The Water and Sanitation Program assisted the Ministry of Urban Development (Government of India) to formulate these guidelines for typical issues that need to be addressed to explore approaches to improve water supply and sewerage services, including suitable partnerships with the private sector.

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Guidance Notes for Continuous Water Supply
(24-7 Supply)

A GUIDE TO
PROJECT
PREPARATION,
IMPLEMENTATION
AND APPRAISAL
ACRONYMS

AMR    Automatic Meter Reading
BABE    Burst and Background Estimates
BOT    Build-Operate-Transfer
BOOT    Build-Own-Operate-Transfer
CARL    Current Annual Real Losses
CBD    Community-based organization
CDP    City Development Plan
CPHEEO  Central Public Health and Environmental Engineering Organization
CWSSU   Continuous Water Supply Support Unit
DMA    District Meter Areas
GDP    Gross domestic product
GIS    Geographical Information System
GoI    Government of India
IBT    Increasing Block Tariff
IL    International Leakage Index
IWA    International Water Association
JNNURM  Jawaharlal Nehru National Urban Renewal Mission
MC    Management Contractor
MDGs  Millennium Development Goals
MDPE  medium density polyethylene
MIS    Management Information System
MoUD   Ministry of Urban Development
NGO    Non-governmental organizations
NRW    Non-Revenue Water
OBF    Output Based Funding
O&M    Operation and maintenance
OZ    Operational Zone
PPP    Public-private partnership
PSP    Private sector participation
PQ    Prequalification
PWD    Public Works Department
PHED   Public health engineering department
RO    Reverse osmosis
SCADA  Supervisory Control And Data Acquisition
SBP    Strategic Business Plan
SPSP   Small-scale private service provider
SSO    Small-scale operators
UARL   Unavoidable Annual Real Losses
ULB    urban local body
WSP-SA  Water and Sanitation Program – South Asia

Units of Measure

Lpcd    Liters per capita per day
m³    Cubic meter
mld    million liters per day
m    meter
l    liter
US$1= Rs 39 (July 2008)
FOREWORD

The provision of safe, reliable and affordable water supply through efficiently managed arrangements is a key goal for the water supply sector. It is being increasingly acknowledged that these objectives are difficult to achieve through conventional water supply networks without targeting continuous water supply through a constantly pressurized system.

It is now well established that intermittent water supply leads to health risks for users due to the higher likelihood of contamination of water pipelines through joints and damaged segments during periods when the system is not pressurized. The absence of sound technical and managerial systems associated with intermittent supply makes supply and demand management extremely difficult. This prevents effective estimation or control of the amount of water produced, transmitted and distributed. Intermittent supply of water also causes great inconvenience to households, especially to women and children who most often bear the brunt of the hardship associated with inadequate and unreliable water supply. To cope with these shortcomings, customers revert to expensive coping strategies such as building expensive underground sumps and overhead tanks, and installing booster pumps, treatment devices etc. Households, especially the poor, who are unable to afford such expensive investments, often have to rely on purchasing water at elevated prices from private suppliers.

The technical and managerial shortcomings associated with intermittent water supply lead to a steady decline in the quality of service over time. The poor and deteriorating service undermines the commercial environment for the service provider, as unsatisfied customers are unwilling to accept water tariffs imposed on them. The adverse financial health of the service provider resulting from this situation reinforces the trend of declining service quality.

The CPHEEO Manual on Water Supply and Treatment also recognizes the shortcomings of intermittent water supply. It states: "The intermittent system suffers from several disadvantages... does not promote personal hygiene.... water is stored during non-supply hours in all sorts of vessels which might
the water mains through leaky joints.... difficulty in finding sufficient water for fire fighting purposes.... taps are always kept open in such system leading to wastage when supply is resumed..... This system (intermittent supply) does not promote hygiene and hence, wherever possible, intermittent supply should be discouraged.”

Given the health imperatives and other inconveniences caused by intermittent water supply, it is unfortunate that virtually no city in India has continuous water supply. The experience of several cities in developing countries, many with per capita incomes lower than India's, has proven that continuous water supply is possible through fairly straightforward and widely practiced institutional, technical and financial innovations.

Recognizing the need for overcoming the shortcomings in the existing system to attain the goal of continuous water supply in urban India in a planned manner, the Ministry of Urban Development (MoUD) has, with the support of the Water and Sanitation Program—South Asia (WSP-SA), drafted these guidance notes. They have been prepared not just to highlight the shortcomings of intermittent water supply but also to elucidate a planning process that would enable exercise of choices aimed at addressing these problems.

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These guidelines are designed to sensitize State Governments, Urban Local Bodies and service providers to the policy and operational issues that need to be addressed as they reform urban water supply. These Guidance Notes should be considered as a guide to best that will continue to grow and transform through incorporation of the actual experience of cities across the country, as they endeavour to improve their water supply arrangements. They are not aimed at being a set of rigid, exhaustive prescriptions, and should be adapted to the cities’ specific circumstances.

Secretary, Urban Development
CONTENTS
ACRONYMS ................................................................................................................................. 2
Introduction ................................................................................................................................. 4
Guidance Notes: Conversion to Continuous Water Supply (24-7 Supply) and
Achievement of the Objectives of the Jawaharlal Nehru National Urban Renewal Mission
.................................................................................................................................................. 9

Guidance Note 1: Why Convert from Intermittent to Continuous (24-7) Supply? .......... 14
Guidance Note 2: Institutional and Financial Issues .............................................................. 35
Guidance Note 3: Building Blocks for a 24-7 Water Supply Service ................................. 68
Guidance Note 4: Planning and Implementing Conversion to 24-7 Supply ....................... 95
Guidance Note 5: 24-7 Supply: Benefiting from Improved Distribution System
Management ............................................................................................................................... 118

Annexes .................................................................................................................................. 124
Annex 1A: Water Transmission and Distribution Systems ................................................. 124
Annex 1B: Water Transmission and Distribution Systems: Basic Customer Data Required
for Planning and Introducing 24-7 Supply .......................................................... 126
Annex 1C Conversion from Intermittent to Continuous Supply ........................................ 128
Annex 2B: 24-7 Supply Conversion Process Check-List ...................................................... 131
Annex 3: Measuring and Benchmarking Real System Losses (Leakage) ........................... 138
Introduction
Operation of water distribution systems to provide a continuous supply of water – 24 hours a day, seven days a week throughout every day of the year – is not an option, it is an imperative. A water distribution system that is operated intermittently can neither be efficiently nor effectively managed, in comparison with the norms of international best practice, and – under most conditions – water supplied intermittently poses a constant threat to the health of households receiving and using the water.

