are predicated on discharge standards. Given that the discharge standards are lower than the environmental quality discharge fees are low and do not generate enough revenue to meet the cost of operating wastewater treatment facilities. Statistics reveal that fees from various pollution charges account for only about 50% of the operating costs of the pollution abatement facilities in China. Additionally poor collection efficiency (one estimate puts it at approximately 67% of demand) exacerbates the problem of inadequate pollution charges.

The low revenue problem is compounded by low water prices resulting in the government earmarking funds from other sources in the form of 'special funds' to deal with water pollution. Further low water prices do not discourage water consumption nor do they incentivise recycling. Moreover low discharge standards cause high concentrations of wastewater pollutants requiring expensive treatment.

The PPP market in China has faced several constraints in its development which hold an important lesson for India. The prime amongst these were:

Legal and regulatory risks: Inconsistency amongst laws governing PPP activities quite often led to problems for investors. Further, government policies were revised without much thought to their consequences on the private sector.

Tariff deregulation proceeded at a slow pace limiting the widespread adoption of the BOT Third-Party PPP (User Charge) model.

The bidding process was not transparent hence, hampered project implementation.

Availability of long term capital from the domestic market to fund PPP projects was limited impacting ability to raise cheap, long term private capital hence enhancing government share in financing project capital expenditures.

Some examples of successful PPP projects in China are discussed below.

- **Shanghai Zhuyuan Youlian Wastewater Treatment Project, China^[12]**

A successful example of wastewater PPP in China is the Shanghai Zhuyuan Youlian No.1 wastewater treatment project providing advanced primary treatment. The Plant serves 23.5 Million residents of Shanghai over an area of 107sq.km. The service fees charged by the project are relatively low on account of indirect subsidies in the form of land and cost of some investments being borne by the government. In this case, the service contract with the local government specified a two-tiered service fee with a fixed component of CNY0.22 per cubic meter and a variable component of CNY0.082 per cubic meter, with the variable component being revised every three years. This experience holds important lessons for India on the need to embark on tariff and regulatory reforms before embarking on PPPs. The two tiered tariff structure used may also be replicated where by operators are compensated for financing and investment costs through a fixed tariff whereas the variable component could be linked to actual performance.

- **Guangzhou Xi Lang Wastewater Treatment Project, China^[13]**

Guangzhou Xi Lang Wastewater Treatment Plant, implemented by the Guangzhou Sewage Treatment Co. (GSTC) and Earth Tech. was one of China's first wastewater treatment plants developed using the PPP framework. The project was developed on a BOT format with the total investment of approximately \$130 million and was completed six months ahead of schedule. The plant was financed in part by Tyco International, Earth Tech's parent company and a major Chinese bank. The project has a maximum capacity to treat 260,000 m³/day. The duration of the BOT contract is 17 years. The city government bears the O&M expenses and a part of the capital cost not funded by it by payment of fixed fees or annuities to the operator. Hence the project is not much dependant on user fees levied on the ultimate consumer.

2.5.2 *The Singapore Experience^[14]*

Treated sewage wastewater forms one of the four sources of water supply in Singapore. Singapore first started using treated wastewater (NEWater) in 2003 and currently NEWater meets 30% of Singapore's total water demand. Singapore plans to expand its NEWater capacity in the long run to meet 55% of its demand in the future. In order to produce NEWater, secondary treated sewage from Singapore's four water reclamation plants is subjected to very high level tertiary treatment at four NEWater treatment plants. Most of the resultant NEWater is then sent to five service reservoirs through a 515 km transmission network and

12 ADB article on Sustainable Urban Development in the People's Republic of China, November, 2010. (www.adb.org/urbandev)

13 Article published in Journal of US-China Public Administration, Volume 7, No. 8 (Serial No. 58), August, 2010 on Public-Private Partnerships in China: A Responsive Participation by LooSee Beh

14 Various articles from Public Utilities Board (PUB), Singapore website: www.pub.gov.sg

from there distributed to 450 industrial connections. The effluent from these industries too is discharged after appropriate treatment into the sewer network of Singapore, hence, finds its way back to the NEWater treatment plants after secondary treatment. A small portion of the NEWater is sent, particularly during the dry season, to recharge Singapore's seventeen water reservoirs and from there through its seven water treatment plants to the general populous as drinking water. Hence, NEWater indirectly gets reused by the population as treated freshwater (drinking quality water).

Tariffs: The Singapore Water Authority, PUB, prices water to recover the full cost of water production as well as wastewater collection, treatment and reuse. In addition, PUB levies a water conservation tax to reflect its scarcity value and encourage water conservation by consumers. Thus the tariff in the monthly water bill comprises of water tariff reflecting the full cost of treated water supply; a water conservation tax expressed as a percentage of water tariff; a sanitary appliance fee and a water borne fee to cover the full cost of the sewer network, water treatment plants and reuse network. The water tariff is a volumetric rate expressed as S\$/KL, while the sanitary appliance fee is a specific rate expressed as S\$/Chargeable Sanitary fitting and the water borne fee is a volumetric rate expressed as S\$/KL. Industrial users are levied two categories of tariff the first is the industrial water tariff for provision of treated freshwater and the second is the NEWater tariff for supply of treated wastewater.

^[15] **PPP Model Followed in Singapore:** Since the beginning of the NEWater experiment, The Public Utilities Board (PUB), Singapore has employed design-build-own-operate (DBOO) PPP model since it started its NEWater service. Thus, today all four NEWater plants are under private operation. In all four plants the private sector has financed, constructed and operated the facilities based on very long term (>=25 year) concession agreements. Under the DBOO structure, PUB is the purchaser of NEWater from the plants as per the tariff formula laid down in the concession agreement. The tariff formula divides the tariff into two components, viz., a fixed charge and a variable charge. The fixed charge covers capital cost recovery, fixed O&M cost, fixed power cost and is payable regardless of the amount of NEWater being purchased. The variable charge is a function of the quantity of water purchased by PUB and covers variable O&M cost as well as variable power cost. These charges are also adjusted annually to allow for inflation and fluctuations in fuel prices over the concession period. The PUB sells the purchased NEWater to the industrial consumers at prices which are regularly determined by it and takes the billing and collection risk. Thus, the revenue risk is borne by PUB and not the private operator. A detailed case study of the Sembcorp NEWater Plant, 50 mgd is attached at Annex 6.

2.5.3 Experience with Wastewater PPPs in Other Parts of the World

- **Sewerage Network and STP in Puerto Galera (Philippines)^[16]**

Tourism is the lifeline of Puerto Galera (Philippines) as more than a million tourists visit the place each year. Untreated sewage was being discharged into the ocean and the local community was quite apprehensive about its impact on tourism. The situation changed when a new mayor, Mr. Hubbert Christopher Dolor, a medical doctor, decided to address this problem as a key priority for the city. He mobilised political and citizen support through public awareness campaigns and one-to-one consultations. He made the enforcement of national and local environment related ordinances more effective and implemented an Environmental

15 Source: Infrastructure Public-Private Partnership Case Studies of APEC Member Economies, Asia-Pacific Economic Corporation, October 2014.

16 Source: Case Study Vol.1 No.3, Public Private Partnership in Sustainable Development: The Case of Puerto Galera, PEMSEA

User Fee (EUF) system where fees were collected from tourists as a mechanism to finance this project. The mayor signed a Memorandum of Agreement (MOA) with the Sustainable Coastal Tourism Asia (SCOTIA, a project supported by United States Agency for International Development) and Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) on March 30, 2006. PEMSEA provided the project development and structuring support while SCOTIA focused on capacity building at the local level and developing a communication strategy for the project. Both these entities supported the local government in conducting stakeholder consultations, communication campaigns and consensus building workshops. Key stakeholders included the public, resort owners and players engaged in the tourism industry as well as local government staff. Willingness to pay surveys were conducted across three groups viz., domestic and foreign tourists, local households and commercial establishments. The results of these surveys were used to develop the EUF system. The initial EUF was set at Philippines Peso 50 (about USD 1) which was lower than what the surveys estimated.

The bidding process was transparent and the local government set up a bid evaluation committee to receive and evaluate proposals. Five parties expressed interest of which the contract was finally awarded to Puerto Galera Water Consortium (now incorporated as Puerto Galera Infrastructure Corporation). The project involved interception of sewage along the beach front as well as collection and conveyance from households to a sewage treatment plant which used SBR-NH4 PO technology and discharge of treated wastewater meeting SA¹⁷⁾ criteria into a wetland rather than the sea. The project also provided other enhancements such as improvement of the beach walkways and creation of an appropriate water transport landing and parking facility (jetty). The project was financed by a 15 year loan facility from the Development Bank of Philippines (DBP). As the initial levy of EUF was found to be inadequate to service the debt and meet O&M expenses, the EUF on tourists was raised to PHP 120 per visitor, separate EUF was levied on households within the municipal limits, tourists were charged per dive into the ocean and terminal usage fees were imposed at the jetty.

The Puerto Galera PPP project happened due to strong political commitment, capacity building, adequate project structuring, wide stakeholder consultations, clear legal and institutional framework, transparency in the procurement process and finally design of a cost recovery and revenue generating mechanism to ensure long term sustainability of the project. In fact, this project is one of the few examples globally where a BOT User Fee model has been tried out. However, actual EUF collection has been much lower than originally envisaged on account of much lower levels of tourist traffic impacting project financial viability. This example once again highlights the vulnerability of BOT Third-Party PPP (User Charge) model to revenue risk.

17 Class SA refers to: 1. Waters suitable for the propagation, survival and harvesting of shellfish for commercial purposes; 2. Tourist zones and national marine parks and reserves established under Presidential Proclamation No. 1801 existing laws and/or declared as such by an appropriate government agency; and 3. Coral reef parks and reserves designated by law and concerned authorities (DAO 34, 1990).

- **Atlanta Integrated Water and Sewerage Project, 1999^[18]**

The scope of this project was to undertake O&M of the water supply and the wastewater systems in Atlanta. In return the private sector operator was to be paid an annuity by Atlanta city to cover its O&M expenses. The project failed because of the contractor's failure to perform. The private contractor was selected based on an unsolicited bid and hired without any detailed feasibility and technical studies on the project. As a result, the risks were not properly identified and allocated. This resulted in an improper assessment of the existing water and wastewater networks, which in turn caused the operator to not achieve its specified performance parameters. This fomented opposition from political bodies and consumer groups resulting in its failure.

There are several lessons to be learnt from this case. The first is that cities need to undertake a thorough examination of their systems, and evaluate the costs and benefits of adopting the PPP approach before undertaking this option. The second is that one should avoid hiring an operator without a competitive bid process unless it is an experienced and well known entity. Third, political will or support is crucial to tide over difficult periods which would otherwise undermine the project.

- **Hamilton Wastewater Project, Canada, 1994^[19]**

The scope of the project comprised O&M of wastewater and water supply treatment plant as well as associated pumping infrastructure. In return, the private sector operator was to be paid an annuity for recovering its O&M expenses. The city of Hamilton engaged the services of an inexperienced private sector operator through an unsolicited bid. The project failed because of the contractor's failure to perform due to the fact that the operator had no charge over the water and sewerage pipe network. Therefore, it would pump most of the water and treated effluent during off-peak hours when electricity was cheaper to fill the reservoirs. This put undue pressure on the pipes resulting in several pipe breaks, frequent leakage and creation of unhygienic conditions. Moreover, improperly drafted clauses in the O&M contract resulted in any expense above C\$ 10,000 being classified as a capital expense. Thus, the private operator did not undertake maintenance work on time so that a small repair job would become a major maintenance issue which could be classified as a capital expense and hence, a city responsibility. Further, improper division of responsibilities between the municipality and the operator with regard to operations and capital investments led to the operator blaming the municipality for failure to invest in capital works, which the city could not refute.

- **Other PPP Projects^[20]**

From the mid-2000s, quite a few projects have been undertaken on a PPP basis across the world such as the New Cairo Wastewater Project, Egypt; Muharraq Wastewater Recycling Project, Bahrain; Atotonilco Wastewater Project, Mexico; As Samra Wastewater Project,

18 Source: PPP in Urban Sewerage Sector in India, CRISIL Infrastructure Advisory Services, March, 2013

19 Source: PPP in Urban Sewerage Sector in India, CRISIL Infrastructure Advisory Services, March, 2013

20 Source: PPP in Urban Sewerage Sector in India, CRISIL Infrastructure Advisory Services, March, 2013

Jordan. The New Cairo, Muharraq and Atotonilco projects are design-build-finance-operate-transfer (DBFOT) models. The New Cairo and Muharraq STPs would be paid an annuity by the public sector CGAs (also referred to as BOT Third-Party (Annuity) models in our report), while the As Samra project would levy a user charge to recover its costs. The key lessons are: political support is essential to overcome problems in mobilising resources and handling land acquisition. For example, in case of the Muharraq project, the Bahrainian Government ensured that the financiers stayed on board despite delays due to civil disturbances and downgrade of long term ratings. The government also ensured that a change in scope which resulted in private land being needed for the project was adequately addressed prior to financial closure. At As Samra, the government enacted enabling legislations to ensure entry of private capital, undertook feasibility studies and environmental impact assessment prior to embarking on the PPP path and finally provided a revenue guarantee to the private operator to take care of the revenue risk posed by the BOT Third-Party PPP (User Charge) model. Please refer to Annex 7 for details on project parameters.

- **Conclusion**

A study of these cases has revealed that except for New Cairo, all the other projects required some amount of investment (29-70% of capital expenditure requirements) by the public sector partner. Further, in order to alleviate the risk associated with uncertain revenues, the public sector authorities had to provide annuity payments or revenue guarantees. Thus, in order for PPP projects in the wastewater sector to succeed, revenue risk and substantial part of capital funding will have to be borne by the public sector, while the private sector should bear the technical including operating and environmental risks. The analysis also brings out the need for strong political will to steer the project through unforeseen hurdles; the need for detailed evaluation of the project at the planning stage; and the need to define terms and responsibilities in contracts carefully.

Chapter 3

Conclusions: Potential for Private Sector Participation and Collective Action in Urban Wastewater Sector in India

Conclusions: Potential for Private Sector Participation and Collective Action in Urban Wastewater Sector in India

Based on the key issues and risk factors impacting PPP projects identified in the previous chapter, a series of recommendations are made in the following sections to facilitate a more congenial climate for public-private community participation projects in the wastewater sector.

3.1 Government of India Initiatives

Existing:

- **Under the National Urban Sanitation Policy**, Gol has already spelt out its vision for the urban sanitation and sewerage sector and has also emphasized the need for an integrated city-wide sanitation approach. It has also suggested the reuse of treated municipal wastewater as an important driver for conserving water and meeting environmental pollution norms. It recommends that at least 20% of the municipal wastewater generated must be reused. It recognises that sanitation is a state subject under the constitution, and recommends that each state must evolve its own policy taking into account local conditions and considerations to achieve the goals set out under NUSP. It also spells out the template for an integrated city sanitation plan.
- While policy formulation by Gol is more strategic in the sanitation sector, it has an important role to play in funding the sector. In order to achieve some of the policy goals spelt out in NUSP, Gol has provided funding under JnNURM, Ganga Action Plan and the Namami Ganga Yojana and Yamuna Action Plan as well as NRCP. In JnNURM, the Gol also formulated full cost recovery of O&M costs for sewerage services as one of the reform measures to be undertaken by the beneficiary ULB.

Recommended:

- **National Level PPP Fund/Guarantee Mechanism:** Apart from funding support provided to sewerage projects as mentioned in the previous point, another important arrangement by which Gol can support PPP interventions in the sewerage sector is by setting up a guarantee mechanism to support O&M/annuity payments to the private sector operator. While capital costs for most planned sewerage projects are largely met through various Gol schemes or multilateral funding agencies, the O&M charges to be paid to the private operator under a DBO contract are typically borne by CGA which is either the ULB or the state level utility/parastatal. Private sector operators perceive a high level of risk in receiving timely payments from CGAs which are not financially sound, and would therefore be more amenable to participate in such projects if O&M payments enjoyed some degree of protection through guarantee mechanisms. (Refer to Exhibit 2: Suggested Security Mechanisms for Sewerage Sector PPP Projects)

Exhibit 2: Suggested Payment Security Mechanism for Sewerage Sector PPP Projects

The key risk factor highlighted by almost all private sector players is the very weak payment structure for most of these PPP projects where the CGA is either a ULB or a state level utility. Payments for services provided by the private operator in the waste management sector are often delayed on account of the poor fiscal health of the CGAs. Feedback from the industry is that only projects which are funded either by multilateral or bilateral agencies or central government schemes provide some assurance on timely payment for capital expenditure but most of these financing arrangements do not cover O&M charges. Therefore, the private party is dependent on the ULB or the state level utility for recovering its O&M payments under DBO contracts. Recently, there have been press reports of UEM Limited stopping operations at the Indrapuram STP in Ghaziabad on account of not being paid O&M charges for nearly two years. The only PPP model where there is some assurance of payment is the BOT end user model where the end user pays the operator O&M charges on account of the criticality of the treated wastewater supply to its own operations. In a nutshell, PPP projects only succeed where the private sector operator is reasonably certain of recovering his investments in capital expenditure (if any) and O&M charges.

Ring-Fencing Revenues at the ULB Level: It is suggested that ULBs ring fence their sewerage revenues in the form of sewerage taxes or sewerage charges linked to water consumption in an account separate from the municipal fund. This will ensure that sewerage revenues are earmarked for financing the sewerage network and treatment expenditures. To provide further comfort to the private operator and lenders to the PPP project, it is also recommended that ULBs provide an amount equal to one year's annuity / O&M payment in a separate account. This account would be a fixed deposit which would be escrowed. The monies in this escrow account would be utilized only for meeting payment short falls to the private operator. The funds in the escrow account would be built up as follows: An initial injection equivalent to 50% of one year's annuity / O&M payments made at the time of signing the concession agreement and the remaining 50% would be deposited in the account prior to commercial operations date (COD). On drawdown from this escrow account, the ULB should replenish the escrow account to extent of drawdown from either its ring- fenced sewerage revenues or from its general revenues within one month from the date of drawdown.

Sanitation PPP Fund at State Level: It is suggested that all states set up a separate Sanitation Fund to provide for O&M payments for sanitation services when projects are implemented under PPP models. Various revenue sources could be tapped to contribute to this fund. States can look at levying a small surcharge on sales tax, cess on vehicle registration fees, annual tax on vehicles linked to their insured value etc. This fund could take care of O&M payments to the private operator in DBO contracts and annuity payments in DBFOT contracts, in the event of non-payment by the ULB. The state government can recover this payout from the ULB by intercepting state government's fiscal transfers to the ULB. This will address the main concern of private bidders. Also, where electricity payments for operations and maintenance are made by the CGA to the electricity utility, long payment delays lead to threat of electricity disconnection and therefore, disruption of operations. Some private players even suggested that the electricity

component of the annual O&M fees should also be covered by the state level fund to ensure continuity of operations of the STP. In short, very few operators are willing to take the payment risk from a ULB or a state level utility which is in poor financial condition. In the long term, PPPs in the wastewater management sector will only take off if the Sewerage tariffs are adequate to cover O&M costs and a viable market mechanism is created for sale and reuse of treated municipal wastewater.

PPP Guarantee Mechanism at national level for Non-NMCG ULB projects: It is recommended that the central government set up a national level PPP Guarantee Mechanism to back-stop payments to private operators for municipal services including sanitation. This PPP guarantee facility for municipal PPP projects in the sewerage sector may be set-up at the Ministry of Urban Development. This mechanism may be supported by partial credit guarantees provided by agencies such as IFC and Asian Development Bank.

