State Policy

For

"Waste Water Reuse "

For

Jammu & Kashmir

1. INTRODUCTION

Water stress has become a perennial concern in most Indian cities. With a growing population, the per capita availability of water has dropped from 1,816 cubic meters in 2001 to 1,545 cubic meters in 2011.The latest census reported that only 70% of urban households have access to piped water supply. The average per capita supply to these households is well below the recommended 135 liters per day in many cities.2

India is expected to add approximately 404 million new urban dwellers between 2015 and 2050. This rapid urban growth will be linked with higher industrial output and greater energy demand. There is a domino effect here, with water demand from households, industries and power plants growing simultaneously and adding to the urban water stress. This is particularly visible in industrial metros such as Chennai, Bengaluru, and Delhi, where acute water shortage has driven up the cost of fresh water production and industrial water tariffs.

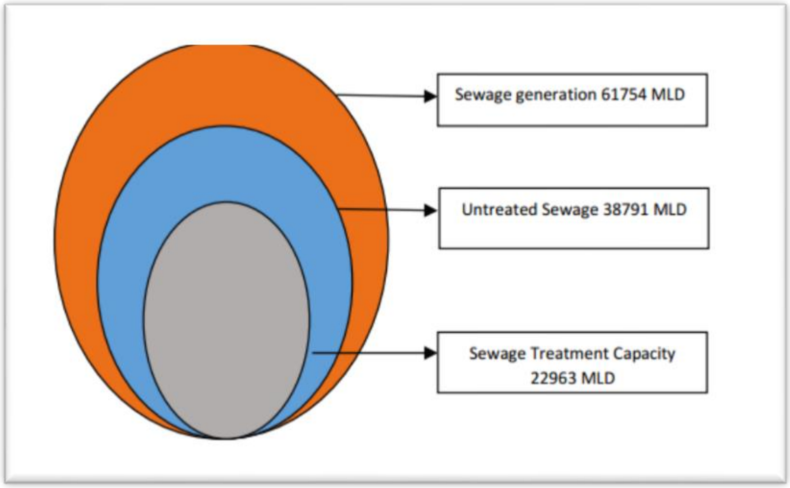
2. STATUS OF WASTEWATER RE-USE IN INDIA

Reuse of wastewater is not new to India. Chennai Petroleum Corporation Ltd (CPCL) built a wastewater reuse plant in 1991. However, the idea did not garner mainstream appeal for several reasons: There is no clear policy environment to encourage and support reuse projects. With low sewerage network coverage and insufficient Sewage Treatment Plant (STP) capacity, there hasn't been much Secondary Treated Water (STW) available for reuse. STW is being used for agriculture in many places. Redirecting STW for industrial reuse may face opposition from the public. Most cities apply a differential tariff for domestic and industrial water consumers, with the industrial tariff significantly higher than the domestic tariff. Revenue from industrial water supply, in such cases, is used to cross subsidize cost of supplying water to households.

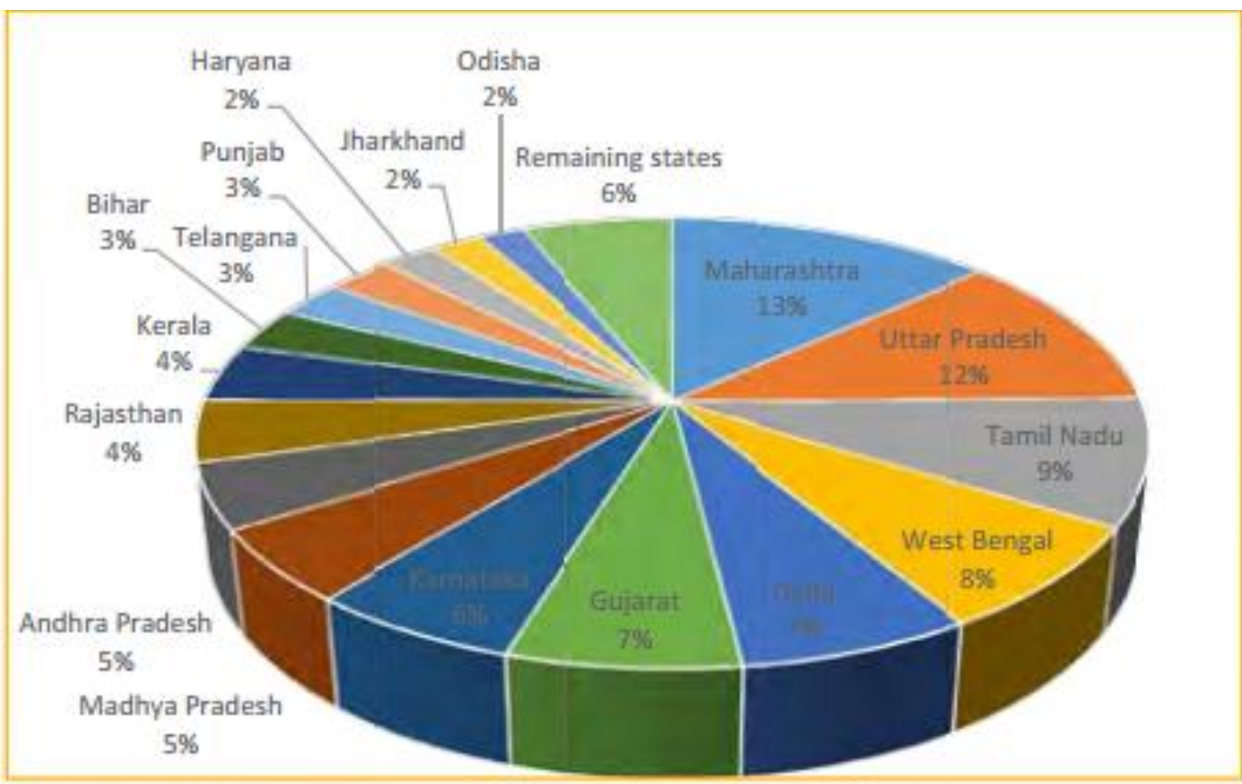
By switching to reclaimed water, utilities will have to forego some of this additional revenue Surplus freshwater availability in some smaller cities and towns has made utilities complacent and over dependent on freshwater sources. These conditions that held back the development of reuse of reclaimed water are fast changing. The Government of India has emphasized reuse of reclaimed water in many urban development schemes such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Swachh Bharat Mission, Smart Cities Mission and the Namami Gange programme. Sewerage coverage and treatment capacity are consistently improving across urban India. The cost of wastewater reuse technologies is falling. As a result, reuse projects have been undertaken in some cities such as Nagpur, Surat and Visakhapatnam.