In addition, under intermittent supply conditions:
- Supply management cannot be practiced, that is, controlling the amount of water produced and distributed through the practice of active leakage detection, pressure management, etc.; and
- Demand management cannot be practiced as this requires a combination of accurate customer metering and a tiered, volumetric tariff – and only very high quality electronic customer meters can measure water use by customers with any reasonable accuracy under intermittent supply conditions.

Unless water service providers convert from intermittent to continuous supply, the populations that they serve will continue to live under supply conditions that:
- Pose a constant threat from waterborne disease – both chronic diarrhea and periodic outbreaks of epidemics of serious diseases; and
- Seriously inconvenience households to the point that personal freedoms are restricted (women and children are tied to their houses to receive or collect water) and household economies are adversely affected (women are unable to work and the education of children is affected).

It is absolutely essential to appreciate that only under conditions of continuous supply will it be possible to reduce leakage from distribution systems and household wastage of water – and therefore to conserve the scarce sources of potable water throughout the country. Systematic reduction of leakage is impractical under intermittent supply conditions.

Eventually, the problems posed by intermittent supply of water can adversely impact economic development and reduce inward investment.

What is 24-7 water supply?
One definition is as follows:
“24-7 supply is achieved when water is delivered continuously to every customer of the service 24 hours a day, every day of the year, through a transmission and distribution system that is continuously full and under positive pressure throughout all of its pipelines and networks.”

Of course, very occasionally, in times of exceptional circumstances, there may be short interruptions to this continuity of supply. However, any service which routinely fails to provide continuity “24 hours a day, every day of the year” must be considered intermittent – and the problems experienced are precisely the same for all periodicities of
intermittent supply, whether there is an intermittency of 20 hours a day or of two hours a day.

One thing is common to all water distribution systems – intermittent water supplies are a considerable danger to health and preclude any possibility of practising service efficiency and cost-effectiveness. The negative aspects of this can be avoided by conversion to continuous (24-7) supply.

Although it may be difficult to believe, there are virtually no cities or towns in India that cannot provide a continuous supply of water to their citizens. The only exceptions to this are locations where daily water availability is extremely low, probably somewhat less than 50 liters (l) per person per day and, even then, there are places in the world which manage to achieve continuous supply.

These Guidance Notes have been prepared to assist governments, municipal administrations and water utilities considering conversion of water distribution services from intermittent to continuous (24-7) supply. The notes have drawn upon experience obtained in this change process in India, from 24-7 supply conversion projects such as the one in Karnataka, as well as related experiences from elsewhere in India and, over a longer period, internationally.

Although, until 30 or 40 years ago, there were urban areas in the country that received a 24-7 supply, operations deteriorated as service providers came under pressure from rapidly increasing urban populations, financial, technical and other constraints arising from the state of institutional incentives, lack of additional bulk water supply infrastructure, etc. Intermittent supply was progressively introduced as the norm to cope with these difficulties and this form of operation led to rapid deterioration in the urban water supply infrastructure. The technical elements involved in the process of conversion from intermittent to continuous supply are not complex. However, the principles, practice and operational experience underlying continuous supply – and what is needed to convert from intermittent to continuous supply – have fallen into disuse in the country.

The conversion process and its constituent technology have been well-tested and proven over many decades in many other parts of the world under a broad range of economic, physical, social and cultural circumstances. The technical achievement of conversion from intermittent to 24-7 supply can therefore be considered to be relatively straightforward, given proper guidance and due attention to process. However, the sustainability of continuous supply in the longer term will rely heavily on the satisfactory resolution of institutional, economic and financial issues that adversely affect the viability of the vast majority of water service providers in the country today. In short, the process of conversion to 24-7 supply must take full account of institutional and financial reform coupled with the technical process. These Guidance Notes address issues involved in the technical and non-technical aspects of the delivery of water supply services.

These Guidance Notes should be considered as a “work in progress” by those consulting them. Although considerable work has been done on preparatory work for conversion
from intermittent to continuous supply in some cities in India, and a number of cities are either in the initial phase of implementation or about to enter into implementation, the process has only been completed in small pilot areas of three towns for a limited number of connections – and this not without some problems. It is therefore intended that these Guidance Notes be updated as further experience is gained. However, in the meantime, they form a useful guide to those cities and towns that are considering embarking upon the conversion of their water distribution system to a 24-7 supply service.

The Guidance Notes first explain the many shortcomings – and dangers – of intermittent supply and why continuous supply is so overwhelmingly beneficial in comparison. Planning and preparatory activities are then outlined and options for implementation defined. The Notes cover institutional and financial matters as well as the technical aspects underlying the entire process.

However, it is important to recognize that the Guidance Notes are just that: a guide to best practice, not an absolute set of rules that apply to all conditions. They should be adapted to circumstances and common sense should prevail in their application.

In fact, as with many other sectors, there is no substitute for a heavy dose of common sense when converting from intermittent to continuous supply! Institutional arrangements and management systems that may be appropriate – even essential – for the management of a water supply system serving a large city may not be affordable, or even necessary, for a small town. However, 24-7 supply will be a practical, affordable and sustainable option for all but a few urban areas suffering from an extreme shortage of water.

Indeed -- as the notes set out to demonstrate -- continuous supply is an essential fundamental if a water service is to be effective and efficient in its operations while maintaining costs at a minimum.

In order to assist in the conversion process of a distribution system from intermittent supply to 24-7 supply, the following Guidance Notes have been prepared:

Guidance Note 1: Why Convert from Intermittent to Continuous 24-7 Supply?
This explains why operation under 24-7 supply conditions is an absolutely essential – and achievable -- goal for all but a very few water utilities throughout India.