PPP Guarantee / Support Mechanism at National level for Sewerage Projects under National Mission for Clean Ganga (NMCG): Ministry of Water Resources (MoWR) proposes to adopt the BOT annuity model for private participation in projects being envisaged under the NMCG. MoWR is contemplating partial funding of capital expenditure through grants while the remaining capital expenditure and O&M expenditure will be met by the private operator and recovered through annuity payments made by MoWR over a period of 15-20 years from budgetary allocations. Further, MoWR proposes to use the Clean Ganga Fund corpus to backstop annuity payments to the private operators.

- **National River Management and Sewerage Treatment Corporation:** Wastewater treatment in India would require billions of dollars of investment to even achieve 50% coverage. (China is aiming for 90% coverage by 2020). However, Indian cities and state water and wastewater utilities have limited capacity to operate such systems, particularly with regard to sewage treatment or to develop and supervise viable business models for PPPs in sewerage. This has been compounded by a paucity of long term funds for this sector. Hence, for programmes like the Namami Ganga Yojana to succeed, the Central Government will need to have strong oversight capacity for it. In China, capacity building of industry was an important element of the whole exercise. Thus, the State Owned Enterprises (SOE) in China entered the sector and developed the technical and managerial capacity to bid for such projects in other regions. Moreover, it was discovered that initially PPP contracts/concessions were tilted against the private sector because of lack of understanding of such contracts amongst city government officials and consequently, their fear of being questioned for unduly favouring the private sector.

Therefore, India needs a different kind of institutional structure. One such model could be a national or regional level entity, akin to NTPC in the power sector, for bringing in financing, technology and trained manpower. Thus a Special Purpose Vehicle (SPV) or corporate entity called the National River Management and Sewerage Treatment Corporation (NRMSTC) could be created at the Central level that would plan, structure, procure concessionaires, and monitor implementation of such PPP projects in the country. It could initially be responsible for Ganga basin projects and later expand its mandate for cleaning other rivers in the country.

Exhibit 3: National River Management and Sewerage Treatment Corporation

- The corporate entity or SPV, National River Management and Sewerage Treatment Corporation with ownership from the Government of India and the riparian state governments (joint ownership model has been tried out in case of Konkon Railway Corporation) would assume responsibility for constructing, operating and maintaining crucial STPs along river basins. To start with the entity can focus on the Ganga basin and later expand its scope it cover other basins in India. The entity can undertake development of the projects including bidding out to the private sector under the PPP framework, construction/construction supervision and provision of O&M services/oversight of O&M contracts outsourced to the private sector. Therefore it would be in a position to provide technical assistance to ULBs / Utilities to undertake PPP projects and assist in the oversight of private sector performance post award of contract. It can also undertake some projects on its balance sheet in cases where private sector participation is not a feasible option.
- The entity would be in a position to hire a large pool of technical and managerial staff with the right technical, procurement and PPP project development skill sets, to enable it to undertake the aforementioned roles and augment Capacity gaps at the ULB and State utility level.
- As a Government of India backed corporation which also executes some sewerage treatment and effluent projects it would have the requisite creditworthiness to attract long-term commercial financing as well as be a conduit for multilateral and bilateral donor agencies. Government of India may also consider providing this entity access to a fund along the lines of NHAI Central Road Fund. The revenue model and the capital structure for this entity will have to be suitably designed.
- Since 74th Constitutional Amendment vests the responsibility of wastewater collection and treatment on ULBs, their consent would be crucial for the operations of NRMTSC. One way of getting their consent would be to co-opt the ULBs through tri-partite agreements / MoUs with NRMTSC and the project SPVs.

3.1 State Government Wastewater Collection, Treatment and Reuse Policy

- **Base for Guidelines**
 - i. To start with, State governments should adopt the Government of India guidelines, particularly with regard to the service level benchmarks (SLB) that recommend that at least 20% of the wastewater needs to be reused. This percentage should be gradually calibrated to reach higher levels over time. For example, the Government of Delhi has in its Draft Water Policy stated that recycled wastewater use should rise to 25% by 2017, 50% by 2022 and at least 80% by 2027.
 - ii. The policy should also specify that a certain percentage of treated wastewater will be used for recharge of groundwater and discharge into surface water bodies to reduce their pollution load and enable minimum environmental flows.

- **Promotion of Reuse by Industry:**
 - i. Industries requiring bulk water (including power plants) and located close to urban areas should be mandated to use treated wastewater for process use instead of freshwater to limit their freshwater use, except in the case of food processing industries.
 - ii. Municipal water authorities should facilitate use of treated wastewater, for example, by supplying raw sewage or treated sewage water at a price which ensures full cost recovery of treatment and supply.
 - iii. Industries located further away from urban areas, should be directed to recycle their own sewage to meet part of their overall water requirement.
 - iv. Plans for development of industrial areas, SEZs and new townships should incorporate provisions for collecting, conveying and treating wastewater as well as its reuse by providing for tertiary treatment systems and allied infrastructure for treated wastewater etc.
 - v. Polluting industries and industries located in water scarce regions could be directed to go in for in-house/on-site wastewater treatment and reuse.

- **Promotion of Reuse by Non-Domestic Users:**
 - i. Reuse of treated municipal wastewater should be incorporated in the planning of new townships and cities. This would involve setting aside land for STPs; and designing building codes making it compulsory to install dual pipelines in households; one for treated drinking water and the other for treated recycled wastewater for toilet flushing etc. Adequate precautions should be taken to ensure that there is no intermixing of sewage with freshwater by careful monitoring of system operations, particularly the operations of STPs. Further, it should be made compulsory for developers to lay not only freshwater pipelines and sewers but also pipelines to carry treated wastewater in new developments.
 - ii. Regulations mandating major wastewater generators such as hospitals, commercial establishments etc. to go in for onsite treatment and reuse, where possible.
 - iii. Sensitizing citizens through focused awareness campaigns on television, radio, social media and live events. The campaigns should aim at educating the citizens of a city on the advantages of saving freshwater and breaking social taboos on reusing wastewater for non-potable purposes.
 - iv. A few examples of recycling and reuse of treated wastewater for non-potable uses already exist in India, like the one in Bangalore, where treated wastewater is used in the golf course and at the international airport. State government and municipal politicians and officials could visit such cities and plants and adopt similar technologies and institutional structures to recycle and reuse the city sewage for non-potable uses.

- **Measures for Harmonious Use of Wastewater:**
 - i. Guidelines need to be issued to earmark a portion of wastewater for agricultural use to avoid conflict with farmer interests and political intervention. The exact percentage of municipal

wastewater allotted to farmers would vary from region to region and would have to be set in conjunction with local authorities, farmer representatives and industry associations.

- ii. Further, quality norms would have to be established for ensuring the quality of wastewater to be supplied to farmers as per CPHEEO guidelines for treated sewage in farming and agriculture. This is to ensure that the treated wastewater is free of harmful organisms and chemicals but not completely devoid of nutrients for plants.

- **Tariff Policies to Promote Recycling:**

- i. The tariff for treated freshwater and treated municipal wastewater used by industry should be determined in such a manner by the various government departments that:
 - a. it recovers the full cost of treatment and supply for both freshwater and municipal wastewater; and
 - b. Treated freshwater used by industries is made more expensive (at least Rs 30-40 per KL) than the cost of using equivalent treated wastewater. This is already the norm in most Southern and Western states such as Andhra Pradesh, Karnataka, Gujarat etc. but is yet to be implemented in the Northern and Eastern states.
- ii. Treated municipal wastewater supplies for non-potable purposes within a municipality should be priced lower than equivalent freshwater supplies to encourage its reuse in public parks, toilet flushing and other non-potable uses.
- iii. However, ULBs should be paid for supplying treated sewage so that they earn revenues which enable them to cover at least the O&M costs of collecting, conveying and treating such sewage prior to supplying it for non-potable reuse in a municipality. For instance, Delhi government has recently announced that all the parks maintained by public authorities will have to purchase treated wastewater at Rs 7/KL for watering the parks. This will result in the Delhi Jal Board (DJB) earning additional revenue of Rs 100 crore per annum.
- iv. In case of power and steel plants, it is recommended that the nominal cess that they pay for abstraction (drawl) of raw water from rivers should be increased substantially. The consequent increase in raw water input costs would make use of treated freshwater comparable to the cost of using secondary treated wastewater. This has already been undertaken in Gujarat where raw freshwater costs about Rs 10 per KL.

- **Measures to Restrict Groundwater Use:**

- i. Groundwater used should be banned for use in construction and public parks.
- ii. For all other industries and non-domestic users, there should be a provision limiting groundwater abstraction by them.
- iii. The ban and provisions would also need to be enforced strictly by the concerned government departments and local authorities in order to encourage reuse of municipal wastewater as well as on-site/in-house treatment and reuse of own wastewater.

- **Measures to Incentivize Private Investments:**

- i. Minimum assured returns on equity up to 18% p.a. for equity investments in pure BOT (User Charge) PPP projects, similar to the minimum assured return values offered by

government in the road and power sectors should be adopted. The assured return of 18% p.a. is slightly higher than 15.5% p.a. assured return in the power sector because of the higher risks associated with levying and collecting user charges in the sewerage sector. State Governments may also explore hybrid annuity models where between 30 - 40% of the capital investment will be paid by the Government through milestones linked to construction progress and the balance will be paid through annuities over the remaining life of the concession which may extend up to 20 years.

- ii. Co-generation should be made mandatory for treatment plants with a capacity greater than 35 mld employing non-pond based technologies such as ASP, SBR etc.
- **State Level Sanitation Fund:**
 - i. Set up a State Level Sanitation Fund to back-stop O&M and annuity payments to the private sector for PPP contracts in the sewerage sector.
- **Investments in Sewer Network:**
 - i. State Governments will have to undertake significant investments in developing sewer networks in the towns and cities within their boundaries out of budgetary and extra budgetary sources as private sector investments in sewerage networks will be rare.

3.3 Local Government/State Utility Measures

- **Ring-Fence Water and Sewerage Service Revenues and Costs:** in order to improve the viability of the sewerage sector, the revenues and costs associated with providing sewerage services within a municipal area need to be ring-fenced in a separate budget within the overall budget of the ULB in states where the ULB is responsible for providing sewerage services viz. municipal corporations in Maharashtra. Another variant is the corporatized city-level water supply and sewerage entity (viz. Chennai Metropolitan Water Supply and Sewerage Board, Delhi Jal Board) where this information is already captured separately. Even in states where a state level utility or parastatal is responsible for providing sewerage services, it is important to account for revenues and costs region-wise so that tariffs may be calibrated according to local costs. A similar but slightly different approach could be to have a separate regional utility providing water and sewerage services to a cluster of neighbouring municipalities.
- **Cost Recovery Tariffs:** As recommended under JnNURM move to a full cost recovery tariff regime from an O&M recovery model which is the current goal under the existing tariff regimes. These actions will make the ULBs/Utilities financially stronger and allow for better ability to honor payment commitments to PPP operators. Please refer to Annex 6 for details on optimal sewerage charge regime.
- **Capacity Building:** To overcome weak PPP implementation capacities at the ULB or state utility level, many states have created nodal agencies at the State Government Level such as the Punjab Infrastructure Development Board, Karnataka Urban Infrastructure Development and Finance Corporation and Tamil Nadu Urban Development Fund. These agencies have the requisite manpower and skill sets to guide local bodies and utilities through the PPP process. Some states have also past PPP Acts which spell out the dispute resolution mechanisms quite

clearly. However, there would still be a requirement for training and capacity building at the local government or state utility level to monitor and manage PPP projects. More specifically, training is required to impart skills in defining project scope, drafting bid documents and contracts, conducting due-diligence of documents, monitoring operative performance and measuring and testing wastewater flows.

3.4 Project Risks and Mitigation Measures

This section summarizes the salient risks or challenges faced by PPP projects in India and recommends certain measures as solutions or risk mitigants.

3.4.1 Revenue Risk Mitigants

Revenue, both demand and payment emerges as the biggest challenge to PPPs according to a cross-section of developers and sector experts. The conventional BOT Third-Party PPP model, as mentioned above, is highly susceptible to both demand (off take) and payment risk. Over the years, hybrid PPP models such as the DBO, BOT Third-Party PPP (Annuity) and BOT End-User PPP have emerged to tackle this risk. Except for the BOT End-User PPP model, none of the other models have managed to mitigate both the off take and payment risk satisfactorily. For instance while the DBO, BOT Third-Party PPP (Annuity) models successfully solve the wastewater demand or off take problem they are still open to payment risk. The revenue risk mitigation measures for different categories of PPPs are given below.

- **BOT Third-Party PPP (User Charge):** Some of the measures suggested by industry players to counteract revenue risk emanating from less than expected off-take volume and non-payment or delayed payment of dues by end users of treated wastewater are:
 - ◆ **Public Consultation:** Extensive stakeholder consultations including end-users to arrive at a mutually acceptable tariff which not only covers O&M and capital investment costs but is economically viable vis-à-vis alternate water sources.
 - ◆ **Demand (Off take) Risk:** The concession and consumer off take agreements should also have a provision requiring the end-user to provide for a minimum off take guarantee (expressed as the product of minimum consumption volume and an agreed upon tariff) to cover fixed costs and any penalties to be paid to input providers such as the ULB for sewage and other supply inputs or provide a financial guarantee covering fixed costs and penalties in lieu of the minimum off-take guarantee.
 - ◆ **Payment Risk:** The concession agreement as well as the consumer off-take agreement should have a provision allowing the BOT operator the right to disconnect treated wastewater supply in case of non-payment of dues and/or request security deposits/financial guarantees equivalent to 2-3 months' revenues. The order of application of the rights of the BOT operator should be to drawn down on the security deposit/ financial guarantee first and if the event of non-payment still persists after the deposit or guarantee have been exhausted then the operator should resort to disconnection of supplies.
- **BOT Third-Party PPP (Annuity):** As the payment for provision of an agreed amount and quality of treated wastewater is by the ULB or a state level water and wastewater utility, the off-take or demand risk is transferred completely to the ULB or state level utility. As far as payment risk is

concerned, one is replacing the default risk of multiple third-party consumers with the default risk of ULB/ State level utility in this implementation structure. Given that the financial health of most ULBs and state level utilities is very weak, payment risk issues still remain quite significant for the operator. The feedback from industrial players and sector experts is that to mitigate the revenue risk emanating from non-payment or delayed payment of dues by ULBs/State Utilities are:

- ◆ **Payment Risk:** Contractual assurances regarding full and timely annuity payments by the ULB and/or the State Government backed by an earmarked or ring-fenced fund (separate from the consolidated fund of the state or central government) along the lines of the Central Road Fund at the state or central government level.
- **DBO:** Revenue risks in this implementation structure boil down to payment risk due to non-payment or delayed payment of capital expenditure (EPC) and O&M expenses incurred by the private operator. In a DBO structure there are three elements of the payment risk: (i) milestone linked payments to the EPC contractor linked to actual project execution; (ii) funding of cost over runs if any during the construction phase; (iii) payment for operations and maintenance of the asset till the end of the O&M period. The suggested mitigation measures are:
 - ◆ O&M/Management Fee guarantees to the operator such that payment for O&M (including electricity) is guaranteed by the state government and this is backed by an earmarked or ring-fenced fund at the State or Central government level (like the Central Road Fund).
 - ◆ Financing in the form of grants and term loans by Government of India and multi-lateral and bi-lateral donor agencies of at least 70% to 85% of the project capital cost for reasonable certainty of payment on time and in full as per the payment schedule.
 - ◆ In the event that the cost over run in the project execution phase is due to ULB's inability to honor its end of the contract, for example, inability to hand over land and other assets on time, or to force majeure conditions, the cost over runs should be borne by the public authorities.
- **Hybrid Annuity Model:** Another approach to address revenue risk concerns of the private sector and Government's own desire to ensure that the private sector has some "skin in the game" to ensure commitment and performance of private sector over the duration of concession is to combine the BOT Annuity and the DBO models. In this hybrid model about 30 - 40% of the capital investment may be paid by the Government through milestones linked to construction progress and the balance may be paid through annuities over the remaining life of the concession which may extend up to 20 years. This will ensure that the private sector puts in some equity in the project unlike the DBO model where the complete capital costs are borne by the Government agencies. As O&M costs are lower in value terms vis-à-vis capital costs, Government agencies have expressed concerns that the private sector may not hesitate to walk out of the contract during O&M period in a pure DBO model. This has been the experience with many STP projects implemented under the DBO model where the private sector has not maintained / abandoned the project primarily on account of non-payment of O&M dues. In the proposed hybrid annuity model, the private sector will have to finance 60 – 70 % of the capital cost and recover this capital cost and O&M expenditure from annuities spread over the contractual / operations period. However, the success of this model will hinge on the Government's ability to make timely payments against its capital cost and annuity commitments. Back-stopping arrangements in the form of a fund would provide comfort to both private players and their lenders.

3.4.2 Project Development Risk Mitigants

The activities undertaken during the pre-construction or project development stage are vital to determining the future financial and technical sustainability of the project. As mentioned earlier, improper scoping, poor quality data and rushed bidding often contribute to delays, cost over-runs and difficulties in meeting KPIs mentioned in the contract.

- **Scoping & Poor Quality Data:** Scoping of the project can be improved considerably through extensive public consultations and detailed technical surveys and audits to determine the base line values. Public consultations enable the project proponents to: more precisely determine need as well as willingness to connect to the network; better define project contours including network alignment and selection of STP sites; arrive at a mutually acceptable connection charges and tariffs; and generate public support for the project. Extensive surveys and audits need to be conducted in Indian cities as the quality of data available with the project authority (ULB and/or State Utility) on, among others, the number and condition of sewerage system assets, energy consumption and the temporal and spatial distributions of sewage volume and sewage quality in the city is woefully inadequate to determine both base year values and future parameter specifications.
- **Bid Process:** The typical process followed by public utilities/ULBs is to get a detailed project report prepared which includes a rudimentary financial feasibility assessment. In case the ULB decides to go in for a PPP model for project implementation, it then appoints a transaction advisor to assist it with the bidding process. In most cases, the DPR becomes dated particularly with regard to the project cost by the time the RFP is floated. In the urgency to award the project, potential bidders are also not given sufficient time to verify the data in the DPR and re-assess the technical and financial feasibility of the project. An example is the bid process in the Surat-Bamroli Wastewater project; the bid process was a success because of the time taken to establish scope, data reliability, project feasibility and marketing. As a consequence, the initial technical and feasibility studies took six months to complete; stake-holder buy-in including approval of bid documents took another ten months; and finally the bid process itself lasted for eight months. Therefore it is important to recognize that the PPP project preparation and bidding takes time and rushing through this process leads to poor quality bids and unsatisfactory project outcomes. Moreover, least cost bid evaluation needs to be replaced by lifecycle cost evaluation on a Net Present Value (NPV) basis, with the CGA intimating the discount rate to all bidders. A consequence of life cycle cost evaluation would be a lengthening of the duration of the O&M period in DBO contracts, as shorter time frames would not be able to cover the economic life of electrical and mechanical equipment.
- **Land Availability and Permitting:** Moreover, the project concession granting authority also needs to be adequately prepared in terms of meeting its commitments like providing land free of encumbrances, giving permits and approvals for commencement of construction, shifting of utilities etc. For instance, in many recent DBO contracts awarded in Tamil Nadu the land was already identified at the bidding stage and bidders were free to choose technology appropriate for the available land and were evaluated on the basis of least life cycle costs for the project. Moreover, in case land availability is an issue, the CGA can put a clear premium on land in the tender/bid document so that industry participants will quote those technologies in their bid that minimises the use of land.