3. STATUS OF WASTEWATER GENERATION IN INDIA

During 2015, the estimated sewage generation in the country was 61754 MLD as against the developed sewage treatment capacity of 22963 MLD. Because of the hiatus in sewage treatment capacity, about 38791MLD of untreated sewage (62% of the total sewage) is discharged directly into nearby water bodies.



The five states viz Maharashtra, Tamil Nadu, Uttar Pradesh, Delhi & Gujarat account for approximately 50% of the total sewage generated in the country. Maharashtra alone accounts for 13% of the total sewage generation in the country. Maharashtra, Gujarat, Delhi, Uttar Pradesh & Gujarat account for 67% of the total sewage treatment capacity installed in the country. No sewage treatment plant has been established in seven states/UTs viz. Arunachal Pradesh, Chhattisgarh, Daman Diu, Nagaland, Assam & Tripura .The capacity of STPs installed in the two states viz. Himachal Pradesh & Sikkim is adequate to treat the total quality of sewage generated in these states.



There are 35 metropolitan cities (more than 10 Lac Population)15,644 Million Liters per Day (MLD) of sewage is generated from these metropolitan cities. The treatment capacity exists for 8040 MLD i.e. 51%

is treatment capacity is created. Among the Metropolitan cities, Delhi has the maximum treatment capacity that is 2330 MLD (30% of the total treatment capacity of metropolitan cities). Discharge of untreated sewage in water courses both surface and ground waters is the most important water polluting source in India. Out of about 38000 million liter per day of sewage generated treatment capacity exists for only about 12000 million liter per day.

Thus, there is a large gap between generation and treatment of wastewater in India. Even the treatment capacity existing is also not effectively utilized due to operation and maintenance problem. Operation and maintenance of existing plants and sewage pumping stations is not satisfactory, as nearly 39% plants are not conforming to the general standards prescribed under the Environmental (Protection) Rules for discharge into streams as per the CPCB's survey report. In a number of cities, the existing treatment capacity remains underutilized while a lot of sewage is discharged without treatment in the same city. Auxiliary power back-up facility is required at all the intermediate (IPS) & main pumping stations (MPS) of all the STPs.

4. STATUS OF WASTEWATER GENERATION IN J&K STATE

The wastewater generation is both generated by Industrial and municipal sources. Initially with development and Industrialization, wastewater from industries generation was significant and municipal wastewater was less. Over a period of time, with increased environmental activism, wastewater generation from industrial sector has been captured, treated and recycled, making it sustainable by its use for majority sector. Municipal sector sewage over a period of time has increased due to exponential degree of Urbanization and left an inseparable impact on urban perennial water sources such as surface riverine and ground water treatment.

As per details from Census 2011, Jammu and Kashmir has population of 1.25 Crores, an increase from figure of 1.01 Crore in 2001 census. Total population of Jammu and Kashmir as per 2011 census is 12,541,302 of which male and female are 6,640,662 and 5,900,640 respectively. Out of total population of Jammu and Kashmir, 27.38% people live in urban regions. Of the total population of Jammu and Kashmir State, around 72.62 percent live in the villages of rural areas.

The decadal growth rate from 2001 till 2011 has shown a decadal growth rate of 23. 7%, but after 2011, there has been a decline in growth rate and average annual growth rate has been 2.10 for last 6 years. After 2012, the population has shown a decline rate and computation related to population growth starting 2012 has been recorded to arrive at average population growth rate of 2.02% per annum.

At present, as per Central Pollution Control Board (CPCB) estimations, 85 liters per capita per day (LPCD) out of 135 LPCD of wastewater supplied to any household is released back in form of sewage from households. It is estimated that this may increase to 121 LPCD in year 2030, with increase population consuming water use and diminishing waste water recycling and reuse in municipal sector. Assuming above provided CPCB estimates, it can be concluded that out of total daily water supply, approximately 62% of total water supply or 187 MLD of water is generated as city sewage or urban sewage. With CPCB records, State poof J&K has a total water supply of 267.42 MLD to Class I cities, while Class II cities had a total water supply of 34.24 MLD in 2010. This makes a total of 301 MLD of water supplied to its citizens.

But in J&K as per estimate made by J&K Urban Environmental Engineering dept. (UEED), 80% of total water supply, including leakages and NRW water is accounted for contributing to sewage generation. Hence sewage generation is high and same is used for computation of total sewage generation for entire state.For wastewater generation estimates, the sewage generation is estimated at 80% of total water supply per capita per day.

Year	Total population	Annual Growth Rate	Total Water supply for J&K State at Average Per capita Waste Water Supply @135 Liter per capita day	Total Wastewater /sewage Generation/day in J&K state@80% of total water supply or 108 Liter per capita day
		Percentage	**MLD**	**MLD**
2012	12,837,551	2.20	1733	1386.4
2013	13,125,956	2.15	1770	1416
2014	13,414,647	2.11	1807	1445
2015	13,703,350	2.06	1844	1475
2016	13,991,468	2.02	1881	1504

For future forecasting population growth in relation to water supply and related sewage generation, 2016 has been taken as a base rate and is used in following table:

Year	Average Decadal Growth Rate	Total Water supply for J&K State in MLD at Average Per capita Waste Water Supply @135 Liter per capita day	Total Wastewater /sewage Generation/day in J&K State in MLD @80% of total water supply or 108 Liter per capita day
2021	10.55	2079	1663
2031	21.1	2518	2014
2041	31.65	3315	2652

Against the, present, J&K total sewage treatment capacity, which includes present operational and proposed STP’s is provided below:

S.N	Parameter	Srinagar		Jammu	Anantnag
		JKLAWDA	UEED		
3	Total capacity of sewage treatment in present.	▪ 16.1 MLD Brari Nambal. ▪ 7.5 MLD Hazratbal. ▪ 4.5 Lam Nishat MLD. ▪ 3.2 Habak MLD	▪ 17.08MLD at Brari Numbal	▪ 27 MLD at Bhagwati Nagar (Completed but network not connected) ▪ 30MLD (Non-functional ▪ 10 MLD (unfunctional)	▪ 4MLD at Mehndikadal
4	Planned for 5 years (Scheme)	▪ Z1 =69MLD ▪ Z11=53MLD	▪ 164 KLD at Aloochi Bagh ▪ 130KLD at Achan	▪ 164 KLD at Bhagwati Nagar ▪ 4KLD at Raipur Satwari,	▪ 5MLD MCDSTP and sewerage pipe line

So with present condition of sewage treatment plant installation, J&K may face a shortfall of providing treatment to entire municipal and industrial wastewater.