Guidance Note 2: Institutional and Financial Issues
This describes the principles that need to be respected to achieve good governance of a water service without which any 24-7 supply conversion process would be placed at risk. Institutions with responsibility for supplying a water service to urban areas throughout the country need to address the issue of incorporating the principles of good governance generally recognized to be essential if the service is to be efficiently and effectively operated in a sustainable manner.
Guidance Note 3: Building Blocks for a 24-7 Water Supply Service
This sets out the essential constituent building blocks of a 24-7 water distribution service – technical, operational, institutional and economic.

While there are some water service providers – and many more individual civil servants and sector professionals – who are convinced of the need to convert to 24-7 supply, they fear the problems they would face were they to attempt to achieve it. Most of these problems can be successfully dealt with through an understanding of the principles and practices underlying the process of planning the conversion process. The purpose of Guidance Note 3 is to elaborate on the planning process for conversion to continuous supply.

Guidance Note 4: Planning and Implementing Conversion to a 24-7 Supply
This sets out the options for implementation of a 24-7 supply conversion process, key actions and issues to be taken into consideration when planning and implementing the project and raises the issue of communication – internal and external. Many water utilities throughout India, whether a public health engineering department (PHED) or a semi-autonomous water board or a municipal provider, presently lack the management systems and system records to plan and implement a program of conversion from intermittent to 24-7 supply. Within Guidance Note 4, the concept of Continuous Water Supply Support Units (CWSSU) is introduced. Their role would be to provide support to local governments and their water service providers throughout the conversion process from various preparatory actions required to plan and launch a 24-7 supply conversion program.

Guidance Note 5: 24-7 Supply: Benefiting from Improved Distribution System Management
This describes the management and monitoring of a 24-7 supply service, once achieved.
Limitations of these Guidance Notes

It is as essential to understand the intended limitations of the Guidance Note as it is to understand their purpose and content. They do not intend to:

- Substitute for textbooks and manuals on the design of water supply and distribution networks, of which there are already many excellent publications;
- Cover the integrated, overall management and operation of a water supply entity – although the text goes beyond covering just conversion to 24-7 supply, where this is appropriate to the core subject; or
- Deal with specific circumstances of particular locations.

Each of the five Guidance Notes poses a series of questions, arising out of issues associated with each topic, and provides responses to these -- rather than material that can be best found in other manuals and textbooks on the subject – particularly the techniques and technology associated with each subject. In so doing, it is intended to ensure that -- with respect to the formulation of a 24-supply conversion program -- national, state and municipal governments and water utilities:

- Are aware of the issues that need to be addressed;
- Know what issues their specialist advisers should be tackling; and
- Can actively contribute to the planning and policy decision making process without necessarily understanding the detailed technology and techniques involved.

Likewise, professional advisers should be aware of the topics that public administrations and water utilities will wish them to address when they contribute advice in the process of formulating, preparing for and implementing a 24-7 supply conversion program. Although the full set of Guidance Notes can be read as a complete unit, it is also possible to read each individually as an introduction and guide to the particular topic addressed by it. To avoid duplication of points covered in a number of Guidance Notes, reference is sometimes made to the specific sections of other Guidance Notes where a topic is covered in more detail.
Guidance Notes: Conversion to Continuous Water Supply (24-7 Supply) and Achievement of the Objectives of the Jawaharlal Nehru National Urban Renewal Mission

In November 2005, Government of India (GoI) launched the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), commonly shortened to the National Urban Renewal Mission. JNNURM is to last seven years commencing with the financial year 2005-06.

Its objectives are to:
- Improve and augment the economic and social infrastructure of cities;
- Ensure basic services to the urban poor;
- Initiate wide-ranging urban sector reforms whose primary aim is to eliminate legal, institutional and financial constraints that have impeded investment in urban infrastructure and services; and
- Strengthen municipal governments and their functioning in accordance with the provisions of the Constitution (74th) Amendment Act, 1992.

In order to achieve its objectives, and to assist cities to contribute to the country’s growth and poverty reduction objectives, the JNNURM considers it essential to:
- Create incentives and support for urban reforms both at state and city levels;
- Develop appropriate enabling frameworks;
- Enhance the credit-worthiness of municipal governments; and
- Integrate the poor with service delivery systems.

Improvement in the quality, coverage and operational efficiency and effectiveness is an important target sector of the JNNURM. There are many references to water supply in the Toolkit and the sector, conversion to 24-7 supply and reduction in Non-revenue Water (NRW) are used as examples to show government intent. Reference is also made to the neglect of financial issues and prudent tariff structures being a significant cause of the poor state of urban India’s present water supply services.

Conversion from intermittent to 24-7 supply is fundamental to the achievement of the objectives of the JNNURM relating to water supply.

As is expanded upon in the Guidance Notes, operation of a distribution system under continuous supply (24-7 supply) conditions is an essential requirement of an urban water service. For a 24-7 supply conversion project to be sustainable, in addition to restructuring, replacing and rehabilitating the distribution infrastructure, it is necessary to address many other issues surrounding the water supply service and its infrastructure – institutional reform, NRW reduction in all aspects [real losses (leakage) as well as apparent losses such as theft of water and metering accuracy], overall utility performance (financial as well as technical), tariffs, extending water services to the poor. These Guidance Notes address all these issues as all of them have an impact on the achievement of JNNURM objectives.
The content of these Guidance Notes should, therefore, be taken into account when formulating applications for funding under JNNURM. They provide support to urban local bodies (ULBs) and parastatal agencies in the preparation of their applications for JNNURM funding at the stage of the city development plan (CDP) and individual project preparation, including:

- Guidance as to how to plan conversion from intermittent to continuous water supply and related aspects of a CDP and to produce those aspects of the CDP in accordance with the needs of the assessment process for funding applications, for example, the preparation of:
  - state and municipal visions with respect to water supply;
  - state urban water supply policies and action plans to assist the state-level steering committees in their role of coordinating and approving applications; and
  - municipal urban water supply policies and action plans that will naturally feed into the broader CDPs as well as providing the basis of projects for funding under JNNURM;
- Background to the importance of studying project options, both for implementation and long-term operations, and their technical, economic and financial feasibility and commercial assessment;
- How provision of services to the poor are not just a social obligation but assist in the financial feasibility of urban water supply and sanitation;
- Support for decisions as to which infrastructure projects or urban services should continue to be provided by the public sector and which could benefit from partnership with the private sector; and
- Background to options for public-private partnerships (PPPs).