- **Quality of Municipal Sewage:** To counter the problem of industrial effluents getting mixed with municipal sewage, effluent treatment will have to be undertaken by industries on site before discharge to public drains, open fields or water bodies. In case of highly toxic effluents such as those emanating from tanneries and dyeing units zero liquid discharge systems would need to be installed to prevent these effluents from entering the municipal sewerage system. This calls for strict enforcement of pollution control norms prevailing in the state and severe penalties for non-compliance. Otherwise the sewerage treatment plants which are not designed to deal with industrial effluents will not function properly and fail to meet output performance indicators. Moreover, dumping of construction waste into sewers causes blockages and ruptures in the sewer lines affecting flow and can also damage the screens, mechanized shredders and other mechanical equipment used in primary treatment. This needs to be stopped by city corporations through awareness campaigns, monitoring of construction waste disposal and imposition of fines.
- **Quantity of Municipal Sewage:** State governments and ULBs to undertake extensive development of sewer networks prior to large scale implementation of STPs to ensure adequate sewage flow to STPs post commissioning. This should be an initiative spearheaded and financed by the state government out of budgetary resources and donor funds as mentioned in the section on State Government Wastewater Collection Treatment and Reuse Policy.
- **Limited Revenue Potential from Recycled Water:** To realize the full potential of recycled wastewater through reuse in industry, toilets, parks and other public uses such as firefighting equipment, the state governments need to promulgate a water and wastewater management policy which encourages re-use of treated municipal wastewater. Some of the elements of this policy have already been enunciated in the section on State Government Wastewater Collection Treatment and Reuse Policy.
- **Limited Revenue Generation from Sale of Sludge:** to overcome the narrow market for manure, the sludge generated in ASP, ASP variants and SBR technology based treatment plants could be used as raw material to generate methane gas for running a gas turbine to generate power. The power generated could be used as a substitute for power purchased from the grid to run the sewage treatment plant. It has been observed that for plants with capacity greater than 35 mld co-generation results in 40% to 50 % less consumption of power purchased from the grid, which is a substantial savings in O&M costs. However, this entails additional capital expenditure of Rs. 5 Mn to Rs. 7 Mn per mld. To promote co-generation the state government should make it mandatory for all sewage plants with a capacity greater than 35 mld to go in for co-generation.
- **Non-Existent User Charge Regime:** As there is no culture of paying directly for sewerage services there is a psychological barrier to payment of user charges for collection and treatment of sewage as well as for recycled wastewater. To overcome this inhibition the state government/state utility along with local governments need to run extensive public awareness campaigns and subsequently start charging sewerage tariffs that reflect current O&M costs and gradually increase these tariffs to allow for recovery of capital expenditure as well.

- **Rigid and Unbalanced Contracts:** Rigidity in PPP contracts becomes an issue as time progresses because: (i) the data on which the PPP contracts and the key performance indicators are based is flawed; (ii) the initial assumptions regarding population growth, its spatial distribution, consumption norms, Inflation and changes in law including taxation may not hold true beyond a decade or so; and (iii) frequent change in scope due to changes in city or state government plans. The unbalanced nature of contracts emanates from, among others, a penalty structure tilted in favour of the CGA / Government, imprecise and vague definitions of operator and CGA responsibilities and poor lender protection on operators. Therefore, it is recommended that:
 - ◆ There should be flexibility in revising the KPIs, costs, etc, periodically, for instance, every five years for KPIs.
 - ◆ The KPIs should be progressively tightened as the project progresses rather than expecting steep improvements in performance within a short time span from commissioning date itself.
 - ◆ LDs should be restricted to a fraction of the contract value, say, 10% and there should be full indemnity from the liabilities arising from consequential damages.
 - ◆ There should be a clear classification of major maintenance and minor maintenance heads in the O&M portion of contracts to avoid future disputes.
 - ◆ Materially adverse impacts due to change in law and taxes should be covered through mechanisms that put the financials of the project at the same level as in the original bid.
 - ◆ To protect the interest of lenders, the contracts should also have premature termination clauses and provisions for lender step in in the event of operator default.

A cross-section of industry players have indicated that the ideal way of addressing the rigid and unbalanced contract issue is to adopt FIDIC Gold standards with minor modifications for DBO contracts and to develop a model concession agreement for longer term contracts incorporating the afore mentioned factors along the lines of model concession agreements prepared for the national highways, ports, power and other infrastructure sectors.

Some of the international players consulted during the course of this study have pointed out that in China the contracts are amenable to renegotiation with regard to significant change in initial bid assumptions and KPIs. The distrust levels between the public and the private sector has reduced over time as the PPP market has matured. This allows one to start with a framework agreement which is constantly improved over time to reflect changing ground realities and project contours and gives the contractor has the freedom to decide on technology even when the client has suggested an alternative.

- **Limited Public/End-User Consultations:** To mitigate the risk of project failure, poor performance or customer dissatisfaction at a later date, it is very useful to have extensive consultations with the affected public and end-users at the initial planning stages of project preparation. It is also conducive to involve the end-users in monitoring the operations of the project through a

performance feedback process. In this regard, information & communication technologies can be used to elicit consumer response in real time on performance and other parameters through the use of applications on mobiles, laptops and other digital devices. Various pilots across the country such as in Pimpri Chinchwad are underway to test the efficacy of this feedback process.

Some of the Benefits of Public Consultation are: (i) determine need, define scope including STP sites and network alignment during project planning stage; (ii) arrive at a mutually acceptable tariff; (iii) generate public support for the project, which in turn reduces socio-political risk considerably throughout the project's life; and (iv) enable project authorities and the private operator to use feedback from the public to initiate corrective action.

- **Private Capital Mobilization Main Motive for Government:** In a sector like sewerage, where projects are not viable on a standalone basis and need either capital grants or viability gap support, the motive for awarding these projects on a PPP basis has to be driven by environmental considerations and to leverage the private sector's ability to execute and manage these projects more efficiently than government agencies. This focus on efficiency is likely to result in better project structures with PPPs chosen not because they mobilize private capital but because rewards are commensurate with risks and there is a more balanced risk allocation between the public and private sectors that alternative implementation frameworks.

Annexures

Annex 1: List of Experts Interviewed

S. No.	Name	Designation	Organization
1	Er. S.N.Basu	Addl. General Manager (Tech)	Indraprastha Power Generation Co. Ltd & Pragati Power Corporation Ltd
2	Dr. Parvin Gupta	General Manager (Chem.)	Indraprastha Power Generation Co. Ltd & Pragati Power Corporation Ltd
3	Mr Neeraj Srivastava	President	UEM India Pvt. Ltd
4	Mr. Praveen Remanan	AVP & Head (Mktg & BD)	UEM India Pvt. Ltd
5	Mr. Verinder Singh Thind	Advisor Technical	Essel Infra
6	Mr. SKV Babu	Deputy CEO	VEOLIA
7	Mr. Mukesh Grover	Chief Technical Officer	SUEZ environment
8	Mr. Sasidhar Gollapinni	Head – O&M	SUEZ environment
9	Mr. A. Mahendra	AVP-Sales & Business Development	SUEZ environment

Annex 2: Responses to Questionnaire

1. Response from: Clearford India Pvt Ltd
2. Response from: Triveni Engineering & Industries Ltd
3. Response from Vishwaraj Infrastructure Ltd.
4. Response from VA Tech Wabag

Response from Clearford India Pvt. Ltd

S. No.	Questions	Remarks
1	What has been your experience in dealing with government agencies involved in the provision of sewerage services?	Capable but often not able to think about out of box solutions. Care only about CAPEX and L1 not lifecycle costs.
2	What are the technology options best suited for Indian conditions and more specifically the Ganga Basin? Are there any recent innovations which may be suitable for India?	The issue in the Ganga Basin is not STP;s but how to get the sewage to the STP in the first place. Most of the area has water supply in the 50-85 LPCD range and conventional sewers choke. Suggest decentralized networks with anaerobic digesters like the Clearford One and DRDO's solutions.
3	What are the issues faced when you introduce new technologies?	Agencies always want to not be the first in their area and corporates are allergic to free pilots as the list would be endless.
4	Are bidding parameters biased in favor of older, more proven technologies?	Yes primarily because of lack of knowledge. NMCG tenders are more neutral but still not completely neutral.
5	Is land availability a big issue in sewerage projects?	In large urban areas only.
6	How much difference does a public consultation process make towards a sewerage project?	None.
7	What is your experience regarding the statutory clearances required for implementing a sewerage project?	Mostly easy as they only care about STP output standards.
8	What is your experience with BOT projects in this sector? What needs to be done to improve the bid process?	N/A do not do these as we build collection networks and supply STP's through our vendors who do this.
9	In your opinion, what are the risk factors that you are willing to manage in a PPP project? Technology Project Execution Revenue Investment Operations and Management	PPP face one major hurdle and that is poor quality data for calculating PPP viability. For example a PPP for a STP will assume CPHEEO norms of water supply at 135 LPCD whereas in actuality it is 70 LPCD for example. This means that half the anticipate sewage reaches the STP, the quality of the sewage is worse increasing OPEX costs. Amount of treated water available for sale or gas generated is halved so PPP model fails.
10	What are the Key Success factors defining an Urban Wastewater PPP project?	Good data collection based on realistic actual data and not done by a L1 Consultant.

11	What are the costs of installing an STP based on technologies that you are familiar with? (Give the same in Rs/Mld)	Vary significantly and no thumb rule applies as space is a major constraint.																		
12	In your opinion, what are the likely costs in Rs/Km for laying a pipeline for conveyance of treated sewerage water to the end users? (One can give cost specifications across the standard diameter used in water transmission and distribution.)	Depends on actual LPCD and population density and therefore varies significantly. The thumb rule of diameter being used to determine slope does not work in low LPCD areas which is 80% of India.																		
13	<p>Based on your experience what are the likely costs on operation and management including expenditures on power?</p> <table border="1" data-bbox="281 1006 731 1183"> <thead> <tr> <th>STP</th> <th>Rs/Annum</th> <th>Rs/kL</th> </tr> </thead> <tbody> <tr> <td>O+M</td> <td></td> <td></td> </tr> <tr> <td>Power</td> <td></td> <td></td> </tr> </tbody> </table> <table border="1" data-bbox="281 1218 731 1512"> <thead> <tr> <th>Treated Sewage water reuse Network</th> <th>Rs/Annum</th> <th>Rs/kL</th> </tr> </thead> <tbody> <tr> <td>O+M</td> <td></td> <td></td> </tr> <tr> <td>Power</td> <td></td> <td></td> </tr> </tbody> </table>	STP	Rs/Annum	Rs/kL	O+M			Power			Treated Sewage water reuse Network	Rs/Annum	Rs/kL	O+M			Power			I have found them to vary significantly because of the water supply.
STP	Rs/Annum	Rs/kL																		
O+M																				
Power																				
Treated Sewage water reuse Network	Rs/Annum	Rs/kL																		
O+M																				
Power																				

Response from Triveni Engineering & Industries Ltd

S. No.	Questions	Remarks
1	What has been your experience in dealing with government agencies involved in the provision of sewerage services?	<p>In most of the towns, sewerage networks have evolved on need basis with hardly any master plan which is understandable for old cities. Concern is that small & medium size ULBs are still following this route whereas what is required is detailed mapping of network with latest software support including GIS.</p> <p>In the above situation, sewerage networks in most of non- metro cities are being laid in very adhoc manner leading to frequent problems which is compounded due to non-cleaning of these sewers for decades</p>
2	What are the technology options best suited for Indian conditions and more specifically the Ganga Basin? Are there any recent innovations which may be suitable for India?	<p>STP technology application cannot be on one-size-fit-all basis and individual situations need to be assessed based on ground realities.</p> <p>Indian market has enough competence to apply range of technologies covering ASP/SBR/MBBR/MBR etc on merit including for up-gradation of existing facilities.</p>
3	What are the issues faced when you introduce new technologies?	<p>In almost all cases client is government body and bids are invited on EPC model mostly. New technology introduction is very limited as these are specified in the bid conditions and few government agencies take risk of introducing new ones.</p> <p>Going forward, such jobs should be on technology neutral basis.</p>
4	Are bidding parameters biased in favor of older, more proven technologies?	<p>Experience suggest that externally funded jobs have better technology selection whereas most of the other jobs rely on old technology model with little incentive for reduced life cycle cost.</p> <p>Reason is that most of the externally funding agencies insist for robust consultants' selection before construction bids are invited.</p>
5	Is land availability a big issue in sewerage projects?	<p>This is generally not an issue as most of the existing STPs have excess land available including SDBs.</p> <p>Excess area in these existing plants can be used for capacity expansion wherever feasible.</p>
6	How much difference does a public consultation process make towards a sewerage project?	<p>This may not add much value in normal course but consultation process is always desired to take people together.</p>

S. No.	Questions	Remarks
7	What is your experience regarding the statutory clearances required for implementing a sewerage project?	This has not been a major issue.
8	What is your experience with BOT projects in this sector? What needs to be done to improve the bid process?	<p>In the current revenue model of ULBs, sewerage services are not billed directly and linked to water supply bills.</p> <p>Unless independent sewerage tariff are calibrated to reflect current O&M cost level, to think of BOT model in sewerage network could be pre-matured.</p> <p>Start with full cost recovery of O&M cost and then only move towards capital works recovery as fixed part of tariff.</p> <p>Until then, if any such network is to be taken on BOT, issue is payment of capital works. This will need repayment through fixed component of O&M charges or through annuity mechanism.</p> <p>Payment security is usually suspect if operator is do deal with non-metro ULBs and will need state or federal government securities for lenders' comfort.</p>
9	<p>In your opinion, what are the risk factors that you are willing to manage in a PPP project?</p> <p>Technology</p> <p>Project Execution</p> <p>Revenue</p> <p>Investment</p> <p>Operations and Management</p>	<p>Biggest risk is revenue / payment surety and need is to de-risk the project among various stake-holders.</p> <p>Other risks can be managed / controlled.</p>
10	What are the Key Success factors defining an Urban Wastewater PPP project?	<p>Clearly established events of defaults and their consequences</p> <p>Risks are shared by all stakeholders instead only by the operator</p> <p>KPIs are clearly defined and calibrated to higher levels over the time</p> <p>Bid conditions must be balanced to ensure that finally project must be bankable</p>

S. No.	Questions	Remarks																		
11	What are the costs of installing an STP based on technologies that you are familiar with? (Give the same in Rs/MLd)	<p>This can vary 1.3 Crs to 1.8 Crs per MLD depending upon capacity, sewage quality, treated quality at tertiary level, biogas based power generation if any, extend of sludge treatment etc.</p> <p>Focus must be on life cycle cost and not just capital cost.</p>																		
12	In your opinion, what are the likely costs in Rs/Km for laying a pipeline for conveyance of treated sewerage water to the end users? (One can give cost specifications across the standard diameter used in water transmission and distribution)	This is difficult to quantify like this as there are large number of variables in terms material, size, depth, soil conditions, water table, etc.																		
13	<p>Based on your experience what are the likely costs on operation and management including expenditures on power?</p> <table border="1"> <thead> <tr> <th>STP</th> <th>Rs/Annum</th> <th>Rs/kL</th> </tr> </thead> <tbody> <tr> <td>O+M</td> <td></td> <td></td> </tr> <tr> <td>Power</td> <td></td> <td></td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Treated Sewage water reuse Network</th> <th>Rs/Annum</th> <th>Rs/kL</th> </tr> </thead> <tbody> <tr> <td>O+M</td> <td></td> <td></td> </tr> <tr> <td>Power</td> <td></td> <td></td> </tr> </tbody> </table>	STP	Rs/Annum	Rs/kL	O+M			Power			Treated Sewage water reuse Network	Rs/Annum	Rs/kL	O+M			Power			<p>O&M cost for STP operation will vary widely depending on capacity, technology, sewage quality, biogas generation if any, extend of sludge treatment, level of tertiary treatment etc.</p> <p>To give a rough indication, O&M may be in the range of Rs 10/- to Rs 17/- per m³ including energy cost but excluding financing.</p> <p>For treated sewage network, not possible to provide these figures as every situation is different from other in terms of quality of tertiary treated water, size of network in terms of capacity & length, users' matrix etc.</p>
STP	Rs/Annum	Rs/kL																		
O+M																				
Power																				
Treated Sewage water reuse Network	Rs/Annum	Rs/kL																		
O+M																				
Power																				

Response from Vishwaraj Infrastructure Ltd.

S. No.	Questions	Remarks
1	What has been your experience in dealing with government agencies involved in the provision of sewerage services?	We have been successfully been talking to various municipalities, PHED departments across states to initiate awareness towards wastewater treatment and reuse and the response has been extremely positive and forward looking. We believe that the awareness towards the subject about treatment of wastewater is high, it is that the agencies and departments are not equipped technically & financially to address the concern.
2	What are the technology options best suited for Indian conditions and more specifically the Ganga Basin? Are there any recent innovations which may be suitable for India?	<p>The use of technology will vary depending on the nature of sewage to be treated, in most cities it is the municipal waste which is getting mixed with the industrial waste and is not segregated properly so there may be need to use CEPT also at many places.</p> <p>Also are we only limiting to treatment of sewage or also trying to reclaim water for subsequent reuse in industries, agriculture, non-drinking purposes which will also decide on the extent and type of treatment required.</p>
3	What are the issues faced when you introduce new technologies?	We are not technology providers
4	Are bidding parameters biased in favor older, more proven technologies?	Yes, the bidding parameters have a pre-condition of using a technology which has been successfully implemented over last 3 /4 years and has 3 or 4 running projects therefore introducing a new technology may be a deterrent in bidding process.
5	Is land availability a big issue in sewerage projects?	Not always, at times it may be especially if we are trying to set up STP for large existing towns with inadequate sewage network.
6	How much difference does a public consultation process make towards a sewerage project?	<p>A lot, looking at the requirement of sewage in tier 1 & tier 2 cities with population size more than 5 lacs only 30% sewage is being treated and to be able to implement a sewage project successfully you may actually need to dig through individual households, narrow streets and areas which may lead to public outcry therefore taking them into confidence is absolute necessity.</p> <p>Not only this public has to be made aware and educated not to block the sewage with unnecessary filth, concrete and plastic and segregate what goes into sewer and what does not. More so ever we have a problem of industrial waste being mixed up with Municipal sewage making subsequent treatment and reuse of wastewater extremely difficult and also expensive, therefore public awareness on such issues is most critical.</p> <p>Sanitizing people to contribute effectively towards building and maintaining sewerage projects can contribute immensely towards successful wastewater treatment projects.</p>

S. No.	Questions	Remarks
7	What is your experience regarding the statutory clearances required for implementing a sewerage project?	Not so difficult if the process is followed. Also, given if there is political and administrative will to implement such projects things are manageable.
8	What is your experience with BOT projects in this sector?	<p>We are implementing a BOT project in this sector and have great expectations from the project and feel it can be win win for all parties if executed and delivered properly.</p> <p>We need to start treating sewage more like an economic commodity that is what can make such projects successful.</p>
9	<p>In your opinion, what are the risk factors that you are willing to manage in a PPP project?</p> <p>Technology</p> <p>Project Execution</p> <p>Revenue</p> <p>Investment</p> <p>Operations and Management</p>	<p>If it is a PPP project then risks are part and parcel of the game and all developers are more or less ready to manage the risks that come with such projects be it technology, execution, revenue, investment or O&M. They all go hand in glove and developers are willing to take calculated risks after detailed study of each project that is available for implementation in PPP mode.</p> <p>The important factor is security of investments made by the developer in the project and willingness of state and central government to secure the investments by suitable undertakings especially because most ULB's which control sewage projects are financially not very healthy.</p>
10	What are the Key Success factors impacting an Urban Wastewater PPP project?	<p>Political & Administrative Willingness</p> <p>The fourth P as in People involvement in the process is very important.</p> <p>Policy reforms which will ensure reuse of wastewater by industries as against freshwater.</p> <p>Strict norms on groundwater extraction, zero discharge by industries, stricter norms by Pollution control board & many other administrative reforms can make wastewater PPP projects successful.</p>

Response from VA Tech Wabag

S. No.	Questions	Remarks
1	What has been your experience in dealing with government agencies involved in the provision of sewerage services?	Overall experience has been good. However delayed Payment during Construction and operation & maintenance phase creates working capital problem impacting the overall profitability of the project.
2	What are the technology options best suited for Indian conditions and more specifically the Ganga Basin? Are there any recent innovations which may be suitable for India?	<p>NEREDA® technology- It uses innovative and advanced biological wastewater treatment technology that purifies water using the unique features of “anaerobic granular biomass”. Technology can be used for-</p> <ul style="list-style-type: none"> • Older dysfunctional STP specifically in GANGA BASIN AREAS. <p>Advantage would be increased treatment capacity with the same infrastructure.</p> <ul style="list-style-type: none"> • Greenfield project <p>The advantage would be lower footprint</p> <p>Bio-gas based STP- The sludge generated can be used to generate bio-gas thereby reducing overall dependency on the external source of power. The technology can be useful in areas where power availability is poor. The plant will have lower O&M cost as compared to other conventional plants due to power generated by Bio-gas plant.</p>
3	What are the issues faced when you introduce new technologies?	New technology has to be proven in the Indian condition, could be through a pilot plant prior to implementation.
4	Are bidding parameters biased in favor of older, more proven technologies?	Yes
5	Is land availability a big issue in sewerage projects?	Getting RoU and RoW for pipeline laying work sometimes creates delay when multiple authorities are involved.
6	How much difference does a public consultation process make towards a sewerage project?	Public consultation is of utmost importance in order to determine the paying capacity of General public. Based on the paying capacity of the General public PPP structure should be designed. Also the general public is not aware of the benefits of Sanitation or 24X7 water supply. Along with public consultation they should also be informed about the importance and hygienic aspect of such program.