5. OPPORTUNITIES FOR USE OF WASTEWATER REUSE IN J&K STATE

Water is a state subject and the provisioning of water and wastewater services to households is a responsibility entrusted to local governments. The regulatory environment for reuse of reclaimed water is influenced by many central, state and local government agencies, as shown in the following figure. The key policy notes that support wastewater reuse are as follows:

- The Water (Prevention and Control of Pollution) Act of 1974 has given discharge norms for sewage and industrial effluents. Industries and local bodies are mandated to treat wastewater to the defined quality level before discharge.
- The National Urban Sanitation Policy (NUSP), 2008, endorses reuse of reclaimed water, and recommends a minimum of 20% reuse of wastewater in every city. The National Water Policy (2012) recognizes reuse of reclaimed water as an important factor for meeting environmental objectives and suggests preferential tariff to incentivize reclaimed water over freshwater.
- The J&K State Water Resources Management Act 2010 also vests responsibilities with state government to prepare the State Water Policy and Plan to ensure sustainable use of water resources through providing treatment and reuse of effluents and wastewater.

Though wastewater reuse is endorsed in many policies and programmes, there is a lack of clear guidelines and frameworks to support the implementation of such projects. As a result, the reuse of reclaimed water for non-potable purposes continues to face challenges. The problem is further exacerbated by limited enforcement of the restriction to extract groundwater for non-potable purposes. More detailed policies and stronger enforcement is needed for wastewater reuse projects to be viable.

In the last few years, the Government of India has taken many concrete steps to promote reuse of wastewater. It began with regulating industrial water consumption and enforcing mandatory water reuse targets for industries. Cities have set their own, more stringent targets. For example, Delhi has adopted aspirational reuse targets to treat and reuse 25% of total sewage produced by 2017, and increase the same to 50% by 2022, and to 80% by 2027. Against this background, municipalities across India have started to pursue reuse projects. Some of these utility-led reuse initiatives in the recent past are as follows:

- Surat Municipal Corporation (SMC) built a 40 MLD reuse plant in 2014 to supply reclaimed water to Pandesara Industrial Estate.
- Chennai Metro Water Supply and Sanitation Board (CMWSSB) awarded a PPP-based reuse project contract in 2016 to develop 45 MLD reuse capacity on the design, build, and operate (DBO) model to supply non-potable water to industries.
- Bengaluru's water utility has built a 10 MLD tertiary treatment plant at Yellahanka that supplies reclaimed water to Bengaluru International airport.
- Maharashtra Generation Company (MAHAGENCO) and Nagpur Municipal Corporation (NMC) have jointly invested in a reuse project where treated water from an STP is further treated and used as cooling water.

• A review of these and other existing reuse projects reveals some common design features:

• Most successful PPP-based reuse projects involve a single large consumer (end user).

• The cost of treatment is bundled with cost of conveyance.

Successful reuse projects, such as the Nagpur Tertiary Treatment Reverse Osmosis (TTRO) plant, and the Bamroli TTRO, needed significant capital subsidies to become viable. The initiation of these projects suggests that businesses are interested in this sector and that reuse projects can be viable if prepared and structured correctly and backed by supportive policies and institutions. Many other municipalities, however, have limited interest in reuse. This may be partly because they are not familiar with the innovative technologies and project structures involved and lack the resources to develop these projects on their own.

The central government could boost the roll-out of water reuse by putting in place a national-level scheme. The first step would be to provide support for city-level scoping studies, leading to more detailed feasibility studies and assistance in contract preparation. A key purpose of the feasibility studies will be to establish the technology and market parameters of the project. Getting these parameters right will be critical to its success. The next section highlights some of the key considerations. The first step would be to provide support for city-level scoping studies, leading to more detailed feasibility studies and assistance in contract preparation.

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6. ENVIRONMENTAL BENEFITS OF WASTEWATER REUSE WITH URBAN PLANNING

Water recycling is a critical element for managing our water resources. Through water conservation and water recycling, we can meet environmental needs and still have sustainable development and a viable economy. Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use. Figure 1 shows types of treatment processes and suggested uses at each level of treatment. In uses where there is a greater chance of human exposure to the water, more treatment is required. As for any water source that is not properly treated, health problems could arise from drinking or being ex posed to re cycled water if it contains disease- causing or gan isms or other contaminants.

Traditionally, water authorities have managed their water supply, sewerage and stormwater drainage systems as separate entities. Integrated urban water planning is a structured planning process to evaluate concurrently the opportunities to improve the management of water, sewerage and drainage services within an urban area in ways which are consistent with broader catchment and river management objectives. Catchment management impacts directly and indirectly on all three components of the urban water cycle, having effects on drinking water quality, wastewater treatment and stormwater management.

A simple framework of hazard identification, assessment and management under-pins the management of both catchments and urban water cycle elements. The New South Wales Department of Land and Water Conservation (DLWC, 2001) has developed an integrated urban water planning process through a number of recent pilot-studies conducted in partnership with local authorities in studies in the New South Wales towns of Finley, Goulburn and Bombala. The process links urban water management objectives to overall catchment and river management objectives. As a prelude to the integrated urban water planning process, DLWC undertakes an assessment of water quality and flow conditions, with particular focus on the sources of nutrients in catchment discharges.

This data assists in shaping appropriate urban planning responses, particularly when urbandischarges are a significant proportion of total nutrient discharges.The pilot studies have shown that an integrated approach to urban water, sewerage andstormwater planning can identify opportunities that are not apparent when separate strategiesare developed for each service. The pilot studies have shown that both water conservationmeasures and water reuse are important contributors to environmental water quality improvements, and can also reduce water supply costs. The result is better-integrated, more sustainable solutions and substantial cost savings for local communities. Savings of up to 50% of capitalcosts have been identified in the pilot studies, but this may be exceptional.