The initial budgetary provision for the GoI-funded part of investment envisaged under JNNURM is about Rs. 50,000 crore for a period of seven years. A total of 63 cities have been eligible for support under JNNURM along the following lines:

<table>
<thead>
<tr>
<th>City Category by Population Size</th>
<th>No. of Cities Listed as Eligible for JNNURM Support</th>
<th>Maximum Support as Percentage of Individual Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 4 million</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>1 to 4 million</td>
<td>28</td>
<td>50</td>
</tr>
<tr>
<td>Selected cities with less than 1 million (state capitals and other cities, urban areas of religious, historic or tourist importance)</td>
<td>28</td>
<td>80</td>
</tr>
</tbody>
</table>

Funding has been made available for:

- Assistance with the preparation of a CDP; and
- Project investment support for:
  - preparation of detailed project reports; and
  - project investment
To be eligible for project investment support, the applicant ULB or parastatal organization must have:

- Produced a CDP; and
- Received approval to proceed to request funding by the state-level steering committee, the role of which is to coordinate applications for JNNURM funding.

Applications sanctioned by the state-level steering committees for funding have then to be assessed for their eligibility at the central level by one or both of the sub-mission directorates, managed respectively by:

- The Ministry of Urban Development (MoUD) (Sub-Mission for Urban Infrastructure and Governance); and/or
- The Ministry of Urban Employment and Poverty Alleviation (Sub-Mission for Basic Services to the Poor).

In November 2005, GoI published a Toolkit including an overview of JNNURM and five notes, respectively, on: Framework and Process; Formulation of a CDP; Guidelines for Project Preparation; Guidelines for Project Appraisal; and Timeline for Implementing the Urban Reform Agenda.

Listed below are a series of checkpoints for projects related to water supply network projects – whether for their rehabilitation and/or expansion – as guidance for those undertaking either project preparation or project appraisal. These have been compiled to check whether applicants for funding under JNNURM take have taken full account of the content of these Guidance Notes for Conversion to Continuous Water Supply (24-7 Supply) in their preparation:

Guidance Note 4, Section 4.11 and Annex 2B, provide a detailed checklist of actions to be considered at each stage in the process of planning and preparing a 24-7 supply conversion project. The first two stages of this process – the Initial Decision and the Outline Planning stages – are relevant to assessments for funding under the JNNURM program.

The following is a summary checklist.

<table>
<thead>
<tr>
<th>Checkpoint</th>
<th>Response</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is achievement of continuous supply an objective of the project?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2. Has a plan been submitted showing how it is intended to achieve continuous supply?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Has a program for achieving continuous supply been prepared?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the project horizons and phasing reasonable and achievable?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Does the water service provider have the capabilities and technology within its staff complement to achieve continuous supply? If not, how do they intend to overcome this?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 The main thrusts of the Sub-Mission for Urban Infrastructure and Governance include infrastructure projects relating to water supply and sanitation and sewerage.

2 The main thrusts of the Sub-Mission for Urban Infrastructure and Governance include infrastructure projects relating to water supply and sanitation and sewerage.
<table>
<thead>
<tr>
<th></th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Have any legal impediments to the intended process for conversion to continuous supply been identified? If so, how will this be rectified?</td>
</tr>
<tr>
<td>6</td>
<td>Does the proposed project include proposals for connecting poor households to the piped supply? Is the approach feasible?</td>
</tr>
<tr>
<td>7</td>
<td>Has an effective communications plan been submitted for both internal and external communications?</td>
</tr>
<tr>
<td>8</td>
<td>Is the technical feasibility study comprehensive and credible?</td>
</tr>
<tr>
<td>9</td>
<td>Has a Strategic Business Plan (SBP) been submitted for operation under 24-7 supply conditions?</td>
</tr>
<tr>
<td>10</td>
<td>Is the financial feasibility study acceptable? How will the work of conversion be funded? Is there a program for tariff reform to increase water charges to full cost recovery levels?</td>
</tr>
<tr>
<td>11</td>
<td>Has an updated infrastructure asset record been prepared? If not, how is it intended to produce one?</td>
</tr>
<tr>
<td>12</td>
<td>Have data – technical, operational and customer - been collected? If not, has a plan been submitted for their collection? Does this include comprehensive system metering – flow and pressure?</td>
</tr>
</tbody>
</table>
Guidance Note 1
Why Convert from Intermittent to Continuous (24-7) Supply?
Guidance Note 1: Why Convert from Intermittent to Continuous (24-7) Supply?

What is the Definition of “24-7 Water Supply”?  
The definition of 24-7 water supply as used in the context of these Guidance Notes is: “The supply of potable water to end users through a system of pipes – comprising interlinked bulk transmission and/or distribution systems – which are continuously full and under positive pressure throughout their whole length, such that the end user may draw off water at any time of the day or night, 24 hours a day, every day of the year”.

The minimum pressure maintained at any point in the system varies between urban areas according to their circumstances. However, a reasonable objective is to maintain a minimum pressure of 10 meters (m) at any point – generally sufficient to reach the second storey of a domestic dwelling. Buildings requiring water at higher elevations receive the continuous supply into a ground-level holding tank from which it is usually pumped to the roof or intermediate level storage from which the water is supplied by gravity to the building through internal plumbing.

Urban areas converting from intermittent to continuous supply – and where the distribution systems are in a poor state of repair – may initially supply water at lower pressures to restrict losses through leakage until they have rehabilitated or replaced the worst lengths of their distribution system.

Continuity of supply may be broken under certain emergencies, for example, major pipe bursts, but should be kept to an absolute minimum duration through efficient repair practices. Breaks in supply will generally require flushing of the affected parts of the system to preclude contamination when supply is resumed.