S. No.	Questions	Remarks
7	What is your experience regarding the statutory clearances required for implementing a sewerage project?	Statutory clearances in all PPP projects should be under the scope of Government. All the statutory clearances should be taken before the start of bidding process.
8	What is your experience with BOT projects in this sector? What needs to be done to improve the bid process?	<ul style="list-style-type: none"> • Projects are delayed due to political reasons. Different parties at state and particular constituency (where BOT project has been declared) results into conflict of interest. • Also opposition by few individual with vested interest hampers the rollout of such projects • The present Pre-Qualification criteria specify that Technology Company should have at least 26% stake. Company like WABAG as a pure technology player with limited financial resource may not be interested in taking financial risk. At the same time technology player should be responsible for EPC and O&M of the quantum of the project involved throughout the concession period. Therefore the maximum amount to be invested by Technology Company should be restricted to 10% with an easy exit route after 2 years from Commercial operation date to enable them to take part in other projects.
9	<p>In your opinion, what are the risk factors that you are willing to manage in a PPP project?</p> <ul style="list-style-type: none"> • Technology • Project Execution • Revenue • Investment • Operations and Management 	<ul style="list-style-type: none"> • Technology risk- The input water quality and quantity parameter along with maximum & minimum variation must be defined in the bid document and WABAG would be ready to take risk within these parameters. For any variation beyond these parameters, concession agreement should define the impact of reinvestment cost with the end product pricing. • Project Execution- WABAG is ready to take all the risk provided all the clearances are provided. • Revenue Risk- Following points to be fulfilled- <ul style="list-style-type: none"> ◆ Guaranteed off-take agreement ◆ Guarantee of receivable in the form of escrow account and other payment surety mechanism. • Investment- Yes willing to manage subject to a counter guarantee from local/central govt. • Operations and management- Yes

S. No.	Questions	Remarks																		
10	What are the Key Success factors defining an Urban Wastewater PPP project?	<p>For the success of PPP projects-</p> <ul style="list-style-type: none"> Political leadership “Willing to pay” by the end user. Local Government has to act as partner throughout the lifecycle of the project. Coordination between various government agencies for speedy clearances. Finally the capacity building of government officials to understand criticality of the PPP projects 																		
11	What are the costs of installing an STP based on technologies that you are familiar with? (Give the same in Rs/MLd)	<p>STP without Bio-gas- 18-20 million/MLd</p> <p>STP with Bio-gas- 28 million /MLD</p>																		
12	In your opinion, what are the likely costs in Rs/Km for laying a pipeline for conveyance of treated sewerage water to the end users? (One can give cost specifications across the standard diameter used in water transmission and distribution.)	<p>Overall Cost- 8 million/km. This may change as per site condition. (Includes pipeline laying, civil cost such as earth work, back-filling, disposal, bedding, and road restoration) but does not include the pipeline material cost.</p>																		
13	<p>Based on your experience what are the likely costs on operation and management including expenditures on power?</p> <table border="1"> <thead> <tr> <th>STP</th> <th>Rs Cr./Annum</th> <th>Rs/kL</th> </tr> </thead> <tbody> <tr> <td>O+M</td> <td>3.3</td> <td>0.9</td> </tr> <tr> <td>Power</td> <td>4.7</td> <td>1.3</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Treated Sewage water reuse Network</th> <th>Rs/ Annum</th> <th>Rs/kL</th> </tr> </thead> <tbody> <tr> <td>O+M</td> <td></td> <td></td> </tr> <tr> <td>Power</td> <td></td> <td></td> </tr> </tbody> </table>	STP	Rs Cr./Annum	Rs/kL	O+M	3.3	0.9	Power	4.7	1.3	Treated Sewage water reuse Network	Rs/ Annum	Rs/kL	O+M			Power			<p>Cost mentioned in red.</p> <ul style="list-style-type: none"> Power cost- Rs. 6.35/kl Plant capacity- 100 MLD Running days in a year- 365 <p>We have not done Treated Sewage water reuse network.</p>
STP	Rs Cr./Annum	Rs/kL																		
O+M	3.3	0.9																		
Power	4.7	1.3																		
Treated Sewage water reuse Network	Rs/ Annum	Rs/kL																		
O+M																				
Power																				

Annex 3: Sewerage Technology and Costs

Comparison of Cost and Area Requirement for various treatment technologies

S. No.	Cost	ASP	MBBR	SBR	UASB+EA	MBR	WSP
1	Capital Cost						
a	Average Capital Cost (Secondary Treatment), INR Lacs /MLD	68	68	75	68	300	23
b	Average Capital Cost (Tertiary Treatment), INR Lacs /MLD	40	40	40	40		40
	Total Capital Cost (Secondary + Tertiary), INR Lacs /MLD	108	108	115	108	300	63
2	Area Requirement						
a	Average Area, m ² /MLD Secondary Treatment + Secondary Sludge Handling	900	450	450	1000	450	6000
b	Average Area, m ² /MLD Tertiary Treatment + Tertiary Sludge Handling	100	100	100	100		100
c	Total Area, m ² /MLD Secondary + Tertiary Treatment	1000	550	550	1100	450	6100
3	Total Annual O&M Costs, INR Lacs pa (Assuming 50 MLD plant upto Tertiary Treatment)						
	Annual Power Cost, INR pa /MLD	4.07	4.9	3.37	2.75	6.65	0.49
	Annual Repair Cost, INR pa /MLD	2.38	1.94	1.84	2.48	5	1.76
	Annual Chemical Cost, INR pa /MLD	5.3	5.3	3.3	6.3		7.2
	Manpower Cost, INR pa /MLD for 50 mld plant upto Tertiary treatment	42.12	30.96	25.92	42.12		32.04
	Total Annual O&M Costs, INR Lacs pa	629	638	451	619	832	505
4	Average Capital Cost, INR Lacs /MLD (Assuming 50 MLD plant upto Secondary Treatment)	68	68	75	68	300	23
a	Annual Power Cost, INR pa /MLD (upto Secondary Treatment)	4.04	4.87	3.34	2.73		0.1
b	Annual Repair Cost, INR pa /MLD (upto Secondary Treatment)	1.5	1.22	1.16	1.56		1.11
c	Annual Chemical Cost, INR pa /MLD (upto Secondary Treatment)	0.85	0.85	0.85	0.85		0.6
d	Manpower Cost, INR pa /MLD for 50 mld plant upto secondary treatment	33.7	24.77	20.74	33.7		25.63
	Total Annual O&M Costs, INR Lacs pa (upto Secondary Treatment)	353.02	372.11	288.15	290.15		116.09

Source: Sewerage Treatment in Class I Towns: Recommendations and Guidelines, IIT Kanpur, Dec 2010

ASP : Activated Sludge Process
MBBR : Moving Bed Biological Reactor
SBR : Sequential Batch Reactor

UASB : Upflow Anaerobic Sludge Blanket
EA : Extended Aeration

MBR : Membrane Bio Reactor
WSP : Waste Stabilization Pond

Annex 4: Analysis of Seven Indian PPP Cases in Urban Wastewater Management

This annex analyses seven PPP projects in the wastewater sector undertaken over the last decade. The projects are located in Alandur, Kodungaiyur, Kohlapur, Nagpur, Salt Lake City, Surat and Vishakhapatnam. The analysis has been presented in the form of three matrices which delineate the parameters of interest to this study, identify the key success or failure factors and present the risk allocation between the public and private sector in these projects. The information contained in the matrices has been sourced from the report on PPP in Urban Sewerage Sector in India prepared by CRISIL Infrastructure Advisory Services in March, 2013, Delhi Jal Board, Central Pollution Control Board, MoEF and Chennai Metro Water & Sewage Board.

Table 2.1: Summary of PPPs in Wastewater in India

Project / Current Status	Project Structure	Scope of Work	Duration of Contract	Capital Cost (INR Cr.)	Funding Pattern of Capital Cost	End User/ Reuse option	Payment Structure/ Revenue Model	Risk Allocation	Key Factors Behind Success/ Failure	Project Development and Operator Selection Process	Community Participation/ Stakeholder Consultation
Alandur Committed 2001 & O&M expired 2005	DB/ EPC O& M/ DBO	Sewerage Network Construction and O&M for five years	5 years	34.6	59% terms loans from TNUISFL & TUFIDCO, 29% public	Households etc Connected to Sewerage Network/ No Reuse	Regular Payment for Construction as per BOQ contract and fixed fee for O&M.	Not Applicable	<ol style="list-style-type: none"> 1. Extensive stakeholder consultation 2. Developing a consensus on levy of connection charges. 3. Strong support from Municipal authorities and state level agencies. 	<ol style="list-style-type: none"> 1. Two Stage National Competitive bid- using World Bank Template. 2. Selection Criteria: <ol style="list-style-type: none"> a. Construction- BOQ Contract- Least Cost b. O&M- Least Fixed Fee 	<p>WTP surveys, Followed by extensive consultation with stakeholders to Educate them on need for project and arrive at acceptable connection charges (one time deposits) and acceptable monthly user charges.</p> <p>Monthly meetings with RWAs to inform about progress of project as well as seek feedback.</p>
Alandur STP In Operation since 2003. Contract to terminate in 2017	BOT Third-Party Operator PPP (Annuity)	Treatment and Disposal 12 MLD Plant	14 years	6.68	100% Private Developer	ULB and Entities connected to the sewer system. No reuse	<ol style="list-style-type: none"> 1. Performance linked Annuity payments by ULB. 2. Minimum Payment Guarantee by ULB to cover fixed Operating costs and Capital investment 	<ol style="list-style-type: none"> 1. Extensive stakeholder consultation 2. Developing a consensus on levy of connection charges. 3. Strong support from Municipal authorities and state level agencies. 4. Sound Project Structuring and Transparent bidding process. 5. However, in the later stages of the contract term, there were delays and non-payment even of the minimum guaranteed amount. This led to VAtech Wabag not undertaking the expansion of the STP as stated in the contract. 	<ol style="list-style-type: none"> 1. Extensive stakeholder consultation 2. Developing a consensus on levy of connection charges. 3. Strong support from Municipal authorities and state level agencies. 4. Sound Project Structuring and Transparent bidding process. 5. However, in the later stages of the contract term, there were delays and non-payment even of the minimum guaranteed amount. This led to VAtech Wabag not undertaking the expansion of the STP as stated in the contract. 	<p>WTP surveys, Followed by extensive consultation with stakeholders to Educate them on need for project and arrive at acceptable monthly user charges.</p> <p>Monthly meetings with RWAs to inform about progress of project as well as seek feedback.</p>	<p>WTP surveys, Followed by extensive consultation with stakeholders to Educate them on need for project and arrive at acceptable monthly user charges.</p> <p>Monthly meetings with RWAs to inform about progress of project as well as seek feedback.</p>

Project / Current Status	Project Structure	Scope of Work	Duration of Contract	Capital Cost (INR Cr.)	Funding Pattern of Capital Cost	End User/ Reuse option	Payment Structure/ Revenue Model	Risk Allocation	Key Factors Behind Success/ Failure	Project Development and Operator Selection Process	Community Participation/ Stakeholder Consultation
Kodungalpur Committed in 2006, O&M to end in 2016	DBO	Treatment and Disposal 110 MLD STP	11.5 years	38.27	70% NRCDC, GoI and 30% CMWSSB	ULB, entities connected to the sewerage network/ No reuse	1. BOQ contract based payments during construction. 2. Fixed and variable fees linked to the quantity and quality of the sewage treated paid by CMWSSB.	Private sector takes design, construction and operations risks. CMWSSB took funding, demand, revenue and land risks.	1. No market or demand risks on private sector. 2. Freedom to select technology. 3. Strict Monitoring of Outputs.	Single stage process - technical and financial proposals. Selection criteria; lowest annuity for O&M.	No stakeholder consultations or community participation.
Kolhapur In operation, committed in 2015.	BOT Third-Party Operator PPP. (Annuity)	Treatment and Disposal (Allied Infrastructure)	15 years	75	70% NRCDC, GoI grant and 30% private operators	KMC and entities connected to sewerage network/ No reuse.	Performance linked Quarterly Annuity payments by KMC comprising: a) fixed charge= fixed O&M cost including inflation and operator capital investment; b) variable charge indexed to inflation = Rs/ML of sewage treated	Private operator takes design, construction, operations and partial funding risks. KMC takes majority funding, demand, revenue and land risks.	1. Availability of Significant grant funding. 2. Annuity payments by KMC guarantees operator its expected returns provided performance obligations are met. 3. Sound Project structure and well formulated and transparent bidding process.	Two stage competitive bidding process. Extensive Technical and financing information provided to bidders. Selection criteria; lowest annuity payment	No stakeholder consultations or community participation.
Nagpur Expected to be commissioned by late 2015.	BOT End User Operator PPP	Sewerage network, treatment and disposal, collection of revenue from reuse wastewater	30 years plus extension option- 0 years	130.11	JnNURM- 50% GoI, 20% GoN and 30% MAHA-GENCO. Cost Escalation MAHA-GENCO	MAHAGENCO to receive entire 110 MLD plus 10% of treated wastewater Pioli Nadi STP	NMC to pay 70% of construction payments grant funded. During O& M period MAHAGENCO to pay NMC a fixed amount of Rs. 15Cr per annum on a monthly basis (1.25 Cr). For Treated sewage beyond contracted amount MAHAGENCO to pay NMC Rs. 2.03 per KL. Benefit to MAHAGENCO is cost savings compared to alternative of freshwater from Rahari Dam.	NMC takes Land, sewage availability and quality risk. MAHAGENCO takes design, O&M, partial funding, cost overrun and demand/ revenue risks.	1. Strong project ownership by MAHAGENCO and NMC. 2. Feasibility undertaken at the beginning. 3. Contracts ring fencing commercial risks. 4. However contracts had loopholes, allowing for significant change in scope post signing.	There was no bidding as the operator approached NMC itself. Thus selection was on a nomination (sole source) basis. MAHAGENCO selected an operator through competitive tendering on least project cost basis. Detailed USAID funded feasibility study undertaken on water reuse opportunities. MoU with NMC akin to a concession and a concession agreement between MAHAGENCO and SMS-GSJ Enviro Ltd spelled out the PPP structure and project components clearly.	Detailed Stakeholder consultations between NMC and MAHAGENCO. However there was no community participation as MAHAGENCO is the only consumer.

Project / Current Status	Project Structure	Scope of Work	Duration of Contract	Capital Cost (INR Cr.)	Funding Pattern of Capital Cost	End User/ Reuse option	Payment Structure/ Revenue Model	Risk Allocation	Key Factors Behind Success/ Failure	Project Development and Operator Selection Process	Community Participation/ Stakeholder Consultation
Salt Lake City, Kolkata Committed in 2010 and currently in operation till 2040	BOT Third-Party Operator PPP (User Charge)	Sewerage treatment network, and disposal, collection of sewage charge from IT Units connected to the Network.	1.5 years Construction, 30 years O&M	36.15	35% JnNURM grant, 3.7% NDITA and 61.3% Private operators	IT units connected to the sewerage network. No reuse.	Recover 61.3% of Capital Cost and O&M cost for Sewerage through levy and collection of a sewerage charge of Rs. 10/ KL. The Sewerage charge was a part of a combined water and sewerage tariff of Rs. 25/ KL applied to Water consumption by the units. Also Levy of a one-time collection fee of Rs. 10 per square foot.	KMDA and NDITA took land and part of Capital funding risks. Private operators took design, partial funding construction, O&M and revenue risks.	1. Availability of significant Capital Grants. 2. Strong implementation Support from KMDA and NDITA. 3. Consumer participation elucidate through road shows on project concept and benefits as well as discussions with IT firms on acceptable tariff levels. Feedback on tariffs incorporate in final tariffs levied.	1. No detailed feasibility/ Technical studies undertaken prior to bidding. 2. After selection of operator through two stage QCBS competitive bidding and prior to signing the concession, DPR prepared by Operator to determine cost of works and tariffs. 3. DPR tariff discussed with consumers for acceptability. Negative feedback resulted in re-working of scope and costs till acceptable tariffs were achieved. 4. After signing the concession, operator undertook detailed site studies and design engineering before commencing construction.	Extensive consultations with stakeholders/ End user community on tariffs and benefits. Extensive road shows conducted by Government and operator to spread awareness about the project.
Surat-Bamroli Wastewater Recycling Concession Agreement canceled prior to signing in July 2010. Later contract awarded on EPC basis in 2012 & now in operation	BOT Third-Party Operator PPP (User Charge).	O&M of 100 MLD Municipal STP and DBFOT of 40-80 MLD TTP and allied reuse network infrastructure	20 years including two years of construction	65.63	100% Pvt Operator	Industrial Units in Pandesara Industrial Estate. Entire supply of 40 scaling upto 80 MLD of Tertiary treated water will be reused.	Pvt Operator to be paid by SMC : 1. Monthly water fee comprising: a. Municipal STP O&M charge. b. Tertiary treated water charge (Volume of treated water supplied at Bid Tariff) 2. Payment for rehabilitation of existing distribution network in Pandesara Industrial Estate. 3. SMC to levy and collect user charge on volumetric basis on industrial consumers.	SMC to take land availability risk. Pvt Operator to take funding, design construction, O&M and revenue risks.	Failure: SMC decided to implement the project on its own through Third Party EPC contract and O & M on its own because this option was considered more beneficial from SMC's perspective.	1. Detailed project conceptualization and evaluation (FIBR) - Dec 2007-May 2008. 2. PPP bid documentation prepared Apr 2008- Mar 2009. 3. Single stage International competitive bid Apr 2009- Nov 2009. Including two pre-bid meetings. 4. Selection criteria: Lowest tariff quote. 5. SMC cancels bid post Nov 2009.	1. Consultations with SMC and Industry association to determine need, key issues and acceptable tariffs. 2. Informal feedback from technology suppliers, operators elicited. 3. Discussions with ADB, MoUD and GoG on innovative ways of structuring the project.