It is probably morepractical to set a modest target of 15% to 20% savings and to see if this can be bettered.The conduct of an integrated urban water planning study is often a less costly processthan traditional separate water and sewerage strategy studies. The integrated urban waterplanning produces a rapid screening and shortlisting of potential opportunities in partner-ship with the community. The process can lead to significant savings in project investigation and development costs, as well as the sorts of capital and operating costs savings whichhave been identified in the pilot studies.

7. TECHNO-COMMERCIALCONSIDERATIONS FOR REUSE OF WASTE-WATER

For reuse projects to be successful, the following are some of the key viability factors that need to be considered during project design and structuring,

- **Water tariff competitiveness**

For reuse projects to be viable, the treated water should be cost-competitive when compared to alternative options available to industries. The conventional sources of water for industries include municipal water supply, private tankers, and direct extraction from freshwater sources. The least cost option is direct groundwater extraction which is regulated in most cities. Thus, the most reliable option for industries is municipal water supplied by utilities. The industrial water tariff in most metropolitan cities and industrial towns range from **20INR** per kilo liter (KL) to **150 INR** per KL. The weighted average of industrial water tariff is approximately **46.24** INR per KL. In times of water scarcity, when municipal water is in short supply, industries resort to buying water from private water tankers which are priced at **56 INR** per KL and above.

- **Quality of reclaimed water**

The quality of water required by industries varies significantly as discussed in the previous chapter. Market demand will be a key determinant for choosing treatment level and technology. It is important to assess the industrial profile and the quality of water demand at a location before designing the wastewater reuse plants.

These estimates include capital and operating costs of the treatment facility but do not include cost of conveyance. In addition to the incremental costs associated with higher levels of treatment, the volume of reclaimed water decreases as we move through the stages and this affects the revenue potential of reuse projects. For example, for 100 liters of STW supplied, up to 80 liters of Grade III water is produced after reverse osmosis.

It is not economical to lay multiple pipelines to supply different grades of water. A single treatment level must therefore be chosen upfront when designing reuse projects with multiple users, and demand for water at this quality level should be assessed. If conveyance costs are covered by end-users, or if water is purchased at plant gate, then it may be viable to produce different grades of water quality.

- **Cost of conveyance**

The conveyance of STW to reuse plants and reclaimed water to industries requires underground pipelines. It is estimated that, on a non-undulating surface, laying these pipelines would cost approximately 31.28 MillionINR per km. In addition, further costs will be incurred for the O&M of the pipelines. These high costs erode the cost advantage of reclaimed water over standard piped water supply from the utility. Land gradation between the treatment plant and customers is another determinant of the overall cost of conveyance of reclaimed water to industries.

It is difficult to recover conveyance costs through customer tariff while keeping the tariff lower than the standard rate for industrial piped supply. Despite these issues, there are advantages in bundling treatment and conveyance components, as it is easy to design and manage, and helps ensure quality and continuity of service.

- **Quality of STW**

The composition of sewage generated and collected by a secondary treatment plant, and the quality of secondary treatment process is another variable that affects the viability of reuse projects.

Under ideal conditions, municipal sewage collected from households is a homogeneous influent. But given the inadequate sewerage network, sewage is collected through open drains where it is often mixed with industrial waste from small-scale industries such as tanneries and dyeing units. This adds high chemical load to sewage and affects the composition of the influent to STPs. This necessitates more expensive treatment at the tertiary level to produce industry grade water. The quality of secondary treatment process in municipal plants is also not consistent. Most STPs are not designed to manage peak flows, leading to overflows and contamination of treated water by untreated sewage. Poor design, power shortages, and mismanagement by operators also lead to STP downtime, resulting in variable effluent quality. This in turn has cost implications for the reuse plant, which uses the STW as an influent, with knock-on effects on operating and potential capital costs.

One way of ensuring more consistency in STW quality would be to bundle O&M of the secondary plant into the reuse contract. This also entails risks— variability in the composition of raw sewage, legacy design issues—and the difference in capacity between the STP and the reuse plant will mean that it is difficult to recover the STP O&M cost through the reuse tariff. A separate O&M fee could be paid instead to the company that operates both STP and the reuse plant.

- **Disposal of residual effluent**

The residual wastewater produced after reverse osmosis process accounts for 12–15% of total STW treated and has very high concentrations of unwanted compounds and microbial load. This residual output does not meet environmental discharge norms of the CPCB. The safest method of disposal is through a marine discharge or evaporative watering. The cost of disposing residual effluent from the RO plant will in turn depend on the distance from the marine discharge area and dewatering technology used. The viability of reuse projects in non-coastal cities will depend on cost of disposal of residual effluent.

8. FINANCIAL MODELS FOR PPP IN WASTEWATER RE-USE

Wastewater reuse projects are technically complex, and require huge capital investments. Considering this, engaging private sector environmental firms to design, build and operate plants could be a good option and the same has two major advantages:

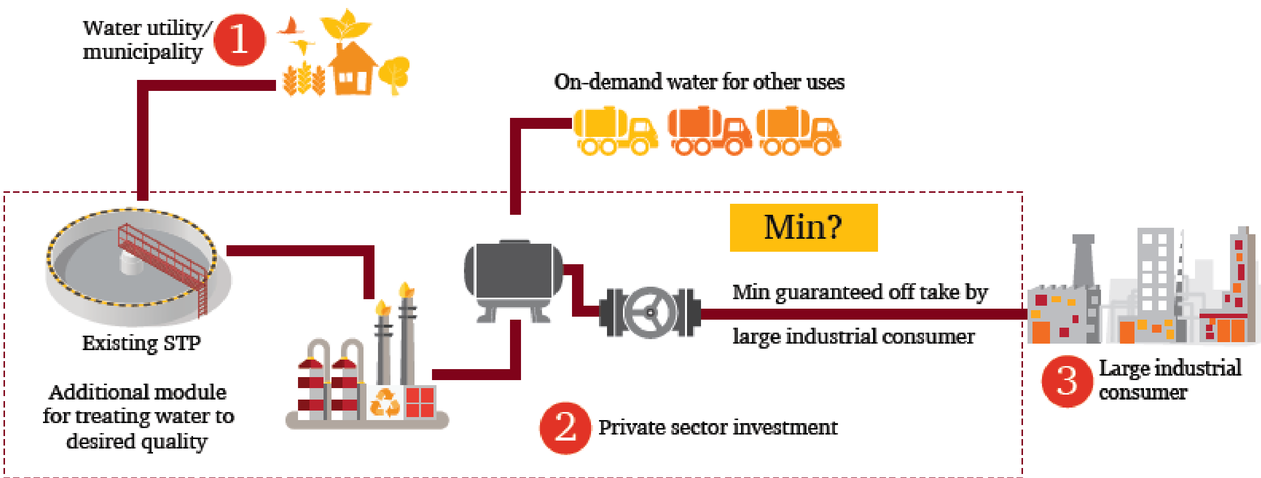
- **Technology migration:** Membrane-based tertiary treatment technology is new to India. There is potential for significant efficiency gains from technology and process innovations which can be better delivered by private sector firms.
- **Capital Investments:** Tertiary treatment and reuse projects require huge capital investments. Given the high opportunity cost of public funds, private sector participation will lead to inorganic growth in wastewater treatment capacity.