Why is Intermittent Supply so Undesirable?  
Intermittent supply gives rise to the following deficiencies in the service and its management:

* Serious risks to health, resulting from ingress of contaminated groundwater to the distribution system;
* Inability to practice efficient supply management;
* Inability to practice effective demand management;
* Operational inadequacies which unduly weaken the physical infrastructure;
* Customer dissatisfaction with an unreliable service of poor quality; and, not the least,
* Customer inconvenience, in many cases to an unacceptable degree, by:
  o imposing financial restrictions on household income;
  o limiting personal water usage to below the level required for the practice of safe hygiene; and
  o translating into an unwillingness to pay for a sub-standard service.
If these deficiencies were ranked in order of importance, the inherent risk to health would be accorded the highest rank. There is little doubt that contaminated water distributed through intermittent water supply systems is a major factor in the extraordinarily high incidence of waterborne disease throughout the South Asia region. Although, clearly, other factors contribute to the high infant and child mortality rates in the region, contaminated piped water has a significant influence. Tests in some areas in the country have shown that high levels of bacterial contamination are experienced in the first 10 minutes of re-pressurization of a system – and that, in some places, dangerous levels of contamination persist for up to 20 minutes. This is in accordance with studies carried out elsewhere in the world. The cause is not difficult to find and is illustrated in Figures 1.1 and 1.2.

Soil, in urban situations, is naturally contaminated by water infiltrating it at times of rainfall, carrying with it the general pollution found on roads. In addition, effluents from septic tanks and leakage from domestic sewers into the main sewer system add to the polluted nature of any groundwater that is present. Although the situation is at its worst when groundwater levels are high and above the water pipes, groundwater itself is created in most localities by leakage from customer connection pipes and water leaking upwards through the soil when the distribution system is under pressure.

**Figure 1.1: Water Reticulation System – No Pressure**

Figure 1.1 shows this accumulation of groundwater contaminated by sewage, oils, greases and heavy metals in run-off from roads. It also shows how this contaminated water can enter water distribution pipes when they have been emptied down at the end of a supply period.
Figure 1.2 shows how this contaminated water within the pipes is then transmitted through to the customer’s premises when the distribution system is pressurized next.

Figure 1.2: Water Reticulation System – Re-pressurized

In addition to the health risk, it is virtually impossible for a water service provider to practice supply or demand management under intermittent supply conditions. Both supply and demand management are absolutely fundamental to the provision of a water service that is efficient and effective. Conversely, it is impossible to be efficient and effective without practicing them. Supply and demand management – and their importance - are explained in the response to Question 1.6 in this Guidance Note.

It is absolutely essential to appreciate that only under conditions of continuous supply will it be possible to reduce leakage from distribution systems and household wastage of water, and therefore to conserve the scarce sources of potable water throughout the country. Systematic reduction of leakage is impractical under intermittent supply conditions.

A distribution system that is frequently and regularly subjected to filling and emptying is continuously subjected to stress for which pipes, ancillary equipment and construction standards were neither manufactured nor specified. This constant stressing of the distribution system infrastructure leads to a far more rapid deterioration in its state than would otherwise be the situation. In turn, this leads to more frequent breaks in pipes and joints and, consequently, greatly increases the number of points of leakage.

The high level of customer dissatisfaction generated by an intermittent supply leads to a reluctance in paying water bills and therefore lowers the water service provider’s revenue.
stream. Under these circumstances, it is also difficult to justify – or obtain customer acceptance – of rationalized water charges.

Customer inconvenience is compounded by the high cost of coping with intermittent supplies. This point is elaborated upon in the response to Question 1.11 in this Guidance Note.

Attention needs to be drawn to a statement in Chapter 10 “Distribution System” of the Manual on Water Supply and Treatment, Third Edition – revised and updated, published by the Central Public Health and Environmental Engineering Organization (CPHEEO) of the Ministry of Urban Development (MoUD), dated May 1999:

“The intermittent system suffers from several disadvantages. The distribution system is usually designed as a continuous system but often operated as an intermittent one. There is always a constant doubt about the supply in the minds of consumers. This leads to limited use of water supplied, which does not promote personal hygiene. The water is stored during non-supply hours in all sorts of vessels which might contaminate it and once the supply is resumed, this water is wasted and fresh supply stored. During non-supply hours, polluted water might reach the water mains through leaky joints and thus could pollute the protected water. There will be difficulty in finding sufficient water for fire-fighting purposes also during these hours. The taps are always kept open in such a system, leading to wastage when supply is resumed. This system does not promote hygiene and, hence, wherever possible, intermittent supply should be discouraged.”

The relevance of this recommendation to avoid intermittent supply by GoI is further reinforced when we take into account the operational inefficiencies imposed on water service providers by intermittent supply and the high coping costs and level of inconvenience experienced by customers.

What are the Advantages of 24-7 Supply over Intermittent Supply?

Distribution systems operated under conditions of continuous (24-7) supply avoid all of the deficiencies set out in the response to the previous question.

Not the least of the advantages of continuous supply is the considerable reduction in risk to health that it brings. This is illustrated in Figure 1.3. If a distribution system is continuously pressurized, it is not possible for contaminated groundwater to enter the pipes, even when there are breaks in the pipes and joints. Only on the rare occasions that there are breaks in service will contaminated water be able to enter the system under 24-7 supply conditions. However, at these times, the areas at risk will be known and, as will be seen from Guidance Note 2, the distribution system in the affected area can be readily isolated from the rest of the system and the contaminated section cleaned.
Leakage from distribution systems occurs predominantly from breaks in pipes and joints of too small a significance for the leaked water to manifest itself at the surface; the vast majority of points of leakage remain hidden from sight. These can only be detected by “listening” for the noise of the leak; these days, this process is carried out using sophisticated electronic equipment. However, for there to be the noise of a leak, water in the pipe must be under pressure. To detect the noise, and hence the leak, pressurized conditions only occur for a sufficiently long period under continuous supply conditions. In some cases, the loss of water through unauthorized connections can also be considered as a “leak” and detected in a similar way. Therefore, systematic detection and location of leaks is only practical under 24-7 supply conditions, and cannot be practiced under intermittent supply.

As explained in greater detail in the response to Question 1.5 on supply and demand management, the vast majority of customer meters can only function with predictable—and credible—accuracy when the system is continuously pressurized. Such meters, with the exception of a relatively new and expensive electromagnetic customer meter, do not function under intermittent supply conditions. The accurate measurement of customer use of water is an essential prerequisite to demand management and, therefore, only under 24-7 supply conditions can demand management be practiced.