Project / Current Status	Project Structure	Scope of Work	Duration of Contract	Capital Cost (INR Cr.)	Funding Pattern of Capital Cost	End User/ Reuse option	Payment Structure/ Revenue Model	Risk Allocation	Key Factors Behind Success/ Failure	Project Development and Operator Selection Process	Community Participation/ Stakeholder Consultation
Vishakapatnam Wastewater Recycling Approval from GoAP for Concession Agreement still awaited.	BOT Third Party Operator PPP (User Charge)	Sewage Treatment and disposal and collection of revenue from Sale of treated wastewater.	26 years (including one year of construction)	107.18	100% Pvt Operator	Industrial users in and around Vishakapatnam. 100% reuse of 60 MLD tertiary treated sewage water.	Sale of treated wastewater by pvt operator to industrial consumers. Pvt Operator to levy and collect user charge directly from industrial user.	VMC to take land acquisition risk. Pvt Operator to take Design, construction, O&M and revenue risks.	Failure: 1. Inadequate study during preparatory stage led to misunderstandings about benefits to Pvt Operator and VMC. 2. Lack of VMC experience in handling such PPP projects led to lack of consensus among VMC and GoAP authorities and delayed project approvals. 3. Delay in signing amendments to Concession Agreement with Pvt Operator, due to bifurcation of erstwhile Andhra Pradesh. 4. As entire revenue risk was with Pvt operator, quotes for purchase of treated sewage from VMC were very low.	1. No detailed financial and economic assessment of the project undertaken prior to bidding. 2. Two stage international competitive bidding process adopted. May 2010- Nov 2010. 3. Pvt Operators selected financial selection criteria royalty for secondary treated sewage paid to VMC in Rs/KL.	Not much stakeholder consultations and no community participation.

Table 2.2: Key Success/ Failure Factors Domestic Case Studies

Factors	Case 1- Alandur BOT Third-Party PPP (Annuity)	Case 2- Kodungaiyur DBO	Case 3- Kolhapur Wastewater Project BOT Third-Party PPP (Annuity)	Case 4- Nagpur Wastewater recycling BOT End-User PPP	Case 5- Salt Lake City, Kolkata BOT Third-Party PPP (User Charge)	Case 6- Surat Bamroli BOT Third-Party PPP (User Charge)	Case 7-Vishakhapatnam Wastewater Recycling Project BOT Third-Party PPP (User Charge)
Overall Success/ Failure	Partial Success (Payment problems in later stages of operations)	Success	Success	Success	Partly Successful	Failure (Project cancelled)	Failure. Project indefinitely delayed.
(A) Factors at Project Development Stage							
Sound need assessment	Undertaken- Pollution Prevention	Undertaken- Pollution Prevention	Undertaken- Pollution Prevention	Undertaken. Shortage of freshwater and excessive cost of sourcing additional freshwater.	Undertaken. To control pollution and hence shift of IT unit to other destinations.	Undertaken. Shortage of freshwater. Thus need for water conservation and recycling paramount.	Undertaken. Shortage of freshwater. Thus need for water conservation and recycling paramount.
Balanced Allocation of Risks and Benefits	Yes	Yes	Yes	Mediocre. Slightly in favour of NMC and as far as payments for treated sewage supply are concerned.	No. Private operator to bear demand and revenue risk as well as majority of funding risks.	No. SMC felt that the bid tariff was too high given that a large part of sewage volume/ quality risks as well as revenue risks were taken care of by SMC.	No. Reuse demand and revenue risks, completely with private operator. Also entire Capex funding risk is with the private operator. Hence the quote for royalty payment to GVMC for secondary treated sewage was abnormally low, resulting in reduced revenue benefit to GVMC.
Availability of Grants and long term, subsidized loans	Available. Partial grant funding by GoTN. Subsidized interest loans from TUFIDCO.	Available. Entire project cost financed by the Public sector. 70% was grant from NRCD, Gol.	Available. 70% of Capital cost has grant from NRCD, Gol.	Yes. 70% of Capex excluding cost over- runs through JnnURM.	Yes. 35% of project costs funded as JnnURM grant. NDITA and KMDA provided land free of cost.	No grants or long term subsidized loans available to the project.	No grants or subsidized long term loans were available to the project.

Factors	Case 1- Alandur BOT Third-Party PPP (Annuity)	Case 2- Kodungaiyur DBO	Case 3- Kolhapur Wastewater Project BOT Third-Party PPP (Annuity)	Case 4- Nagpur Wastewater recycling BOT End-User PPP	Case 5- Salt Lake City, Kolkata BOT Third-Party PPP (User Charge)	Case 6- Surat Bamroli BOT Third-Party PPP (User Charge)	Case 7-Vishakhapatnam Wastewater Recycling Project BOT Third-Party PPP (User Charge)
Revenue Guarantees/ Assurances	Given Minimum payment guarantee under 'take or pay' clause. However, in the later stages of the contract term, there were delays and non-payment even of the minimum guaranteed amount. This led to VATech Wabag not undertaking the expansion of the STP as stated in the contract.	Given. Fixed and variable annuity payments for O&M subject to penalties for Non-Adherence to standards. Variation in sewage quantity to be compensated by CMWSSB. In case of variable annuity, only power cost to be compensated.	Given. O&M cost and Capital invested recovered through quarterly annuity payments by KMC. Annuity payments comprise a fixed charge and a variable charge and protect the operator against variations in quantity of sewage. The payment can be adjusted for non-adherence to performance standards.	Yes. MAHAGENCO to pay NMC a fixed amount on a monthly basis.	None.	Inflation indexed fixed payment by SMC to operator for O&M of Municipal STP. SMC to compensate operator for variation in sewage supplied. SMC to deposit 5% of project cost in Escrow account to backstop timely and full payment of water charges.	No revenue guarantee/ assurance by GVMC to the operator.
B) Factors During Project Development Stage							
Sound and Transparent bidding procedure	Yes. World Bank and FIDIC processes followed. Oversight and Approval by World Bank and Public.	Yes. Single stage competitive bidding followed. The bid comprised a technical proposal and a financial proposal. Extensive Technical and financial information provide to bidders. Clear bid selection parameter.	Yes. A two stage competitive bidding process was adopted. Extensive technical and financial information provided to bidders. Clear bid selection parameter.	MAHAGENCO selected on a sole source basis by NMC. MAHAGENCO selected EPC contractor and O&M operator through a single stage competitive tender.	Only partially. Operator selected through two stage competitive bidding process. However no detailed feasibility and technical studies undertaken prior to bidding by KMDA and NDITA. All these were undertaken by the operator post selection.	Bidding was extremely sound and transparent. Utilizing single stage international competitive bidding process including two pre-bid meetings. Detailed feasibility and technical studies were conducted including discussions with the Pandesara Industries Association. Road shows held prior to initiating bid process. Resulting in market oriented bid documents which also incorporated SMC concerns.	Only Partially sound. No detailed financial and economic assessment of the project undertake prior to bidding. However two-stage international bidding process adopted. (19 firms submitted EoIs. 14 firms shortlisted but only two submitted final bids.)

Factors	Case 1 - Alandur BOT Third-Party PPP (Annuity)	Case 2- Kodungaiyur DBO	Case 3- Kolhapur Wastewater Project BOT Third-Party PPP (Annuity)	Case 4- Nagpur Wastewater recycling BOT End-User PPP	Case 5- Salt Lake City, Kolkata BOT Third-Party PPP (User Charge)	Case 6- Surat Bamroli BOT Third-Party PPP (User Charge)	Case 7-Vishakhapatnam Wastewater Recycling Project BOT Third-Party PPP (User Charge)
Public Sector capability or technical assistance for procurement of works on PPP basis	AM capability limited. Assistance provided by donor agencies- USAID, engineering consultants, Chennai Corporation and TNUIFSL.	CMWSSB, the concessioning authority, had adequate capability to select the operator and monitor the project.	No. KMC hired IIPDF, CRIS, NJS Engineers and Clarus Law associates to help it with project development and selection of private operators.	NMC capability limited. Feasibility study undertaken by USAID. Remaining detailed scoping and bidding undertaken by MAHAGENCO.	KMDA and NDITA capability Limited. Not much assistance from external agencies.	SMC capability limited, hence took assistance from ADB, GoG, MoUD, IIMaCS, JSA, Lovells Singapore.	GVMC's capability to implement PPP projects limited. Also GVMC did not take assistance from external agencies conversant with the process.
Competent Private Sector Players	Yes- IVRCL and Va Tech Wabag	Yes. VA Tech Wabag GMBH/ VA Tech Wabag India.	No. Vishwa Infrastructure and Services Pvt Ltd has delayed work for no specific reason and has not submitted financing agreements as yet.	Yes so far. MAHAGENCO and SMS-GSJ Environment Ltd.	Yes. JUSCO-Voltas consortium.	Yes. All the bidders were competent in the field of wastewater treatment and reuse.	Competency unknown. A.V.Ram Babu Infra Private ltd is the concessionaire.
Contract Administration and Project Monitoring Skills	Yes undertaken by AM, TNWSSB, CMWSSB, TNUIFSL and Citizen's Committee.	Yes. Undertaken by CMWSSB.		Yes undertaken by MAHAGENCO, Joint Oversight Committee and JnNURM monitoring committee.	Mediocre. KMDA and NDITA delayed handing over of land; inability to supply contracted Raw water to JUSCO-Voltas. Hence inability to enforce groundwater abstraction ban.	Not tested as PPP project was canceled prior to award.	GVMC to undertake project management during construction and monitor O&M alongwith APPCB. GVMC currently operates two STPs and the Vizag sewer network therefore has sufficient expertise in standard project supervision and O&M monitoring. However it has limited experience in administering and monitoring DBFOT/BOT type PPP contracts.

Case 1- Alandur BOT Third-Party PPP (Annuity)	Case 2- Kodungaiyur DBO	Case 3- Kolhapur Wastewater Project BOT Third-Party PPP (Annuity)	Case 4- Nagpur Wastewater recycling BOT End-User PPP	Case 5- Salt Lake City, Kolkata BOT Third-Party PPP (User Charge)	Case 6- Surat Bamroli BOT Third-Party PPP (User Charge)	Case 7-Vishakhapatnam Wastewater Recycling Project BOT Third-Party PPP (User Charge)
Stakeholder Consensus	Yes. Strong support by citizens and AM officials.	No stake holder consultations or community participation.	No stake holder consultations or community participation as MAHAGENCO is the sole source concessionaire.	Yes. Extensive consultations with Units on project contours, benefits and acceptable tariffs.	Yes. Extensive consultations with SMC and Industry to determine need and key issues and acceptable tariffs. Informal feedback from technology suppliers and operators.	No stakeholder consensus and no community participation
Political Will	Strong Political Will and quick decision making by the council.	CMWSSB and MoEF, Gol strongly backed the project.	NMC and MAHAGENCO, GoM strongly committed to the project	KMDA and NDITA, GoWB were strongly committed to the project and provided a lot of support in obtaining permissions, consultations with consumers and in re- designing the project to meet consumer needs.	In later stages of operator selection, political will of SMC was lacking as it felt that it was losing out on reuse water revenues and the perception that the private operators were quoting too high a tariff given that the revenue risks were mainly taken care of by the SMC.	Political will to see the project through has been lacking both at the level of GVMC and GoAP. GoAP in particular has been dragging its feet in signing agreements. This has led to inordinate delays in getting approvals and achieving financial close.

Table 2.3: Risk Allocation by Contract Type and Category of Stakeholder

Risk Parameter	Case 1- Alandur BOT Third-Party PPP (Annuity)	Case 2- Kodungaiyur DBO	Case 3- Kolhapur Wastewater Project BOT Third-Party PPP (Annuity)	Case 4- Nagpur Wastewater recycling BOT End-User PPP	Case 5- Salt Lake City, Kolkata BOT Third-Party PPP (User Charge)	Case 6- Surat Bamroli BOT Third-Party PPP (User Charge)	Case 7-Vishakhapatnam Wastewater Recycling Project BOT Third-Party PPP (User Charge)
Delays in land acquisition	Public	Public	Public	Public	Public	Public	Public
Financing risks	Private	Shared	Public	Shared	Private	Private	Shared
Design risk	Private	Private	Private	Private	Private	Private	Private
Construction risk	Private	Private	Private	Private	Private	Private	Private
Approval risk	Shared	Shared	Shared	Shared	Shared	Shared	Shared
O&M risk	Private	Private	Private	Private	Private	Private	Private
Volume/ demand risk	Public	Public	Public	Shared	Shared	Private	Private
Payment/ revenue risk	Public	Public	Public	Private	Private	Private	Private
Performance risk	Private	Private	Private	Private	Private	Private	Shared (Minimum Sewage Amount guaranteed by NMC.)
Environmental risk	Private	Private	Private	Private	Private	Private	Private
Change in law	Public	Public	Public	Public	Public	Public	Public
Force majeure	Shared	Shared	Shared	Shared	Shared	Shared	Shared
Responsibility for employment of existing ULB / State Utility employees	Not Specified	Public	Public	Public	Public	Public	Public
Availability of power	Private	Private	Private	Not Specified	Private	Private	Private
Socio-political risk*	Shared	Shared	Shared	Shared	Shared	Shared	Shared

*Part of the risk is mitigated by the private operator through, among others: (i) attending public consultations to ascertain level of acceptable tariff, STP site locations and sewer alignments acceptable to the public etc. and incorporating the feedback in project design to the extent possible; (ii) providing a portion of treated wastewater to farmers free of cost; (iii) adopting technology / practices to reduce unsanitary conditions in the vicinity of the wastewater treatment plants to overcome the Not-In-My-Back-Yard (NIMBY) syndrome.

Annex 5: Extract from “Water Policy for Delhi”

The Government of NCT, Delhi has taken the initiative to develop a policy for water and wastewater. The relevant extract of the policy is as under:

“EXISTING POLICY BASELINE: Delhi will increasingly recycle treated wastewater to augment resources. Some initiatives have been taken but there is no coherent policy in this regard”

“Sewage has to be seen as a resource and urban society as the greatest generator of wastewater needs to set up incrementally increasing targets on recycle and reuse. It does not make sense to transport sewage away from the point of origin, treat it for reuse, then pump it all the way back – hence the importance of decentralized treatment systems”

Wastewater Resources in NCT Delhi

- 4. 18. “At present about 1349 MLD of wastewater generated in the city is treated by sewage treatment plants and the rest of the wastewater is being discharged into the drains without any treatment. To treat the all-available wastewater Soil-Aquifer Treatment plants can be put up near the existing sewage as well as near the major drains carrying the wastewater. A battery of tubewells for using the treated wastewater for domestic purposes can pump this wastewater out. As the water is free of foul smell it can be used for all purposes after proper chlorination.” – CGWB [Hydrological Framework AND Groundwater Management Plan of NCT Delhi, February, 2006]
- 4. 19. “The total installed wastewater treatment works capacity (2004) is 2,330 MLD. As part of this study, flows were measured at the WWTP and observed dry weather flows in 2003 were estimated as 1,384 mld (304 mgd).” [Report of Price Waterhouse Coopers, DHV, TCE, 2004 for DJB]

Table: Projections of Influent Wastewater Volumes at STPs

Source of wastewater	projected wastewater volumes (MLD)				
	2004	2005	2006	2011	2021
Total water demand	2727	2842	2961	3623	5321
Total net water supply	2185	2566	2774	3573	5259
Wastewater generated	1748	2053	2219	2858	4207
Diverted to CETP	200	217	234	346	755
Proportion not sewered	14%	13%	13%	10%	5%
Outside sewered area	244	267	288	286	210
Net generated wastewater	1304	1569	1697	2226	3242
Infiltration	518	518	518	518	518
Gross wastewater for treatment	1822	2087	2215	2744	3760

Levels of Treatment

- 4. 20. Presently most of the sewage treated is upto secondary levels of treatment [<20 mg/l of SS and <30 mg/l of BoD]. This is as per the MoEF's norms for discharge into surface drainage. 'If made mandatory by the Honorable Supreme Court all new WWTPs have to be designed for an effluent quality of 10 mg/litre BOD and 15 mg/litre SS. All WWTPs are to have disinfection facilities for coliform reduction to $<10,000$ MPN per 100 ml. If made compulsory for older works this will entail construction of tertiary treatment plants.' - [Report of Price Waterhouse Coopers, DHV, TCE, 2004 for DJB]
- 4. 21. Presently of the wastewater generated 200 MLD is from the industrial estates and this is treated in 10 operational CETPs. However, it is observed that the treated effluent quality of these CETPs is much above the treated effluent norms of CPCB with detectable levels of heavy metals and very high levels of TDS. As such this effluent cannot be utilized for recharge purposes.
- 4. 22. It may also be added that the High Court has directed the installation of decentralized STPs [package units] in about 189 villages of Delhi and thus a decentralized, unquantified but substantial resource would be available for recharge purposes.

Treated Wastewater

- 4. 23. The treated wastewater must be considered as an available resource that has the potential to be reused/ recycled for the non-domestic purposes, to allow the groundwater table to rise to enable withdrawal of groundwater. Some of the options available in general have been suggested in the Report prepared for the 'Delhi Jal Board - DWSSP – Project Preparation Study – DFR 3 – Part C – Sewerage - Volume I by PWC' below:
 - Discharge into natural bodies of water
 - Utilisation for irrigated agriculture where agricultural produce which are eaten only after cooking comes in contact with treated wastewater
 - Utilisation for irrigated horticulture, parks, gardens, green areas, road flushing, fire-fighting storage, forestry etc.
 - Use in industries as cooling water, boiler feed water and any other industrial process water.
 - Recharge of groundwater after treating to suitable standards or indirect recharge and creation of recreational reservoirs/ lakes

- 4. 24. Delhi is bound to return 250 MGD to River Yamuna under the Upper Yamuna Water Sharing Agreement. However, DJB provides 822 MGD water supply [from all basins and groundwater] and after Munak channel contribution another 100 MGD whereas private tubewells provide further 100 MGD i.e. a total of 1022 MGD. Assuming 80 % of this figure as return water [i.e. 815 MGD] Delhi has a potential wastewater resource of 565 MGD.

Private Sector Participation

Private sector participation should be encouraged in planning, development and management of water resources projects for diverse uses, wherever feasible. Private sector participation may help in introducing innovative ideas, generating financial resources and introducing corporate management and improving service efficiency and accountability to users. Depending upon the specific situations, various combinations of private sector participation, in building, owning, operating, leasing and transferring of water resources facilities, may be considered.

Annex 6: Recommended Sewerage Tariff

SEWERAGE TARIFF

The sewerage tariffs, existing and proposed, in 24 towns for which DPRs approved under JnNURM schemes have been examined and following are observations:

There are broadly three types of tariff structure viz. Percentage of water charges, property area-based charges and charges based on no. of connection/toilets. Due to diversity in proposed tariff structures, tariff based on type I i.e. percentage of water tariff, is being considered to evolve suitable sewerage tariff.