PPP project structures can be defined based on how roles and risks (design, finance, asset ownership, construction, operation, revenue, etc.) are shared between public and private entities. Based on the viability considerations discussed earlier, there could be three project structures for implementing reuse projects under the PPP mode.

The PPP structures we set out here could be designed to produce Grade III water for industrial use. In these models, the O&M of source STP and the conveyance cost of STW and reclaimed water are not recovered from the water tariff.

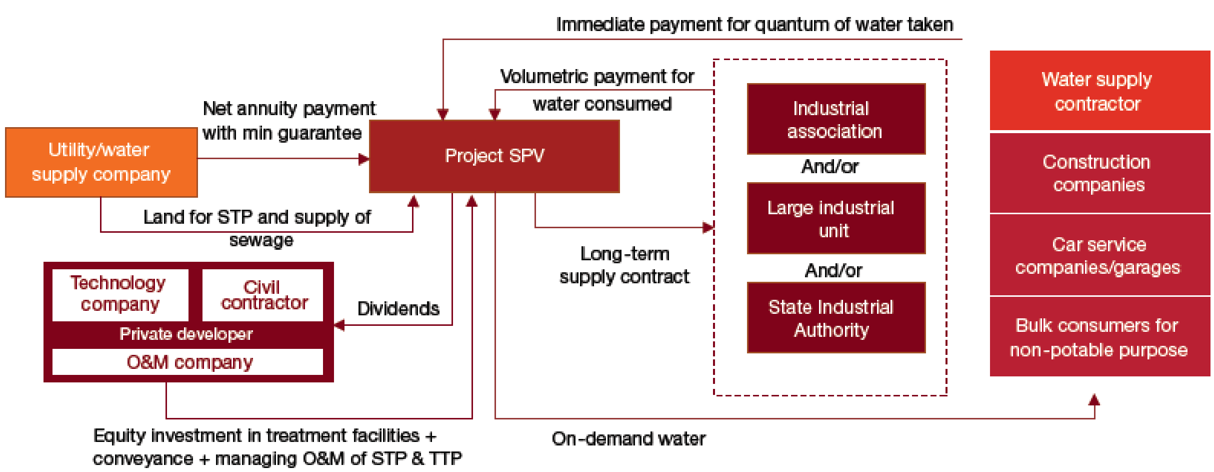
I. Three party fixed price (TPFP) model

This model is designed to use STW from existing STPs (owned by utilities) and would treat it to produce industry grade water for a single entity, which could be one industry or an industrial zone. These three players—utility, developer, and industrial entity—enter simultaneously into long-term contracts, assuring supply of STW and reclaimed water at predetermined rates and quality levels. The key stakeholders in this project design are as shown in Figure below:



1. **Water utility/ULB:** Provides land either within existing STP or outside for installation of tertiary treatment modules. The utility is the enforcer of the contract terms and will also ensure quality compliance and oversee operations. The utility makes a net annuity payment to the private developer to ensure guaranteed minimum revenue for the developer. Utility also has rights to levy penalties on the private developer for delays, quality non-compliance, and breach of contract.
2. **Private sector developer:** Invests in building treatment and conveyance infrastructure to the customer gate, and operates the same for a fixed period, after which it transfers the assets to the utility. The developer could also be given responsibility for the operation of the STP.

3. **Industrial bulk consumer:** A single entity with large water requirement that provides assured purchase guarantee for reclaimed water at a predefined quality, quantity, and tariff. The private developer would study the quality of STW from existing STP and would choose the most appropriate technology mix for the treatment plant based on the need of the bulk consumer.



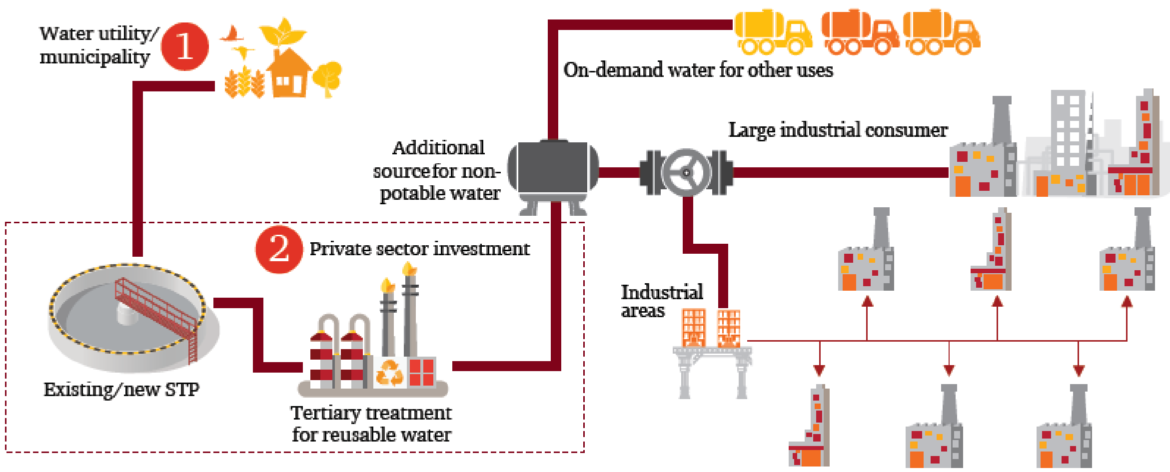
A Special Purpose Vehicle (SPV), fully owned by the private developer, will be established. The utility will provide land for reuse plant and transfer operational responsibility to the SPV. The private developer will operate the TTRO plant and will supply the agreed quantity of treated water to the bulk consumer, and will also sell additional treated water available in bulk or retail to other consumers. After the end of the term period, the SPV shall transfer all assets back to the utility.