The infrastructure in a distribution system operated under continuous supply conditions is subject to far fewer shocks and changes in pressure than one operated under intermittent supply conditions. As a result, the water distribution infrastructure in a 24-7 supply system will last longer than that in an intermittent supply condition.
Under a continuous supply situation, there is no need to invest in domestic storage, booster pumps, supplementary boreholes, domestic filters and other household treatment systems or purchases of water from private suppliers. Nor is it necessary, therefore, to spend on the energy used to operate these. Coping costs are therefore virtually eliminated.

Customers of a continuous supply service do not have to be on hand to receive and store water at their premises at any time of the day or night. This frees women and children to undertake employment or education, from which they are precluded by their dependence on erratic and intermittent supplies.

What is the Supply Situation in the Rest of the World?
A continuous, 24-7 supply is the norm in the rest of the world. All developed countries have continuous water supply systems. In the United Kingdom, for example, if the water supply to an area must be interrupted, for whatever reason, the water company must pay a monetary penalty to every customer in that area for every day that the supply is interrupted for a given number of hours.

It is true that, in many parts of the developing world, some systems may suffer from breaks in service and some parts of a distribution system may be on a regular scheduling of services. However, in most situations where intermittency is presently practiced, the objective is to raise performance to continuous supply.

It is to be noted that continuity of supply is not necessarily dependent upon abundance neither of water resources nor on the economic standing of a country:

- Many countries in Africa manage to provide a continuous water supply service with daily per capita water supplies of 50 liters (l);
- Phnom Penh, the capital of Cambodia, has successfully completed a conversion from intermittent to universal continuous supply, and the country has a per capita gross domestic product (GDP) half that of India.

Are there Situations under which Continuous Supply is Impossible?
Yes, where there is an insufficient availability of water resources to satisfy the basic needs of the population of an area, continuous supply might very well prove impossible – seasonally or continuously. Although a system operating under continuous supply conditions allows a water service provider to practice demand management, there is clearly a limit below which per capita demand has to be satisfied for basic living and sanitary needs.

It is difficult to place a precise value on the level of water availability below which 24-7 supply will prove impossible. However, this is likely to be of the order of 50 liters per capita per day (lpcd).
Most urban areas in the country have water availability in excess of this figure and should, therefore, be able to practice continuous supply throughout the year. However, it is recognized that there are areas with chronic water shortage, either seasonally or throughout the year, and these may well experience difficulty in introducing continuity.

In its favor, continuous supply is a generator of a “virtuous”, upward spiral and improved quality of service should be coupled with the application of higher water charges and accompanied by improved willingness to pay. This results in higher revenue that can provide funds for improving security of supply in areas of water shortage through investment in dams, acquisition of water from a distance and local storage.

What are “Supply Management” and “Demand Management”? Why are they so Important, and Why can’t they be Practiced under Intermittent Supply Conditions?

“Supply management” is the term used to describe activities that manage the water on the supply side of a water distribution service. The two main supply management activities are:

- Reduction of leakage from all parts of the transmission and distribution system through to customer meters; and
- Identification and regularization of unauthorized connections to the distribution system.

“Demand management” is the term used for activities practiced by the water service provider to reduce customers’ use of water distributed to the minimum needed to satisfy their reasonable needs. Demand is managed by a combination of operational activities and other mechanisms:

- By controlling system pressure to just meet agreed service levels – normally a minimum pressure at the customer’s premises - it is possible to reduce the flow rate from taps in domestic premises to a minimum;
- By water pricing, using a tiered structure for water tariffs, it is possible to penalize excessive usage with a high volumetric charge while applying a lower, more affordable charge for reasonable levels of use; and
- By regular publicity campaigns showing customers how to minimize their water usage – and thereby keep their water bills to a minimum.

Only by practicing supply management can the two main components of Non-revenue Water (NRW) – real losses (leakage) and apparent losses (unauthorized use and inaccuracies in customer metering) -- be controlled and reduced. A water utility that can control and reduce NRW has all the capabilities, and the infrastructure, to be an effective and efficient water service provider.

Demand management is important as it ensures that water use is restricted to a reasonable minimum and therefore maximizes the effectiveness of available resources.

It is therefore understandable why supply and demand management are vital to any water service provider’s effectiveness and efficiency.
Are There any Downsides to 24-7 Supply?

It is perhaps a brave statement to make but there are no downsides to 24-7 supply that are inherent in the practice when compared to intermittent supply.

However, conversion to continuous supply requires a number of actions and operations:
- Restructuring of the distribution networks;
- Rehabilitation and replacement of parts of the distribution system in extremely poor repair and the replacement of a proportion of customer connections and meters;
- The practice of supply management to control and reduce leakage;
- The practice of demand management to ensure that limited water resources are put to reasonable and revenue-generating use; and
- Planned maintenance and systematic replacement of the water service infrastructure.

As is the accepted norm across the world, the above must become standard practices for all water service providers that strive to achieve good international standards of service. The vast majority of water service providers, throughout the country, will require:
- Acquisition and application of relevant technological skills, some of which may, at present, not be widely available in the country;
- Rationalization of water charges to target financial sustainability (for an improved level of cost-effectiveness) while addressing affordability concerns through appropriate and targeted mechanisms (see Section 1.12 for an explanation of financial sustainability and full cost recovery as used in the context of these Guidance Notes); and
- Reform of institutional structures and culture.

In turn, these changes require:
- Strong political commitment to reform the water service;
- Cooperation of managers and staff of the water service provider, possibly through a system of incentives, to effect the necessary changes and to improve performance; and
- Continuity of staff.

The downsides of introducing 24-7 supply are therefore related to the commitment and discipline needed to achieve it, not the practice itself.

Do We have Enough Bulk Water Resources to Provide a 24-7 Service?