- i. 9 towns are having sewerage tariff in the range of 25-60% of water charges. 4 nos of towns are charging tariff on the basis of volumetric basis which is also similar to the percentage of water tariff.
- ii. 2 towns of Punjab and Perungudi are having sewerage tariff according to area of the household. It varies from Rs.6-8 per sq.mtr. 2 Towns are charging sewerage tariff as percentage of annual property tax at the rate of 1 to 4% of property tax. This is similar to charges based on property area.
- iii. 4 towns charge based on nos. of toilet seat/sewer connections varying between Rs.5-6 to Rs 30 per toilet seats and Rs.75-200 per connection per month. One town charges flat rate on monthly basis.

Considering the above conditions, it seems that tariff charges may be better collected with respect to percentage of water charges. The sewerage system is designed based on percentage of water supply leading to sewage. Tariff based on property area/tax and flat rate based on no of connections/toilets may not be desirable. However, until the water connections are metered, a flat rate may be accepted initially.

To arrive at proposed sewerage systems tariff as given in subsequent paragraphs, other related documents in the matter have also been examined like those of TERI and HPEC reports.

Proposed Tariff Model for Sewerage system

- (a) Metered Connections rates: Normally, it is advisable to fix up sewage tariff as 50-75% of water tariff according to the water use for a viable system. The above charges may be subsidized for BPL family up to 50% for water use/sewage up to 20 Kl/month usage. Rates are indicative and may vary from city to city to fully recover at least O&M charges to begin with.

- (b) Unmetered Connection Rates: Flat rate for unmetered connections can be grouped into five categories. These categories are:
- i. based on ferrule size of connection;
 - ii. based on the number of taps in a house;
 - iii. based on number of toilet seats in the house;
 - iv. a fixed monthly flat rate and
 - v. a variable monthly flat rate based on the Annual Rateable value (ARV) of property.

In case of un-metered connections fixed charges may be collected based on the built up area of the property, this may range from Rs.50-200.00/- per month.

The above charges may be subsidized for BPL family up to 50%.

Rates are indicative and may vary up at regular intervals in transparent manner. While changes due to inflation, etc should be passed through in tariff manual basis.

(Source: Advisory on Tariff Structure, MoUD, GoI, July – 2013)

Annex 7: International Case Studies

Salient Features of a Few International PPP Wastewater Projects:

Name	Scope of work	PPP Category	Project cost and sources of financing (public/private)	Cost Recovery
New Cairo STP, 2009	Design, construction, and O&M of STP of 500 MLD capacity	BOT Third-Party Operator PPP- (Annuity)	USD 482 million (Private)	Annuity payments
Muharraq STP, 2010	Design, construction, and O&M of STP of 160 MLD capacity and main trunk lines	BOT Third-Party Operator PPP- (Annuity)	USD 325 million (shared)	Annuity payments
Atotonilco STP, 2010	Design, construction, and O&M of STP of 4500 MLD capacity	BOT	USD 16.7 billion (Shared)	-
As Samra STP, 2003-04	Design, construction, and O&M of STP of 540 MLD capacity	BOT Third-Party Operator PPP (User Charge)	USD 169 million (Public)	User charges

Source CRISIL INFRASTRUCTURE ADVISORY

1. Sembcorp NEWater Plant at Changi, Singapore

I. PROJECT DESCRIPTION

a. Background

PUB's best sourcing strategy for procurement has evolved through the years to help Singapore secure adequate water supply at the best value for money. Starting with in-house design and supervision combined with outsourcing of construction, PUB has progressed to outsourcing of design and construction to the private sector. In Nov 2001, PUB initiated a greater liberalization of its best sourcing strategy when it called its first PPP tender for a 30MIGD desalination plant in Tuas (later known as SingSpring Desalination Plant) under the design-build-own-operate (DBOO) arrangement. In fact, PUB is the first public agency in Singapore to adopt such a PPP approach. To date PUB has implemented five DBOO projects, namely, the afore-mentioned SingSpring Desalination Plant, the 32MIGD Keppel Seghers NEWater Plant, the 50MIGD Sembcorp NEWater Plant, the 70MIGD Tuaspring Desalination Plant and the 50MIGD Second Changi NEWater Plant.

This case study on Sembcorp NEWater Plant outlines key features of the DBOO project, which includes the technical, financial, commercial and legal frameworks, benefits of PPP and challenges faced during conceptualization and implementation.

Fig 1: NEWater Plant



b. Project Timelines

The timeline for the Sembcorp NEWater Project is listed below:

Date	Activities
Aug 2007	Request for Proposal (RFP) issued
Nov 2007	Bids received
Jan 2008	Preferred Bidder Selected
Feb 2008	NEWater Agreement signed
May 2008	Financial close
May 2010	Commercial operation

II. PROCESS ANALYSIS

The Sembcorp NEWater Plant at Changi is developed using the Public Private Partnership (PPP) approach. Under this PPP arrangement, the concession company, Sembcorp NEWater Pte Ltd (Sembcorp), was contracted by PUB to design, build, own and operate the 50MIGD NEWater Plant. The water produced, which must meet all of PUB's stringent water quality requirements, is supplied to PUB for a period of 25 years from 2010 to 2035. The Sembcorp NEWater Plant has been in operation since May 2010 and has consistently produced NEWater that meets PUB's requirement.

a. Procurement

For the Sembcorp NEWater Plant, the PPP DBOO procurement approach has resulted in a lower than expected bid price for NEWater due partly to economy of scale, design innovation and improvements in membrane technology. Some of the other benefits of this approach include improved economic optimization, increased innovation and greater opportunities for the private sector.

Improved Economic Optimization - Under the PPP DBOO approach, the design, financing, construction, operations and maintenance are undertaken by the same company or consortium. There is therefore strong incentive for the private concession company that design and build the NEWater Plant to also optimize the operation and maintenance costs of the facility. For the Sembcorp NEWater Plant, the concession company used the “optimal lifecycle costing” approach instead of the “lowest capital cost” approach. The plant design incorporated a number of energy saving features to lower the operating costs. All pumps have variable speed drives to maximize energy efficiency. Inter-stage energy recovery turbines (turbo boosters) were installed in the RO membrane trains to reduce their energy consumption and thus the operating costs for the plant.

Increased Innovation - Since the design and operation of the plant is the responsibility of the concession company, there are opportunities and incentives for the private sector operator to introduce innovative ideas and add value to the project. The technical requirements for the DBOO project were mostly performance-based, with the quality and quantity of NEWater as the key performance criteria. This approach allowed the concession company more flexibility to innovate and optimize the plant design while implementing the established treatment processes necessary for meeting the high quality standards of NEWater. Some examples of innovation and optimization in their design include the following:

- Stacking RO pressure vessels higher than normal to reduce building footprint
- Using variable speed pumps to optimize process performance and reduce energy demand
- Using inter-stage energy recovery devices between the two stages of the RO train to reduce energy consumption and balance permeate flux across the membrane stages

Greater Opportunities for the Private Sector - The PPP DBOO procurement approach also offers greater business opportunities for the private sector in Singapore’s water industry. Under the traditional procurement methods, PUB would have contracted private firms to design and construct a NEWater facility, and then PUB would operate the plant with its own staff. With the DBOO approach, PUB utilizes the expertise and experience of the private sector partner to not only design and build the facility, but also to finance, operate and maintain the plant. This procurement approach creates new business opportunities for the private sector in Singapore to be involved in service delivery to the public sector.

b. Challenges

In addition to the benefits of the PPP DBOO procurement method, there are challenges which need to be addressed. Managing these challenges requires expertise in the technical, commercial, financial and legal aspects of the project. Some of these challenges include:

- Preparing comprehensive DBOO bid documents which cover legal, financial, commercial and technical aspects of the project
- Conducting a fair and thorough evaluation of all DBOO bids
- Managing the performance of the private sector service provider
- Managing the relationship with the private sector service provider

Preparing Comprehensive DBOO Bid Documents – Comprehensive and well thought out DBOO bid documents, and agreements, which cover legal, financial, commercial and technical aspects of the project, are needed to have a successful project. These documents and agreements must clearly state PUB's requirements, what the concession company must do, the criteria used to measure performance, etc. The DBOO bid documents must achieve the right balance between having enough prescription to ensure that the proven NEWater multiple barrier treatment processes are included in the design, while also containing performance-based specifications which allow the concession company to implement cost saving innovations. The risk allocation matrix should aim to allocate risk to the party most able to manage it and cover technical, market, resource, and financing categories, as well as the traditional building and operating risks.

Evaluating DBOO Proposals – A fair and thorough evaluation must be made of all DBOO bids. This evaluation must consider the legal, financial, commercial and technical content of each bid. In addition, the levelized NEWater tariff (product water price) must also be evaluated. For example, a financial analysis must be made of a Bidder's financial plan/model to ensure economic soundness and robustness of their proposal. In addition, the technical review must check that a Bidder has complied with the mandatory requirements, considered the suggested good utility practices, and met the Technical & Performance specifications. Similarly, the legal and commercial reviews must assess a bidder's adherence to the legal and commercial requirements, as well as the financial strength of the bidding consortium.

Managing the Performance – Performance monitoring and measurements are critical to PPP DBOO projects since they form the basis for payment to the private sector service provider. Successful PPP DBOO projects are the result of the public agency understanding and defining the performance standards that it requires and establishing service outputs which can be easily monitored and measured. For the Sembcorp NEWater Plant project, a comprehensive monitoring and audit system has been established to allow PUB to routinely check on water quality, operation and maintenance of the plant. This system includes linking the NEWater plant's key on-line water quality monitoring system to PUB's monitoring room, which allows PUB to have continuous, real-time information on the NEWater quality before it is delivered to the consumers. The water is also sampled and analyzed regularly by an independent accredited laboratory to provide a double check on its quality. In addition, audits are conducted regularly by PUB's auditors to ensure the operation and maintenance meets the specified standards.

Managing the Relationship – Managing the relationship with the private sector partner is vital to ensuring that the PPP DBOO deal is value for money for the public agency. This relationship must last the full 25-year concession period. A strong project management team is needed to address the concerns of the multiple stakeholders involved. This specialized team must have expertise in the financial, commercial, legal and technical aspects of PPP DBOO contracting. During the implementation of the Sembcorp NEWater Plant project, PUB played an active role beyond the contractual obligations by participating in the various phases of the project implementation, including plant commissioning. PUB staff attended their weekly project meetings to share our experience and help resolve problems. This close working relationship has contributed to the smooth delivery of the project.

c. Contracts

The legal framework for the Sembcorp NEWater Plant is formalized into two major agreements, namely:

- **NEWater Agreement**

The NEWater Agreement is a water purchase agreement which prescribes the legal rights of the “Owner” of the NEWater Plant (Sembcorp) and the “Purchaser” of the NEWater produced (PUB). Sembcorp’s main obligation is to treat feedwater (meeting a quality standard) provided by PUB to produce NEWater meeting the quality standards and at the warranted capacity. PUB’s obligation is to provide an adequate quantity of secondary treated effluent from the nearby Water Reclamation Plant as feedwater which meets the quality specifications. Under the agreement, there is no minimum quantity of NEWater that PUB must take.

Being a 25 year agreement, it is inevitable that there will be changes over the term of the contract. The NEWater Agreement allows a certain degree of flexibility to cope with future changes. For example, there are provisions in the Agreement that address: Changes in laws, Step changes in technology, Force majeure, Dispute resolutions etc.

- **Direct or Step-In Agreement**

As this is a 25-year contract, there is need for step-in provisions under the NEWater Agreement to address events that may threaten the continued supply of NEWater. A step-in agreement was included in the NEWater Agreement to prescribe the step-in rights of the parties involved; which are PUB, Sembcorp and their Financier.

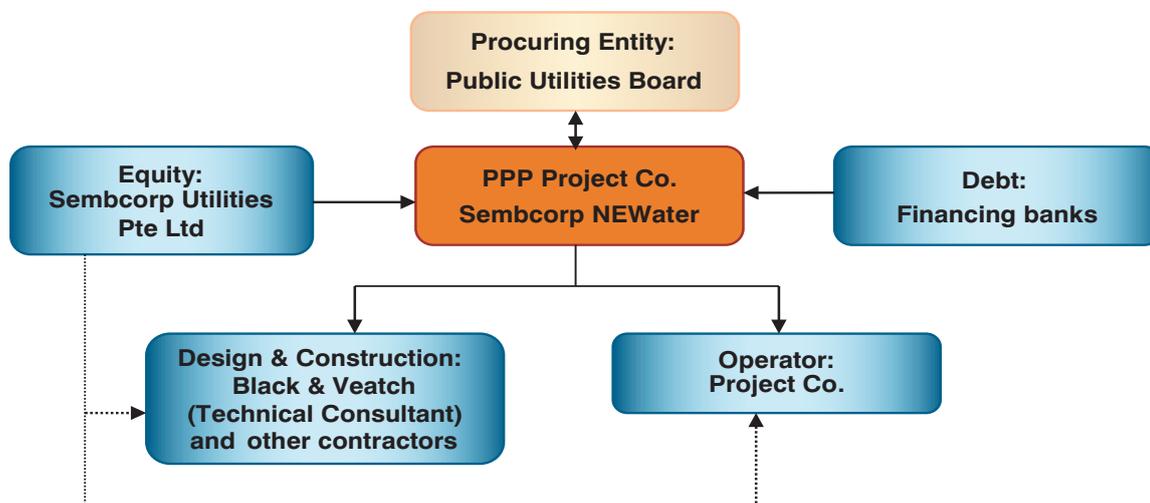
d. Financial

The total project cost was SGD 120 million. The concession company will usually raise project finance through equity and debt finance. The equity investors are typically the construction and operation companies who are involved in the actual service delivery. Fund managers and other financial institutions may also take an equity stake in the concession company. Debt finance, in the form of bank loans or bonds, may also be raised to pay for the construction and operation of the facilities.

e. Commercial

The commercial principle behind the Sembcorp NEWater Plant DBOO project is based on a “tolling” model. In this model, Sembcorp will design, construct, own and operate a NEWater Plant for the sole purpose of further treating the secondary effluent from the nearby Water Reclamation Plant (owned and operated by PUB) to produce NEWater. In return PUB will pay Sembcorp a tariff or “toll” for the treatment services provided and the NEWater supplied to PUB. PUB will transfer and distribute the NEWater that Sembcorp produces to PUB’s customers.

Fig 2: Commercial structure



f. Tariff Structure

The tariff for the Sembcorp NEWater Plant DBOO project is structured according to performance based payment mechanisms. The tariff structure comprises two parts, namely: Fixed Availability Payment Variable Output Payment

The Fixed Availability Payment is the fixed charge which PUB is required to pay Sembcorp regardless of the amount of NEWater it purchases. This charge includes the following:

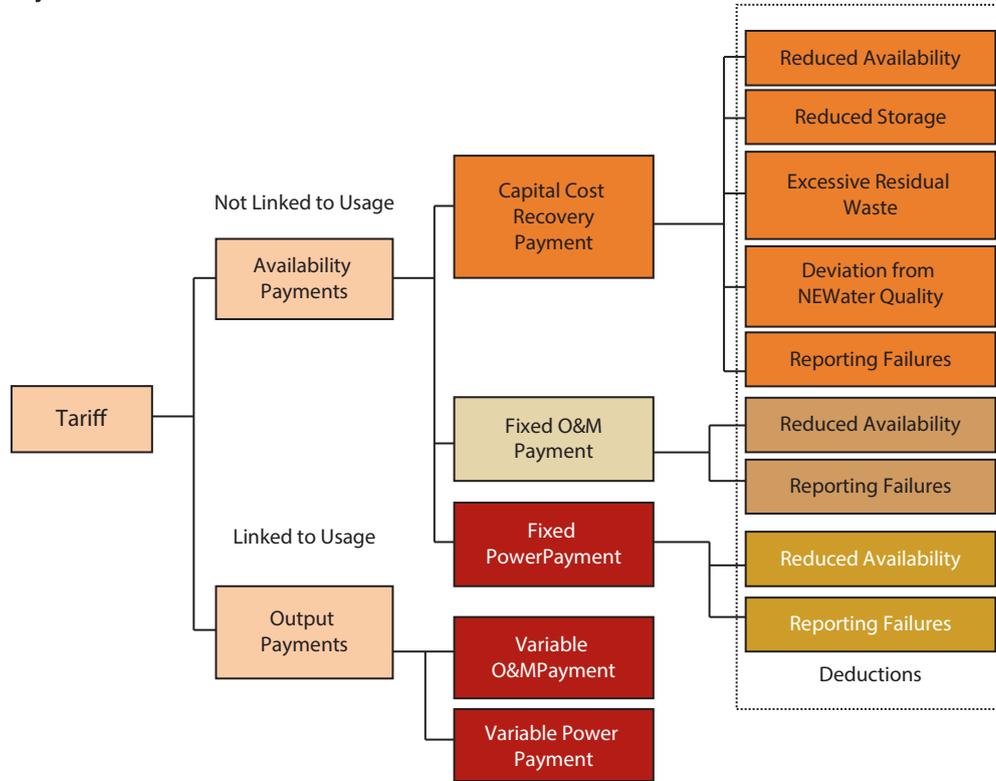
- Capital Cost Recovery Payment
- Fixed O&M Payment
- Fixed Power Payment

The Variable Output Payment is dependent on the quantity of NEWater supplied to PUB. This payment includes:

- Variable O&M Payment
- Variable Power Payment

To allow for inflation and fluctuations in fuel prices over the 25-year Term, there are provisions in the business model for annual adjustment of the tariff based on consumer price and fuel indices. These provisions for adjustment in the tariff due to unpredictable changes in costs reduce the risks and therefore allow the private sector service provider to offer a very competitive NEWater price to PUB.

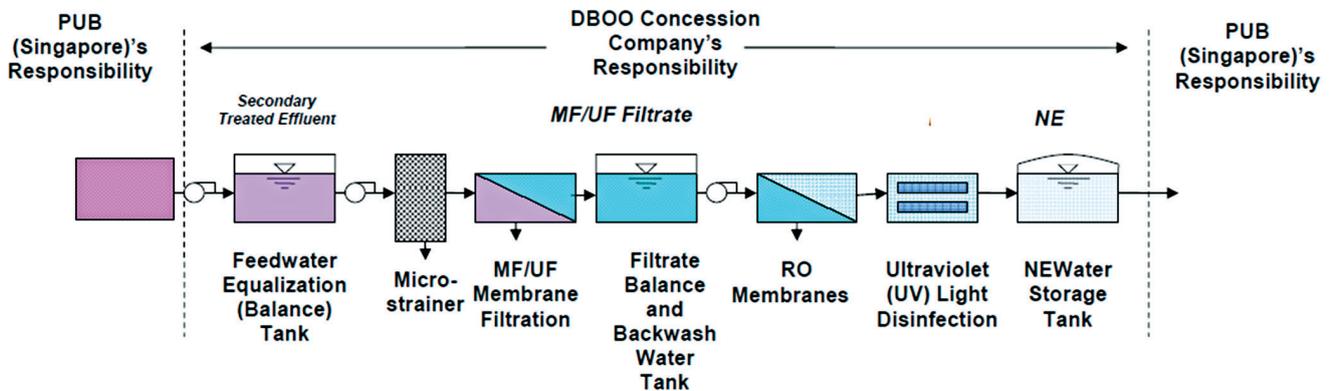
Fig 3: Payment Mechanism



g. Process Flow Diagram

As discussed above, the Sembcorp NEWater Plant uses the same treatment steps of MF/UF membrane filtration, RO membrane demineralization, and UV disinfection that have reliably produced high quality NEWater at the other PUB's NEWater Plants since 2003. A simplified process flow diagram for the Sembcorp NEWater Plant is shown in Fig 4.