- **Bid parameter:** The minimum guaranteed annuity payment can be the bid parameter.
- **Payment terms:** The industrial consumer will pay volumetric charges to the utility at a predefined tariff rate. The utility will pay only the differential between minimum guaranteed revenue (bid parameter) and water charges collected from bulk and other consumers, as shown in Figure 9.
- **Risk allocation:** With a water purchase guarantee from bulk consumers and minimum guaranteed revenue from the utility, the revenue risk and revenue source risk are low for the private developer, as shown in Figure 10. Given that the developer also operates the STP, its supply quality and variability risk is moderate. The finance risk rests with the private player but is moderate as the project remains viable without heavy subsidies.
- **Advantages and challenges:** In addition to the benefits of reuse discussed earlier, this project structure offers specific advantages to all stakeholders involved:

    1. Leverages existing infrastructure and improves quality of treatment by engaging private sector for end-to-end treatment process
    2. Reduces revenue risk of private developer as there is assured purchase commitment from the bulk industry consumer
    3. In a fixed price model, the private developer has incentives to improve efficiency by investing in technology upgrades.
    4. The key challenge in this model will be in clearly defining the contract terms between all three stakeholders. The price discovery process for determining reclaimed water tariff must adopt a long term view and should sufficiently address cost escalation risk. Dependence on a single buyer also poses revenue risk which is hard to mitigate in this model.

II. **Reuse utility buy-back model**

This model assumes that the utility shall enter into a buy-back agreement with the private developer and shall off-take the predefined quantity of reclaimed water from the tertiary treatment plant (TTP) at predefined quality levels. The model excludes the end user and has only two key stakeholders, as shown in Figure below:

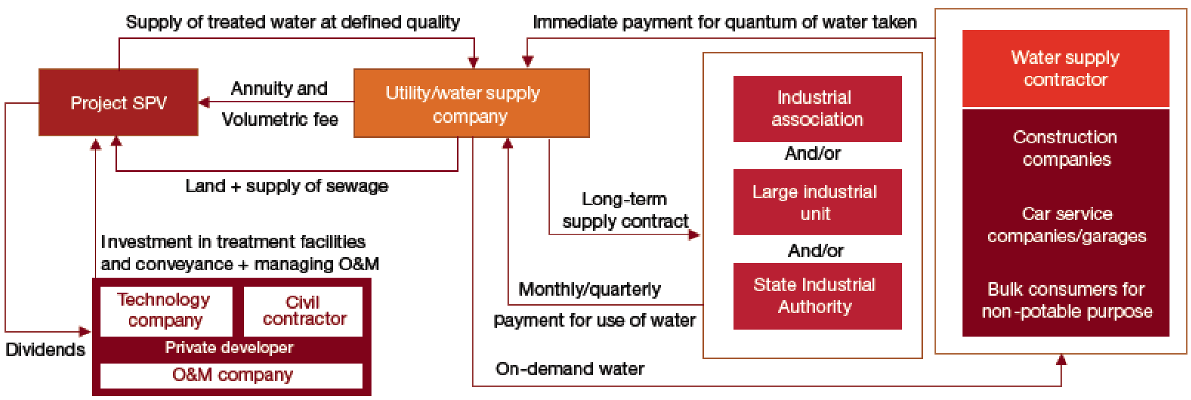


1. **Water utility/ULB:** Provides land either within existing STP or outside for installation of tertiary treatment modules. The utility is the enforcer of the contract terms and also ensures quality

compliance and supervises operations. The utility supplies STW/sewage, as the case may be, and provides full buy-back guarantee for reclaimed water produced by the developer.

2. **Private sector developer:** Invests in building treatment and conveyance infrastructure to the utility's water storage reservoir, and operates the same for a fixed term, after which it transfers the assets to the utility. The ideal private developer is a technology provider who also has civil construction and O&M capabilities.

Utilities will be responsible for collection of sewage and will build, own and operate the sewers up to the project involves new STPs; the construction will be financed by the water utility, either directly or through annuity payments to the private developer. Likewise, the O&M of the STP and conveyance network will be financed by the utility and implemented by the private developer.



This model also assumes that water utility is best suited to engage with industrial consumers and distribute non-potable water. The utility will either use the existing distribution network, or build and operate new distribution mains for supplying reclaimed water to industries. The quality of inflowing sewage and that of the reclaimed water will need to be clearly defined in the contract, which will be the basis for choosing the right technology option for the TTP.

- **Payment terms:** The utility will pay pre-fixed annuity fees to the private developer that will cover the O&M cost of the STPs and conveyance mains, and contribute to the recovery of capital costs of the conveyance mains. The annuity fees can be performance-linked to ensure timely completion of infrastructure works, service levels at STP and TTP plants, etc. The utility will pay volumetric charges to the private developer, as shown in Figure below.
- **Bid parameter:** The tariff for reclaimed water at the plant gate could be the bid parameter.
- **Risk allocation:**The most significant risk in this model lies with the utility's ability to pay for the reclaimed water without any major delay. The other important risk comes from dependency on the utility to meet its obligation to efficiently collect and transport sewage from households to the STP.
- **Advantages and challenges:** The key advantages of this transaction model are:
    1. This model with buy-back guarantee from the utility reduces revenue risks of the private developer as it is not required to identify potential buyers for reclaimed water.
    2. This model can be easily implemented as an add-on to all new STP projects and also all new large-scale industrial water supply projects;.
    3. As the utility is the final beneficiary, it can subsidize tariff by providing capital subsidies