This is the most common doubt concerning the introduction of 24-7 supply. Generally, everyone accepts that, under intermittent supply conditions, there is considerable wastage of water and that it is difficult to discover unauthorized connections. Water is wasted when taps left open lead to overflowing storage tanks and containers. Wastage also occurs when water in excess of needs is emptied from tanks and containers ready to receive new water during the next period of supply. There is also an awareness of the large amounts of leakage experienced with intermittent supply, mainly due to
undiscovered bursts and the high system pressures needed to “punch” large volumes of water through the system in a short period. The lay person’s perception is: “If large volumes are leaked when a system is operated for only a few hours, how can the system cope when it is always pressurized?”

Operation as a continuously-pressurized network, managed through a system of small District Meter Areas (DMAs)\(^3\), has a number of operational advantages:

- Water flows through the system at a lower rate than for intermittent supply. Therefore system pressure can be lower and the lower the rate of leakage;
- System pressure can be measured and routinely controlled (recent studies of water systems in a number of countries, in diverse regions of the world, show that lower pressures also give rise to a lower frequency of bursts as well as lower rates of leakage);
- Most significantly, as the distribution system is always full and under pressure, leaks can be detected using traditional or modern sounding techniques, accurately located and repaired; and
- Unauthorized connections can, in some cases, be considered as “leaks” and therefore detected.

In effect, under 24-7 supply conditions, both wastage and leakage can be reduced and converted to water supplied to customers and from which revenue may be recovered.

By way of illustration, the experience of sample city XYZ is being drawn upon here. According to available estimates, city XYZ has a production capacity of just less than 3,000 million liters per day (mld), all of which goes into supply but only 40 percent of which is billed; 60 percent or approximately 1,800 mld is therefore NRW (simplistically, leakage and commercial losses)\(^1\). Under a managed 24-7 supply system, to serve the same population, only about 2.7 mld would need to be produced, with total NRW reduced to about 40 percent and supply at 135 lpcd. Under well-managed, 24-7 supply conditions, NRW would have been reduced to 1,080 mld, a saving of 720 mld. Of course, in time, with further leak detection and system replacement, even lower levels of NRW can be achieved. Figure 1.4 shows four situations arising out of initial assessment work undertaken for city XYZ.

The top-most bar shows current production capacity and planned additional capacity; the bar beneath this shows the current situation with intermittent supply. Of the water produced, only 40 percent reaches customers and translates into revenue for the water utility of city XYZ. A total of 60 percent is lost, comprising leakage (estimated to be approximately 42 percent of the water produced) and “commercial” losses (unauthorized use and inaccurate customer meters, making up the balance 18 percent);

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\(^{1}\) District Metered Areas (DMAs) are considered the fundamental building block for conversion from intermittent to 24-7 supply. A DMA is a hydraulically discrete portion of the network, isolated from neighboring DMAs by a system of boundary valves and preferably fed with water from a single point on its boundary. For more details refer to Section 3.2.4 in Guidance Note 3.
The third bar illustrates what would happen were the existing system to be operated under 24-7 supply conditions but without repairing leaks or replacing pipes in the worst condition. Customers would use more water as there is no demand management and losses would increase considerably. It has been estimated that, under these conditions, NRW might increase to 65 percent of production. This would be unsustainable as considerably more water would be needed than is currently available – and more water than could be made available without constructing several more dams.

The lowest bar shows a situation in which 24-7 supply is well-managed, that is, the distribution system is restructured into manageable units (DMAs), leakage detection and repair is practiced and pipes in the worst condition replaced. Overall, approximately 10 percent less water would be needed than under the present intermittent supply conditions to supply the same population, with households receiving 35 percent more water while NRW would be reduced by 40 percent.

Figure 1.4: Demand versus Supply in city XYZ

This example illustrates how 24-7 supply, coupled with leakage management, converts wastage and leakage into useful supply.

Some urban areas may not have sufficient capacity to deliver 135 lpcd. As has previously been noted, there are places in the world with per capita water consumptions of less than 50 lpcd but which have continuous supply. Low pressures, flow control devices and other means can be used to limit the amount of water that passes through the systems where water is scarce.

The practical feasibility of 24-7 supply does not depend so much on the quantity of water available as on the efficient and effective management of the distribution system so that the available water is used to best effect.
There are, of course, exceptional circumstances where a 24-7 supply service may not be practical for all or part of the time, for instance, when per capita water availability is so low for all or a part of the year that a continuous service cannot be maintained.

It is impossible to be precise as to the minimum amount of water needed to maintain a 24-7 supply. It is self-evident that there must be a lower limit below which continuity of supply cannot be maintained. However, there are examples of cities with 40 lpcd of supply that maintain a 24-7 service. The minimum amount of water required is dependent on too many site-specific conditions for specification of such figures to be a constant everywhere.

However, whilst emphasizing their imprecision, the following values might be used as a guide:

- Where per capita availability entering the distribution system exceeds 100 lpcd, continuity of supply should be readily achievable with efficient management and operation of the infrastructure;
- At the other end of the scale, urban areas having a per capita availability of less than 50 lpcd could experience problems in achieving continuity of supply – although, in many such cases, it will still be possible; and
- An intermediate range of supply availability, 50 to 100 lpcd, where continuity of supply should be possible but where more careful control will need to be exercised over both restructuring and operation of the distribution system if 24-7 supply is to be maintained at all times.
- A large number of cities and towns in India have water resources available in excess of the nominal threshold value of 50 lpcd and should, therefore, be actively considering conversion to continuous supply.

Guidance Note 3, Section 3.2.9, lists some of the methods by which areas with low per capita water availability may still attempt conversion to 24-7 supply.

Won’t We Use more Water with 24-7 Supply?
This is another commonly asked question to which it is difficult to give a definite response! It is true that there will be some urban areas which will use more water under 24-7 supply conditions than when they operated under intermittent conditions. However, it is equally true that there will be some areas that will use equivalent water, and some even less water, than was used under intermittency.

In Section 1.8, in the case of city XYZ, the study carried out estimated that a competently-managed 24-7 supply would use about 10 percent less water overall than under the present intermittent supply conditions.

If the customers of the water utility have installed measures that allow them to simulate 24-7 supply from the public network operated intermittently, then it is probable that, with reduced wastage and leakage, less water will be used under 24-7 supply conditions. Most households can find space for two, 200-l containers, representing supply for one or two
days. Therefore, an area where water has been supplied only once every three days or with lower frequency will almost certainly use more water under 24-7 supply conditions, as it will have been difficult to simulate 24-7 supply from the network with such low frequencies of supply.