Fig 4: Process flow diagram



III. CONCLUSION

The Sembcorp NEWater Plant is the largest NEWater facility in the region to be implemented using a design-build-own-operate (DBOO) arrangement. This procurement approach has proven to be successful, as measured by the competitive water price, high quality NEWater produced, reliable operation, and the state-of-the art facility being brought on-line within the required time schedule.

For more information: http://www.pub.gov.sg/mpublications/Documents/OurWaterOurFuture_2013.pdf

Source: *Infrastructure Public-Private Partnership Case Studies of APEC Member Economies*, Asia-pacific Economic Corporation, October 2014.

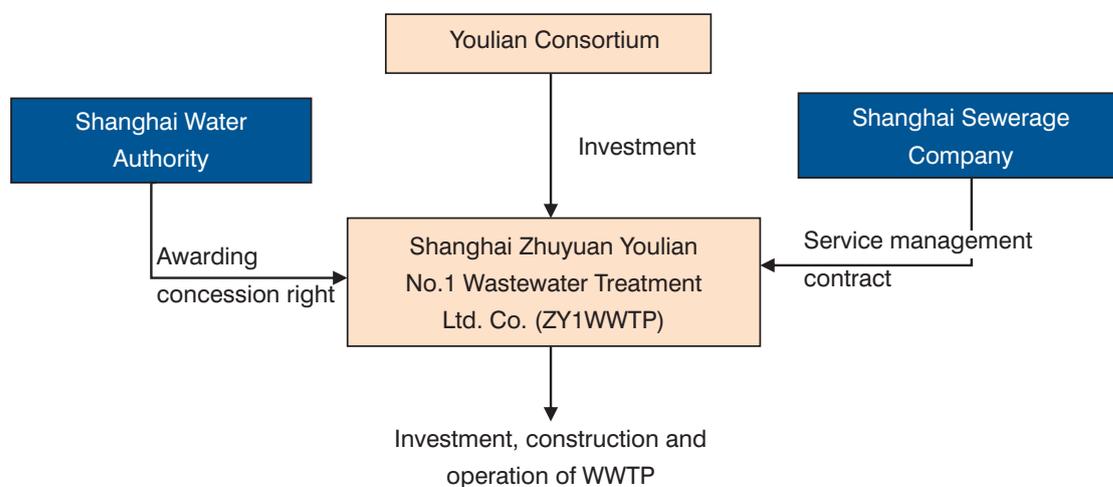
2. Wastewater Treatment: Case Study of Public–Private Partnerships (PPPs) in Shanghai

1. Background

Private sector participation may be brought into public projects for several reasons, for example, to compensate for and/or improve on the structural inefficiencies caused by state management, or to gain access to additional financing not provided directly by the government. For example, the modernization of urban water governance in the PRC encompasses: (i) water tariff reforms to allow the water price to reflect full costs, and to instill safeguards to ensure that vulnerable groups have access to drinking water; (ii) improvements in transparency, accountability and management by the managing authorities; (iii) enhancements to the level and scope of public participation; and (iv) decentralization of water tasks and responsibilities down to the local level. The PRC began to deregulate the water sector in the 1990s, permitting private and foreign investment in water supply and sewage treatment infrastructure. The country's public urban water and sewerage infrastructure systems are generally underinvested and understaffed, making them largely inadequate in meeting growing demands for water and sewerage treatment. The poor infrastructure and growing demand for water supply and wastewater treatment have made the PRC one of the most active markets for PPPs. The private sector can participate in the water market through various models ranging from full privatization of government assets to public–private partnerships. Foreign investors were also permitted to hold majority stakes in joint ventures (JVs). There are currently an estimated 400 water supply and wastewater PPP projects in the PRC, although the exiting of foreign investors from the water sector, partially due to legal and regulatory restrictions, has also been noted (Choi, et al.). Companies in the water sector include transnational water companies, foreign specialized operators, PRC investment developers, privatized local water companies, and domestic operators. Privatization has led to a sharp increase in the number of wastewater treatment plants since 2002, but a more gradual growth in water treatment and supply as well as other projects which are a combination of treatment projects and private water distribution networks. The most common model for wastewater projects is the Build–Operate–Transfer (BOT) model, reflected in the increase in new wastewater projects. On the other hand, water supply projects take the forms of BOT, Transfer–Operate–Transfer (TOT) and divestiture models, reflecting the fact that most projects involve modifications or rehabilitation of existing facilities. Full or partial divestiture models are mainly intended to fund operational and management costs for existing treatment plants. Management and lease contracts are less commonly implemented.

2. Wastewater Treatment in Shanghai

The Huangpu River and Yangtze River serve as surface water sources for urban water supply to the Shanghai municipality, which has a total population exceeding 17 million. However, water pollution remains a problem given the presence of manufacturing activities including textiles, chemicals, food, and electronic products. Wastewater and drainage services fall under the Shanghai Sewerage Company. The Shanghai municipal government plans to raise the wastewater treatment ratio to 90% by 2020, with wastewater collection and treatment covering the whole of downtown Shanghai. These steps would help ease the extent of pollution of the river systems around Shanghai. A wastewater treatment fee of CNY0.9 per cubic meter is currently built into the water tariff in Shanghai (Fu, et al.).



3. Structure of PPP

The Shanghai Zhuyuan Youlian No. 1 wastewater treatment project (ZY1WWTP) is the first mega-ton wastewater treatment plant (WWTP) in Shanghai, with advanced primary treatment capacity of 1.7 million m³/day. The plant is part of the Suzhou River Comprehensive Treatment Stage 1 project. In 2002, the Youlian Consortium—formed by Youlian Development Company (45%), Huajin Information Investment Ltd. Company (40%), and Shanghai Urban Construction Group (15%)—was awarded a 20-year concession with the Shanghai Water Authority through an open tender process to provide wastewater treatment services. The consortium set a service fee of CNY0.22 per cubic meter, which was notably low. The JV also signed a service contract with the state-owned Shanghai Sewerage Company. The project was 35% funded by private capital from the consortium, with the remainder financed by bank loans. The JV was also indirectly subsidized by the local government, which invested \$30 million in fixed infrastructure in the sector, while the land for the plant was provided at no cost. The organizational structure of the JV is shown in Figure 1. ZY1WWTP is paid a service fee as agreed between the consortium and the local government. The service contract stipulates a two-tiered service fee structure paid to ZY1WWTP, depending on the volume of wastewater treated. There is a fixed service fee of CNY0.22 per cubic meter and a variable fee of CNY0.082 per cubic meter. The fee for volume in excess of the 1.4 million cubic m³/day is CNY0.15 per cubic meter. The variable fee may be adjusted every 3 years from the fourth year onward. Some of the conditions of the service contract include an online monitoring system and third-party monitoring of quality standards for the treated water.

4. Outcomes

The plant serves 23.5 million residents over an area of 107 sq km at a relatively low service fee of CNY0.22 per cubic meter of treated wastewater and a minimum treatment level of 1.4 million m³ /day. According to reports, the Zhuyuan No. 1 WWTP has been meeting its obligations under the service contract (Zhong, et al.). The savings generated through the PPP arrangement are reflected in the service fee, which was about 40% below the government's own projected cost of CNY0.38 per cubic meter. The indirect subsidies through fixed investments and the provision of land from the government help explain how the JV was able to offer a relatively low service fee. By aligning the service fee to performance and investments made by the JV, the government was also able to transfer the financial risks of the project from the public to the private sector. The same consortium won a second tender in 2004 for the Zhuyuan No. 2 WWTP project, a smaller plant with a capacity of 0.5 million m³ /day for secondary biological treatment. However, one of the JV partners, Youlian Development Corporation, exited the consortium in 2005, selling its stake in the JV to a Hong Kong company, Interchina Holdings Group, for CNY150 million. A re-tender for Zhuyuan No. 2 WWTP was called and eventually won by Shanghai Urban Construction Group (part of Shanghai Construction Group, which was a minority shareholder in the Youlian Consortium for ZY1WWTP). This second WWTP was partly financed by loans from the World Bank. This illustrates a potential risk of such PPP models, especially when the JV is made up of a number of enterprises with different expectations, expertise, and objectives.

5. Considerations for PPP Projects

Since PPPs have been introduced into the PRC with the economic reforms of the late 1970s, such projects have faced a number of constraints that hinder more successful and widespread implementation. Some of the key issues are outlined below.

Legal and Regulatory Risks: The legal and regulatory infrastructure in the PRC for PPP activities presents a risk to private investors. For example, laws which govern PPP activities are not always consistent with one another, or government policies may be revised with little consideration for the impact on private partners.

Tariff Pricing Policies: The slow pace of deregulation of tariffs for public services could impact project profitability for the private investor.

Lack of Transparency in Bidding Process: Most PPP projects in the PRC remain hampered by a lack of transparency in the bidding and project supervision processes.

SOE Participation: State-owned enterprises (SOEs) in the PRC have been involved in several PPP infrastructure projects, creating a category of public SOE partnerships. SOEs could increasingly crowd out local private sector firms as well as foreign participation.

Access to Capital: While BOT projects and others of similar scale generally have a long-term horizon of up to a few decades, long-term financing options in the domestic financial markets in the PRC are limited.

Source: ADB, Urban Innovations and Best Practices, November 2010

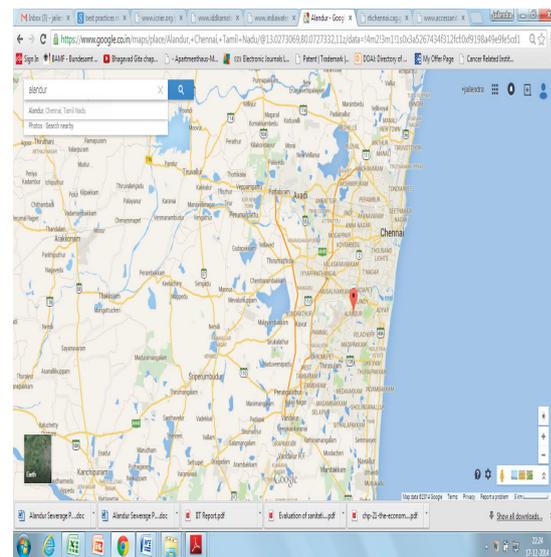
Annex 8: Indian Case Studies

1. Alandur Sewerage Project, India

Recognising the need for a centralised sewerage system in the city but lacking the funds to pay for it, Alandur municipality initiated an innovative public-private financing scheme which encouraged the local population to contribute to construction and operation costs through connection and service provider fees. The approach has been shown to be economically sustainable and the new system has contributed to reduced sanitation related disease within the community and environmental benefits in the local area.

Type of Case Study: Innovative Community involvement in PPP model to implement an Underground Sewerage System.

The Alandur underground sewerage project became a bankable project through a coordinated effort involving the municipalities of Alandur and Chennai, the State of Tamil Nadu, the state asset management and credit facilities, and the donor community working together to implement a comprehensive package of innovative financial and credit enhancement arrangements. The uniqueness of the project lies in the fact that it mobilized private money for developing public infrastructure. The innovative financing mechanism ensured people's involvement right from the conception and design of the project. The initiative was awarded the National Urban Water Award in 2008.



The importance of the issue

Prior to the initiative, Alandur municipality had no underground sewerage system; sewage was primarily collected in septic tanks or holding tanks. Sewage overflows from septic tanks would regularly enter storm water drains creating unsanitary conditions.

To address these problems, Alandur Municipality announced an ambitious proposal to construct an underground sewage system and wastewater treatment facility, to be implemented through a combination of private sector participation and municipal funding. A system was designed for an estimated population of 300,000 in 2027 with the objectives of improving the standard of living of the residents; disposing of sewage through an exclusive drainage network; avoiding recurring expenditure on septic tank cleaning; and preventing groundwater contamination. The proposal was transformational as it involved a service never before made available by the city, with financial and management responsibilities being shared by the municipality, residents, the private sector, and state government bodies.

Alandur in context

Located 14 km south of Chennai, Alandur is part of the Kanchipuram district of Tamil Nadu and forms a part of the Chennai Metropolitan Development Area (CMDA). The town has developed as a residential suburb of Chennai with a population of 160,000 (Census 2004) of which approximately one-fourth lives in slums.

The Alandur Sewerage Project (ASP) was the first project in the municipal water sector to be undertaken through the Public Private Partnership (PPP) route in India. Prior to the project, Alandur had no sewerage system and wastewater from the majority of its residents was collected either in septic tanks or holding tanks. The sewerage was collected periodically in tankers and disposed of in low-lying areas outside the municipal limits. The clearance of septic tanks was irregular due to lack of sufficient vehicles and staff in the public health department. In 1997, the Government of Tamil Nadu decided to provide a sewerage system in 12 selected major urban centers, including Alandur, in the context of a World Bank funded project. The Chairperson of the Municipality took up the task of implementing the project in Alandur.

Public Private Partnership in Underground Sewerage Network – Alandur, India

The Alandur Municipality found that due to a lack of financial and technical resources, it would not be in a position to implement the project on its own through the traditional Engineering Procurement and Construction (EPC) procedure.

To overcome this issue, the municipality worked in partnership with the state asset management company Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) and partnered with USAID's Financial Institutions Reform and Expansion (FIRE) Project. To address issues of the sewerage charges, a "willingness to pay" survey was conducted covering over 10 percent of the city's population. According to the survey, although the public generally had strong support for the project and accepted that users should pay for sewerage service, this willingness had its limits. The municipality initially proposed monthly sewer charges of Rs. 150 per month per household, to be increased by 6 percent a year until reaching a target level of Rs. 180 per month.

- **Public Awareness:** To gain public acceptance of these rates, the municipality mounted a vigorous public participation campaign with extensive media coverage to explain the project's benefits, costs, and tariff system. An election-style campaign was launched where officials and councillors informed people about the project through various means; local cable TV networks were roped in; pamphlets in English and Tamil were distributed; door to door canvassing was done by municipal sanitary workers along with senior municipal officials. All holidays and weekends were used for discussion with the Residents' Welfare Associations. Although, initially a large population of the town was not ready to pay the high deposits of sewerage connection charges and monthly tariff, the active canvassing and awareness raising activities educated people on the benefits of the project and succeeded in persuading residents that the services were worth paying for. To ensure effective participation of the local population it was decided to collect deposits from at least 10,000 residents before calling for tenders.

- **Collection of Charges:** By the end of May 2000, more than 13,000 connection seekers (domestic and non domestic) had deposited the one time connection fee to the municipality. In order to facilitate the collection procedure, collection centres at different locations were opened for the convenience of people and arrangements were made for collection of deposits including through the receipt of phone messages and at designated banks. The names of the depositors were displayed in public places to motivate others to pay.

To further reduce the burden on consumers, the city council decided to split the connection fee into two instalments. People who were unable to pay the deposits on their own were given the option of loans from local banks on nominal interest rates. While special provisions were not made for waiving fees for the poor, plans did include the connection of public latrines to the sewer system. The construction of community toilets was taken up on demand from slum dwellers and hence helped extend sanitation services to the poorest segment of the population who could not afford the non-refundable deposit and were therefore not connected to the system. Full transparency was maintained regarding financial aspects with status updates provided every month. Communication with the local community was maintained through a feedback and grievance redressal system which was reviewed daily by the project management team and twice a week by the municipal commissioner. Approximately, 29% of the project cost was garnered from public contribution which far exceeded expectations.

Results

The Alandur Sewerage Project was the first project in the municipal water sector to be undertaken through the Public Private Partnership (PPP) route in India. To implement this complex and politically challenging project, the Alandur Municipality worked in partnership with the state asset management company, Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) and with USAID's Financial Institution Reform and Expansion (FIRE) Project. TNUIFSL and the municipality decided to undertake the project as a whole on a BOQ (Bill of Quantities) basis, and construct the sewerage treatment plant (STP) on a BOT (Build, Operate and Transfer) basis due to the absence of financial and technical capacity at the municipal level. The Alandur sewerage project is a unique case of public participation in financing of municipal infrastructure where the use of active campaigning and awareness raising convinced the community that the payment of sewerage charges in exchange for benefiting from the services was a worthy investment. As mentioned above, the public contributed almost a third of project costs allowing a functional underground sewerage system to be created in the city through genuine and effective public participation. About 120 km of branch and main sewers have been laid, and a BOT operated Sewage Treatment Plant has been completed. The replacement of septic tanks has led to a reduction in the contamination of storm water drains and the underground sewerage system has eliminated the breeding grounds for mosquitoes thereby reducing the risk of related health impacts to the citizens. Once the scheme was implemented, the municipality levied an initial fee of Rs. 150 to the consumers per household. This was essential in reducing financial pressure on the municipality to a great extent. The impact of the project financing scheme on sectoral policy for financing projects through PPPs and self-financing as introduced through this project has been significant.

Sustainability of the Initiative

The Alandur urban sewage scheme, and the PPP method to finance it, considers a number of sustainability factors that help to ensure that the benefits provided by the scheme are maintained in the long-term. These include the following:

- **Health and Hygiene:** In the absence of a proper sewage system, Alandur faced serious unhygienic sanitation related issues. The construction of underground drainage enabled structured and hygienic disposal of sewage leading to a cleaner, healthier and safer environment
- **Environment and Natural Resources:** In the absence of a wastewater drainage network in Alandur, untreated wastewater from the city used to drain into nearby streams causing pollution in the river Cauvery. This posed a risk to both the environment and public health. The construction of an underground sewer system prevented the pollution of water resources leading to considerable improvements in the well being of natural habitats.
- **Technology and Operation:** The Alandur Sewerage Project was the first project in the municipal water sector to be undertaken through the Public Private Partnership route in India. This enabled funding to be raised for construction costs and continues to provide the necessary revenue streams to operate and maintain the system.
- **Financial and Economic Issues:** The total project cost was estimated to be approximately Rs 340 million and the contribution came from various resources through loans and grants. About 29 percent of the project cost was garnered from public contribution.
- **Socio-cultural and Institutional Aspects:** An aggressive public outreach campaign and awareness generation was embarked upon to involve people in the initiative. This formed a key part of the project and was essential in convincing members of the community that the sewer charges were worth paying. Simultaneously, involvement of stakeholders throughout implementation ensured timely completion of the project.

Lessons Learned

The PPP method to finance the Alandur Sewerage Project (ASP) led to an improved sanitation situation in the city, while at the same time reducing the recurring costs of sewage disposal from septic tanks and holding tanks as well as reducing pollution of groundwater due to the discharge of untreated sewage. The then chairman Mr. R S Bharati played an important role in promoting the project by introducing it to his council and generating popular support for it. This high-level commitment was an essential requirement for getting the project up and running.

The most challenging issue faced by the municipality was to convince people about the need for the project. Since there had been no previous examples of private participation in municipal services along with the fact that the success of the project required people to pay for the service, public outreach was critical. Moreover, there were also objections from people residing near to the proposed pumping stations.

It took considerable effort and time to convince the community about the importance of a sewerage management system and the need for public involvement during project implementation and maintenance. To gain the confidence of the public, Alandur Municipality made a strong and concerted effort to spread awareness about the benefits of the project. Involvement of stakeholders throughout the project has been a key factor in ensuring its successful completion.