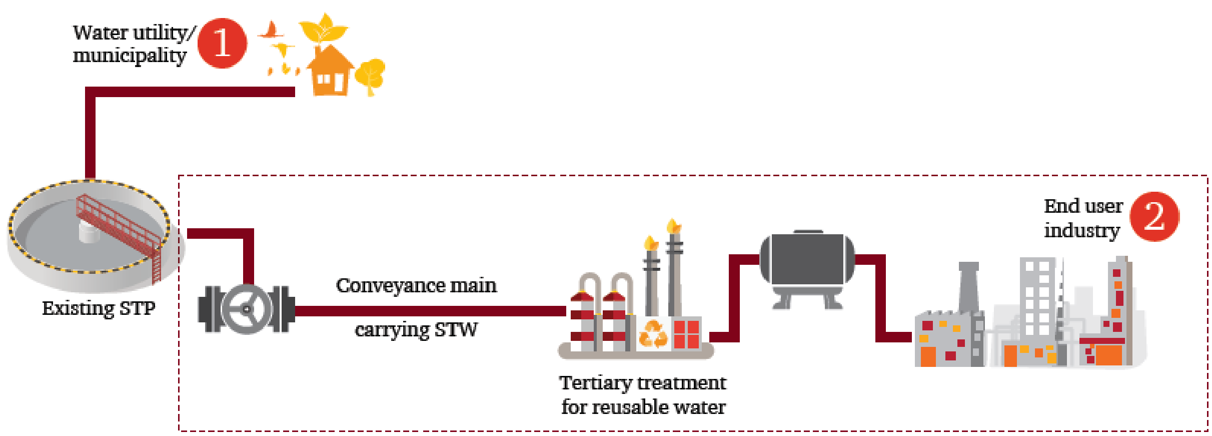
The challenges of the model will be:

1. Mobilization of public funds by the water utility/ local government for developing STPs and conveyance infrastructure.
2. The financial condition of the water utility and its ability to pay will influence the private sector's willingness to participate in the project. Some form of payment guarantee arrangements may make the project attractive for the private sector.

III. End user reuse PPP (EURP) model

This model is designed such that the end user industry will purchase STW from utilities at a defined cost and will invest in conveyance mains. The end user industry will then hire the services of a technology provider to build and operate the reuse plant for its internal consumption.

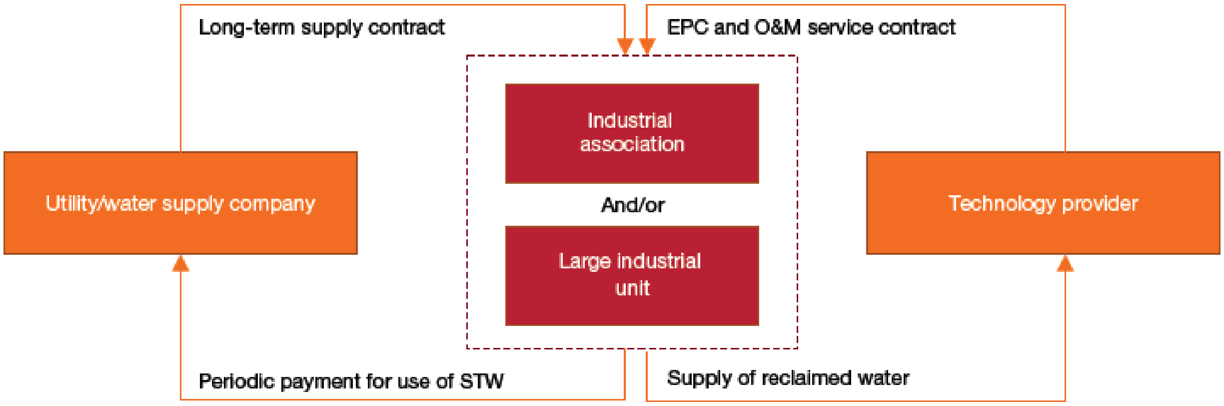
There are two main stakeholders in this model as shown in Figure 14:



1. **Water utility/ULB:** Supplies STW from existing STPs to the end user industry and charges a minimal volumetric charge for the STW supplied at the end user point.
2. **Private sector developer:** Invests in conveyance mains to bring STW to its premises and in TTP to produce industry grade water for its own consumption.

The end user industry will engage one or more technology firms through performance-based service contracts for the construction and operation of the conveyance mains and treatment plants. The design risk here will lie with the end user company that will have to undertake a detailed study of its water demand and technology options available.

- **Bid parameter:** These projects are usually not awarded on a competitive bidding basis and will have to be awarded based on case by case basis. The end user industry will apply for STW supply, and will enter into discussions with the utility to seek approval for supply of STW and determine the charges to be paid for the same.
- **Payment terms:** The end user industry will pay monthly or quarterly volumetric charges for the STW that it takes from existing STPs. The end user will also pay the technology providers a service fee for O&M of the treatment plant and service mains which can be estimated based on the volume of water supplied, as shown in Figure below.



- **Risk allocation:** There are two significant risks in this model. The first risk is that supply variability both in terms of quality and quantity is high, since the utility will be primarly responsible for the secondary treatment.The second risk stems from the fact that the end user is responsible for technical design, including choosing an appropriate technology option.

In terms of role definition, the end user takes the responsibility from conveyance to treatment, and, therefore, it is a high-risk effort from the end-user point of view.

- **Advantages and challenges:**
  1. This model is entirely end user driven in terms of design and financing, therefore mobilizing resources will be much faster for the project.
  2. The model provides greater financial benefit (realized as lower water costs) as there is no intermediary treatment company involved. Thus the reuse projects of this kind are competitive even in places where industrial water tariff is less than 0.76 USD per KL
  3. The most significant challenge will be that such large consumers are limited in numbers and many of them are located further away from cities. This increases conveyance cost and in addition place administrative bottlenecks on execution. The other key challenge is to get the technology design right.
- **Financial analysis:** When an end user industry opts to use reclaimed water (Grade III) and invests in a TTP plant, it can bring down the cost of water to 0.52 USD per KL, after servicing the debt raised for building the TTP plant. This model is the most easily applicable amongst the three models suggested. It is suitable for industrial units (end users) such as power plants and fertilizer units that are water intensive and can invest in in-house reuse plants to meet their water requirements.

9. IMPLEMENTATION OF WASTEWATER RECYCLING PROJECTS IN J&K STATE

Public support is proving to be one of the most important, and potentially volatile, aspects ofsuccessful recycled water project implementation. As the public becomes more aware of theuse and role of recycled water, more attention may be focused on applications, potentialcontact with humans or other plants or animals that humans come in contact with or ingest,and potential health concerns related to recycled water (particularly in non-industrial uses).New pollutants are emerging, and will continue to emerge, as testing technologies improve,and potential health effects of the pollutants (or combinations of pollutants) are discovered.

Current examples include endocrine disrupters,pharmaceuticals, and personal care products(PPCPs). Initially there will be limited scientific information related to these contaminantsdue to low pollutant concentration levels, detection limitations, statistical error, complexity ofthe pollutants, limitations in treatment technologies, and lack of long-term epidemiologicaldata. Agencies, the public, and politicians will have to weigh relative risks against real andperceived costs, increasing water demands, and in many cases, diminishing quality andquantity of raw water supplies. Successful promotion and implementation of recycled waterprojects will require proactively addressing these concerns through education, research,advancements in water treatment technologies, O&M practices, and public outreach.

The points below expand on the broad 'success'criteria previously discussed. Not everyproject will be able to satisfy all these points, and many projects may not need to do so to besuccessful. Varying degrees of emphases will berequired, depending on the recycled wateruse, and many other aspects of the project.The most successful projects will tend to have:

- Public and political acceptance and support of the identified use(s), proposed or planned facilities, monitoring and safety protocols, long-term O&M procedures, and overall acceptance of the sponsoring agency and its ability to successfully build and operate the project.

- Well-defined project purpose(s) and identified project driver(s), including (but not limited to) offsetting of potable water use, reducing pollutant loads and dischargevolumes in receiving waters, and reducingtreatment volumes in possible downstreamtreatment facilities.

- Regulatory and project sponsor support of the project at all levels including the ability of the sponsoring agency to successfully build and operate the project.

- Full assessment (to the extent possible) of health and safety implications of recycled water being used for its identified purpose(s).

- Ability, through diversions, storage, expansion of existing facilities, or construction of new facilities, to supply each user'sdemand when and as it is needed.

- Full assessment of environmental advantages and disadvantages of the project, including handling of treatment facility waste streams.

- Full consideration of how the project fits into other possible integrated planning efforts.

- Construction or acquisition of adequate conveyance facilities to deliver recycled waterto the locations of use.

- Full assessment of the cost of the project(s), incorporating anticipated future supply restrictions, waste stream management, and anticipated adjustments, if any, to costs and available funding sources.

- Full assessment of alternatives, with strong public involvement.

- Attainment of adequate funding for any required acquisition and construction, and arrangement for long-term O&M funding for project infrastructure and facilities.

- Long-term project performance and water quality that meets or exceeds commitments and expectations

10. STEP-BY-STEP APPROACH TO IMPLEMENTATION

For a successful wastewater recycling steps, a minimum number of following steps are discussed in this subsection:

- **Identification of Project**

The purpose of this step is to look at the 'big picture' to see how water recycling can (or must)fit into the overall water supply andmanagement structure of an area.

- **Needs and Project Drivers**

In the short-term, the purpose of this step is toimplement the recycled water project. In thelong-term, planning should broadly determine how water recycling will fit into short andlong-term water use and supply.

- **Project Planning**

The purpose of this step is to identify all the relevant properties of the recycled water and itssources to enable available water to be matchedto appropriate uses and users. This step alsoprovides a baseline for determining what additional treatment or facilities may be required ifthe supply characteristics don't match identified uses (e.g., a plant upgrade to tertiarytreatment or beyond, or storage reservoir toaugment lower night-time treatment flows anddeliver more consistent supply to users).

- **Identification and Characterization of Recycled Water Sources**

Public outreach has emerged as one of the most volatile and potentially unpredictable aspectsof some water recycling projects. The purpose of this step is to obtain public participation andsupport in the planning and implementation ofa proposed recycled water project, or tounderstand the opposition and develop alternatives to gain public support.

- **Public Involvement and Public Information and Education**

Public outreach has emerged as one of the most volatile and potentially unpredictable aspectsof some water recycling projects. The purpose of this step is to obtain public participation and support in the planning and implementation ofa proposed recycled water project, or tounderstand the opposition and develop alternatives to gain public support.

- **Market and Infrastructure Assessments**

The purpose of this step is to identify a water reuse market and assess the infrastructurerequirements. Once a market is identified and demands quantified then a comparisonbetween the cost of infrastructure development and the revenue or benefits can be performed.

- **Environmental Issues and Approval**

The purpose of this step is to determine what environmental review process will be requiredand what approvals and permits (other than those obtained from the PHED and the UEED)will be required.

- **Economic and Financial Review**

The purpose of this step is to identify possible funding sources for design, construction,and O&M, and to develop internal financing options (e.g., rate structures, taxationoptions, debt repayment, etc.).

- **Project Outline Submission to State Government Agencies**

The purpose of this step is to present an outline of the proposed project to the two stateagencies most involved in the approval and permitting of a recycled water project to obtain aconceptual review and guidance on formal regulatory review submission requirements.

- **Regulatory Review and Approval by local, state, and Union Government Regulators**

The purpose of this step is to determine what specific environmental, health, and otherreviews and permits will be required for the successful implementation of a proposedrecycled water project. This is facilitated through the informal review described in step related to Environmental issues approval above.

- **Project Design and Report**

The purpose of this step is to complete the engineering design and to finalize theimplementation details to the satisfaction of UEED, PHED and other permitting/approving agencies.

- **Funding Mechanisms**

The purpose of this step is to identify funding sources, including any specific constraints, anddiscuss contractual arrangements.

- **The Permitting Process**

The purpose of this step is to obtain required permits prior to the start of construction andservice delivery.

- **Construction**

The purpose of this step is to build the infrastructure, or make the necessary modifications, sothat the users' identified recycled water needs can be met. A key component of this effort isinforming the public and gaining acceptance for the inconveniences and disturbances tonormal activities that may occur during construction.

- **Project Commissioning and Delivery of Services**

The purpose of this step is to transition smoothly from construction and testing to supply ofrecycled water.Various inspections are requiredto ensure that there are no cross-connections between thepotable and non-potable systems by the responsible state agencies. Attention to water quality testing and O&Mprocedures are particularly critical at start-up, as staff and users must become accustomed tothe new services and operations. It is important to note, that anumber of recycled waterprojects have experienced strong public opposition prior to initial delivery of water.Therefore, it is imperative to time the startup of a recycled water project so that it cannot beused during an election year asan issue or politically rallying point.

- **Operation and Maintenance**

The purpose of this ongoing step is to provide effective long-term O&M. If the project is an indirect potable reuse project, the detailed O&M plan will have been developed as part of the design report. Regardless of the type of recycled water project, regular water quality testing and periodic inspections of infrastructure will be required. Specific requirements will be detailed in the various permits, but will not likely be onerous, with the exception of groundwater recharge projects, which have extensive groundwater testing requirements.

As with all other steps in the development of the recycled water project, public outreach continues to be important. Consistency in signage, service response, continuous user evaluation, regular testing, and other proactive measures can help ensure that a fully informed public comes to expect water re cycling solutions to water supply and demand issues.