The innovative financing mechanism of bringing together private money to develop public infrastructure was a big factor in meeting the financial requirements of the project. The Alandur experience demonstrates that mobilizing people's participation for infrastructure projects is possible through effective leadership, collective efforts and transparent procedures. Political will, effective communications, transparency and partnerships with community-based organizations represent the key factors for the success of the project. Inter-departmental coordination and active involvement of all stakeholders also ensured successful completion and sustenance of the project.

Source: accessanitation.org

2. Tertiary Treated Municipal Sewage Reuse, Madras Fertilizers Ltd., Chennai, India

Type of Case Study: Recycling and reuse of municipal sewage for non-potable uses in the fertilizer plant.

Project Background: Chennai city has perennially limited water resources. Two industries i.e. the Madras Refineries Ltd. (MRL) and the Madras Fertilizer Ltd. (MFL) are the biggest users of water for their process requirements. Both industries commissioned tertiary treatment plant (TTP) for municipal sewage reuse in order to become water self-sufficient and to meet increasing process water requirements.

Project Features: In 1992, the Madras Fertilizer Ltd. constructed a 16 MLD tertiary treatment and reverse osmosis (TTRO) producing 16 MLD of recycled water. Based on these TTPs, the Chennai Metro Water and Sewerage Board (CMWSB) supplies 12 MLD of secondary treated sewage (with BOD 120 mg/L even after secondary treatment) and 3 MLD of treated freshwater and the MFL provides the required further treatment depending on its end uses. The TTP infrastructure at Madras Fertilizer Ltd. consists of following:

- MFL constructed their 16 MLD TTRO plant in 1992 at a cost of Rs. 30 crores.
- A 1.6 km Pipeline from STP to TTRO plant.
- 5km pipeline and pumping machinery from TTRO to Fertilizer Plant.

Transaction Mode: MFL are the owners of the pipelines and the associated pumping infrastructure, as well as the TTRO and De-Mineralisation (DM) Plant. MFL also undertakes the entire O&M of the facilities mentioned above itself.

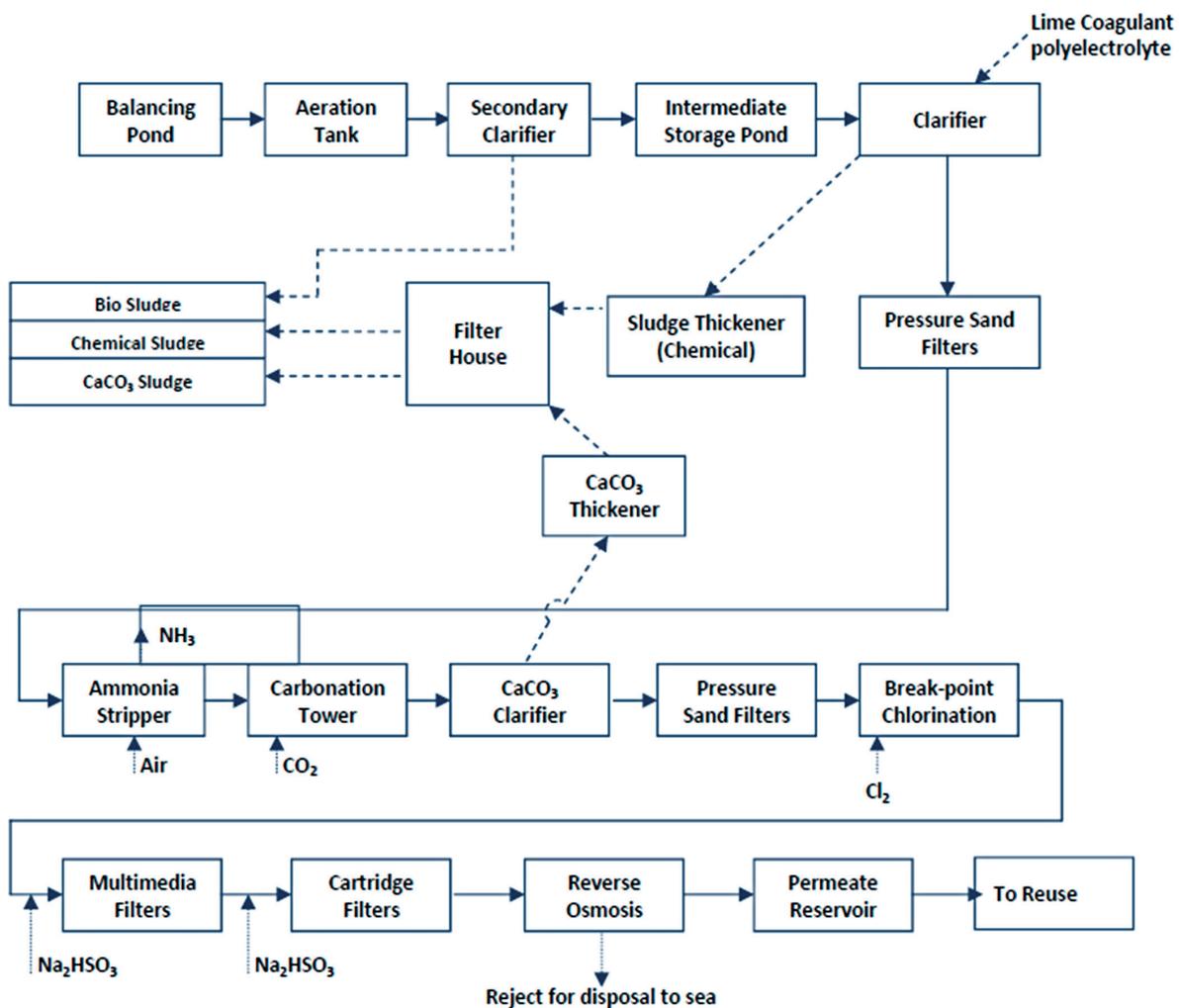
Unit Cost: Unlike most other municipalities in the country, Chennai's water board CMWSB treats all sewage to the required CPCB level. Therefore, MFL agreed to purchase 12 MLD of sewage treated water (STW) from CMWSB at Rs. 10.20/KL, which they would then treat further to their specifications and 3 MLD of freshwater at Rs. 60/KL and require a high share of water at the DM level. MFL utilizes 60 percent of its water at the tertiary treatment level while 40 percent is sent for RO and DM. Stage-wise cost of treatment and weighted average incremental cost of treatment are below.

	MFL	
	Sewage treated water	Freshwater
At Plant gate	10.2	60
At TTP plant	28	Not Req
At RO Plant	70	Not Req
At DM Plant	100	130
Weighted avg treatment cost	47	28

It is evident that it costs more to bring sewage treated water to the DM level than it does freshwater – in MFL’s case these costs are Rs. 90 (100-10.2) /KL and Rs. 70 (130-60)/KL respectively. However, cost differences should be weighed against having a reliable supply of water and control over quality which is highly valued by these kinds of industries. Moreover, there is scope to reduce cost differentials. For instance, MFL is able to use tertiary level STW rather than RO water for cooling which is more cost-effective.

Treatment Process: The TTPs which receive secondary treated wastewater from the Chennai city at the Madras Refineries Ltd. and the Madras Fertilizer Ltd. consist of following treatment units:

Additional Secondary Biological treatment → Chemically-aided Settling + Pressure Filtration + Ammonia Stripping, Carbonation, Clarification, Pressure Filtration → Chlorination → Sodium Bisulfate Dosing → Multimedia Filtration → Cartridge Filtration → Reverse Osmosis → Permeate for Reuse.



Source: 'Review of Wastewater Reuse Projects Worldwide', Consortium of IITs, Quarterly research note by IDFC on 'Sewage wastewater recycling for industrial use', No. 12, June 2011

3. Sewage Reclamation Plant, the Rashtriya Chemicals and Fertilizers (RCF) Plant, Chembur, Mumbai, India

Type of Case Study: Reuse of complex wastewater (municipal sewage polluted with various industrial wastes) for industrial uses.

Background: Municipal sewage generated in the vicinity of the Rashtriya Chemicals and Fertilizers (RCF) Plant, Chembur, Mumbai is heavily contaminated with various streams of industrial wastes and results in complex wastewater. In order to become water self-sufficient and to meet increasing process water requirements, the RCF plant realized the importance of recycling and reuse of wastewater for non-potable industrial use and commissioned a sewage reclamation plant for itself.

Project Features: The RCF Plant commissioned a 23 MLD capacity sewage reclamation plant involving reverse osmosis to treat complex wastewater comprising municipal sewage heavily contaminated with various industrial wastes. RCF's STP, which is located in the heart of Mumbai, came on line in 2000. RCF constructed a 5 km pipeline to receive raw sewage from Brihan Mumbai Corporation's (BMC) Ghatkopar pumping station. They also buy 11 MLD of freshwater from BMC.

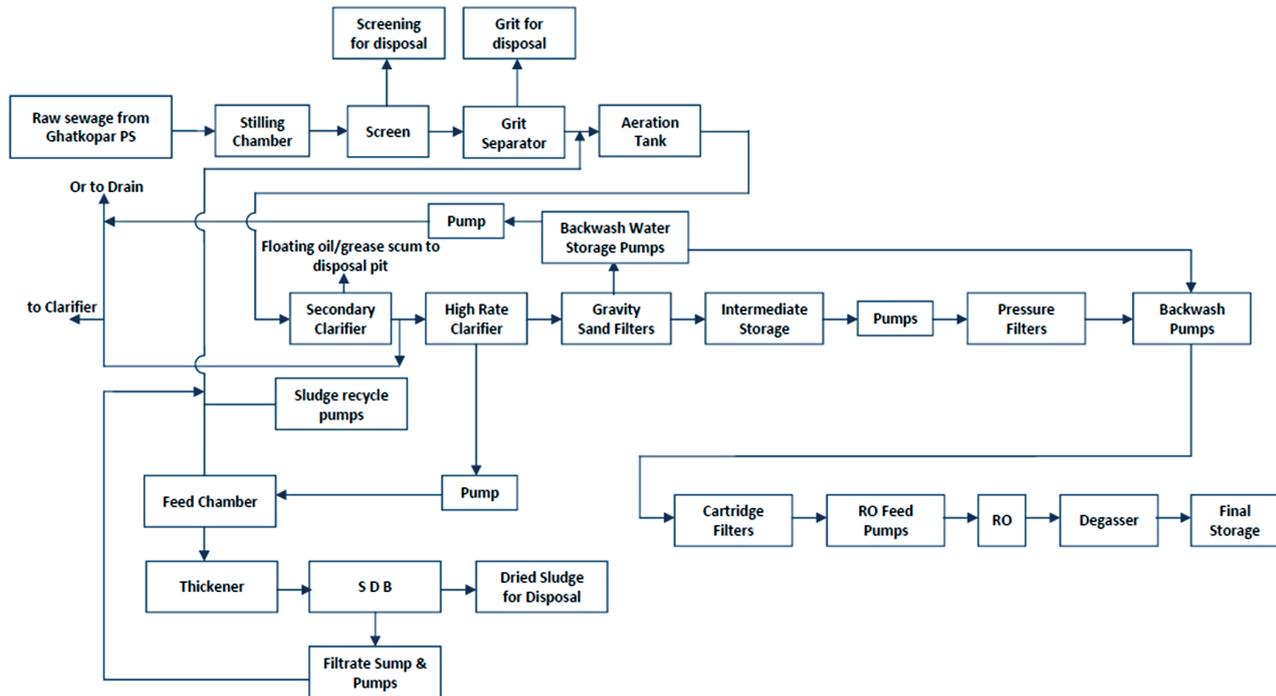
The sewage reclamation plant at the RCF consists of following treatment units: Screening → Grit Removal → Activated Sludge System → Clarifier → Sand Filter → Pressure Filter → Cartridge Filters → Reverse Osmosis → Degasser to remove CO₂ → Reuse in Industry.

Transaction Mode: RCF owns the 23 MLD sewage reclamation plant as well as the 5km pipeline conveying the raw sewage from Ghatkopar pumping station to its treatment plant. RCF undertakes the O&M of the sewage treatment plant and the pipeline that they own itself.

Unit Cost: Since RCF requires a high amount of De-Mineralised (DM) water, of the total water they receive from BMC and their STP, RCF uses 73 percent at the RO level and 27 percent at DM stage. The RCF purchases raw sewage from BMC at apporimately Rs. 0.60/ KL and treated freshwater from BMC at Rs. 40/KL. The stage-wise cost of treatment and weighted average incremental cost of treatment are given below.

	RCF	
	Raw sewage	Freshwater
At Plant gate	0.60	40
At TTP plant	NAa	Not Req
At RO Plant	45	Not Req
At DM Plant	100	100
Weighted avg treatment cost	59	16

The plant cost nearly Rs. 40 crores to build in 1998 and the operating cost as reported in 2005 came to Rs. 39/- per m³. With the passage of time and the success of reuse schemes, the municipal charge levied also became higher at Rs 6/- per m³ of raw sewage. Some additional treatment steps like use of Ultrafiltration became necessary in order to improve the quality of the water reaching the RO system (keeping the silt density index, SDI < 3.0) owing to the more polluted nature of the influent wastewater.



Source: 'Review of Wastewater Reuse Projects Worldwide', Consortium of IITs

4. Wastewater Recycling Initiative by Pragati Power Corporation Limited (PPCL)

Type of Case Study: Recycling of treated municipal wastewater for Gas Power Plants.

Project Background: Pragati Power Corporation Limited (PPCL) is a subsidiary of Indraprastha Power Generation Corporation Limited. PPCL commenced operations of its 330 MW gas based power plant in mid-2004. At its planning and development stage, PPCL was denied a freshwater linkage but given the option to operate and use two sewage treatment plants (STPs) of 10 MLD each built atop nearby nallahs 1 and 3 kilometers away.

Project Features: Gas based Power Plants use over 90% of their water for cooling, requiring only slightly higher than secondary or in some cases tertiary and only a fraction of water, 5 percent, is required at the high-end level which requires de-mineralization (DM). The STPs that PPCL was given to operate and use, were two of nine Activated Sludge Process (ASP) plants built along the Yamuna River under JICA funding as a pilot project for the Delhi Jal Board (DJB) in 2002. The STPs used by PPCL treat only 5-10 percent of the sewage that flows through the nallahs and the rest is discharged untreated into the Yamuna. The STP treats water to the secondary level with output parameters of BOD < 10, COD < 25-30 and TSS < 15. After that 19 MLD of STW is pumped to the PPCL power plant where it undergoes lime-softening treatment to remove TSS further reducing BOD and COD as well as hardness by reducing Ca and Mg. The bulk of the water is utilized within the PPCL plant at this level of treatment. Only 9-9.5 percent of lime-softened water is sent for Demineralization (DM) using Reverse Osmosis. and Ion-Exchange Resin processes so it can be used in boilers. While DM is an expensive process that adds to the cost of production, this step is required even if freshwater were used. Lime-softening and DM take place within the power plant and utilize electricity generated by the plant itself. Moreover, both processes are required regardless of water source.

Transaction Structure: Ownership of the STPs vests with the Delhi Jal Board (DJB). As far as O&M is concerned, initially, it was agreed that DJB would provide free Sewage Treated Water (STW) to PPCL in return for free electricity to run the plants. However, since DJB had little interest in running the plant they signed an MOU with PPCL in 2004, in which PPCL had the right to use the STPs for as long as required provided they took care of operation and maintenance (O&M) responsibilities.

PPCL has in turn outsourced the O&M contract to Degrémont, an international water treatment company, which had built the plants for Japan International Cooperation Agency (JICA). PPCL's O&M contract with Degrémont is renegotiated every two years; for 2015–2017 it is Rs. 1.83 crores per year for both plants combined. The O&M payment to Degrémont excludes the cost of power as that is the responsibility of PPCL. Since the STP is not located on PPCL premises electricity must be purchased from the power distribution utility BSES at commercial rates to run the STP and pump treated water to the power plant. This comes to a cost of Rs. 30 lakhs or Rs. 0.3 crores. PPCL (a power generating plant) adjusts this amount against the dues owed to it by BSES.

In case in-house additional/tertiary treatment of cooling water and boiler feed water PPCL outsources treatment plant management to specialist operators through one year O&M contracts. The specialist operators provide management staff, wastewater treatment experts as well as unskilled staff, while PPCL is responsible for electricity provision and its cost, chemicals, membranes, resins and spares. The auxiliary power consumption of 3% of generation is also used to provide electricity for in-house treatment and conveyance. The current total O&M budget including electricity is Rs. 3.5 crore per annum of which Rs. 1 crore is paid to the O&M operator. The total O&M cost including power for additional treatment (higher than secondary treatment) for cooling water works out to approximately Rs. 3.30/kl.

Unit Costs: The current O&M cost of producing STW, including electricity, is Rs. 2.13 crore or ~Rs. 4.70/KL. However, since variable costs change over the life of a plant it is useful to have a single unit levelized cost incorporating both capital and operating expenditures. IDFC calculated the levelized annual cost of treatment including capital expenditure over a 20 year period in 2011 as given in Table 1. Since both Lime softening and DM are required regardless of water source the costs in Table 1 below are only for secondary level treatment. However, PPCL engineers note that given the quality of Yamuna freshwater they receive; further treatment costs are lower when using STW.

Table 1: Levelized Annual Treatment Cost, PPCL

	Levelized costs*	
	Rs/KL	Rs/kWh
Total Costs (incl ROE)	~17	~0.05
Total Costs (excl ROE)	~15	~0.05

Source: Interviews with Degrémont and Pragati Power Corporation Ltd; Delhi Electricity Regulatory Commission Tariff Order 2008-2011; IDFC Analysis.

*Levelized costs are calculated by dividing the net present value of the total cost into an equal annual per unit cost. A 10% discount rate is used.

Assumptions: All non-fixed costs escalate at 5.5% per year over 20 years. Capital expenditure is Rs. 2.5 crores per MLD, debt: equity ratio is 70:30, loan is for 10 years at 12.5% interest and Return on Equity (ROE) is DERC-approved at 14%. All estimates include pumping costs from the STP to PPCL.

Source: Quarterly research note by IDFC on 'Sewage Wastewater Recycling for Industrial Use', No. 12, June 2011; Interviews with SUEZ environment (Degrémont) and Pragati Power Corporation Ltd.

About 2030 WRG

The 2030 Water Resources Group (2030 WRG) is an innovative public-private platform for collaboration at global as well as national/local levels. It mobilizes stakeholders from public and private sector, civil society, centers of academic expertise and financing institutions to engage in fact-based, analytical water security approaches and coalition building.

The 2030 WRG aims to support governments in their long-term development and economic growth plans by catalyzing sustainable water sector transformations and accelerating reforms. The 2030 WRG acts as an independent entity and offers no political, partisan or national nuance to its advice.

After an incubation phase within the World Economic Forum, it has become part of the International Finance Corporation, a member of the World Bank Group, since March 2012.

For more information: www.2030wrg.org

Contact: rkhemka@ifc.org

About FICCI Water Mission

FICCI constituted a “Water Mission” to promote and provide thought leadership in the area of water efficiency. It aims to facilitate the sharing and dissemination of best practices across industry sectors in order to encourage corporate and industry players to imbibe a culture of water conservation within their organizations.

The Mission is working to create awareness on the existing situation pertaining to water scarcity and quality and generate a discourse on sustainable use of water amongst various users. With growing and extensive depletion of and pollution of our water resources, the Mission’s current work is being restructured to bring this issue back in focus to provide a sense of urgency to the debate of water management.

For more information: www.ficci.in

Contact: rita.roychoudhury@ficci.in; watermission@ficci.in



Knowledge Partner



POWERTEC ENGINEERING PVT LTD