Studies that investigated the effects of 24-7 supply on pilot areas in four cities in Karnataka estimated that two of the cities might use more water and two cities might use less water under 24-7 conditions of supply. The pilots of 24-7 water supply in all four cities are now operational, and they are in fact using less water under conditions of continuous water supply than earlier.

Wont’ We Use more Energy with a 24-7 Supply?
This is not an aspect that has yet been investigated. However, it is thought that significantly less energy will be consumed under 24-7 supply conditions than under intermittent supply. This is thought to be particularly likely where a utility supplies water every one or two days.

Only where water is served in very low frequencies, say less than once every three or four days, may a system operating continuously consume more power. Even under these conditions, it is unlikely that significantly more power would be used under 24-7 supply.

The main reasons for concluding that 24-7 supply would use less energy, under most circumstances, than an equivalent intermittent supply are:

- The amount of energy consumed in distributing water is related to the amount of water passed through the system, the pressure in the networks under which the water is transmitted and pipe friction, in turn related to the velocity of the water through the pipes and the type of pipe material;
- Generally, with appropriate demand management, approximately the same amounts of water are pumped into supply over a 24-hour period under continuous supply than is the case with intermittent supply;
- Most conditions under which water is pumped to major storage reservoirs will be the same whether the water is distributed intermittently or continuously – and so, under most circumstances, power used for this purpose will be neither greater nor lesser. However, it may prove possible to retain less storage with a continuous supply, in which case less static head would be needed in the reservoir, resulting in a slight reduction in power consumption under 24-7 supply conditions;
- The velocity of water through distribution pipes is generally lower under 24-7 supply conditions, particularly where the pipes have been designed for intermittent supply conditions. However, a network must be operated at higher pressures under intermittent supply conditions as large volumes of water have to be transmitted through the network to households in a very short timeframe – a few hours rather than over the full 24 hours of a day. Therefore, as velocities and pressure are both higher under intermittent supply than necessary for a 24-7 supply situation, under most circumstances, more energy is consumed under intermittent supply conditions than for 24-7 supply;
Under continuous supply conditions, with suitably-designed secondary storage reservoirs and recourse to cheaper, off-peak rates for electricity (as these become available), water utilities could reduce energy costs even further; and

Under 24-7 supply, there is the potential to significantly reduce both leakage and wastage. Energy used to distribute water that is leaked under intermittent supply conditions can be recouped as the saved water is sold to customers under continuous supply, instead of being non-revenue generating. Similarly, but with no effect on revenue, water that would be wasted by customers under intermittent supply conditions is put to productive use under conditions of 24-7 supply.

Overall, it is not difficult to understand why it is considered that, under most circumstances, distribution systems operated under continuous supply conditions could use less power than an equivalent intermittent supply.

Can We Afford to Convert to 24-7 Supply?

The question of affordability can be viewed from two perspectives: from the perspective of the customer of the water service; and from the perspective of the overall economics of the entire system and the provision of a cost-effective service.

Affordability: the customer’s point of view

An increasing proportion of urban customers provided with intermittent water services are already making their own investments to simulate 24-7 supply at the household level. The need to cope with intermittent supply does not depend upon the economic class of a household, for example:

- Households that can afford to do so may install one or more of a number of measures to make the most of, or to supplement, the public supply. These measures include tube wells, surface and overhead storage, booster pumps, tanker supplies, etc. These investments may be supplemented with water purification methods such as boiling, filtration and, in some cases, household reverse osmosis (RO) plants to reduce salt content. The annual cost of coping has commonly been found to vary between Rs. 4,500 and Rs. 5,500. However, this can rise to as much as Rs. 14,000 where an RO plant must be installed, operated and maintained; and
- Poor households that cannot make capital investments often have to rely on purchasing water – frequently at inflated prices – from private suppliers. It has been shown that such households may spend between Rs. 2,000 and Rs. 3,000 annually on supplementing the water received from the public supply through standpipes, tankers and the purchase of bottled water.

The need to cope with intermittent supply is economically inefficient, as it reduces household savings that could be invested more productively. The cost of coping with intermittent supply has the greatest impact on the poorer households. When comparing the cost of coping with household income, poorer households suffer disproportionately more from intermittent supply.

In Karnataka and in Delhi, work has been carried out on estimating water charges that would be economically sustainable for water service providers operating a continuous
supply. These have indicated that economically sustainable rates in these two situations would presently range between Rs. 8 and 12 per cubic meter (m³) – and for another city, where the difficulty and hence the cost of obtaining bulk water is extremely high, the charge is presently Rs. 15 per m³.

A household of five persons consuming 100 lpcd would use approximately 180 m³ of water each year. The annual range of cost of a 24-7 supply service would therefore range between Rs. 1,440 and 2,700. This compares well with the current cost of coping that averages Rs. 2,500 for poorer households and Rs. 5,500 for middle-class households.

It must be emphasized that these costs of water delivered under 24-7 supply conditions have not been tested in practice. However, a rate of Rs. 10 to 15 per m³ compares well with water rates for systems operated under continuous supply conditions in the general region, for example, Malaysia (rates being equivalent to a range of Rs. 9 to 14 per m³).

The introduction of a 24-7 supply would benefit the economies of those households that have already invested in facilities to cope with intermittent supply, by making the following savings:

Pumps installed to either assist in drawing more water from the network than would arrive under system pressures or for raising water to a higher elevation to assist supply within the property would not need to be operated, leading to considerable savings in power charges; these will not need maintenance or spare parts, and will not need to be replaced.

Household water treatment units would not need to be operated, leading to considerable savings in power charges for units such as RO-based units; no longer need the purchase of consumables, such as filter media or chemicals, or maintenance or spare parts; and not need to be replaced.

Roof or ground storage tanks would not need to be replaced or could be replaced by smaller tanks, once the reliability of a 24-7 supply has been established and accepted.

The affordability of 24-7 supply from the point of view of provision of a cost-effective service

Each m³ of water supplied to an urban area has value. This value varies depending upon whether it should be assessed at the “full cost” or the “marginal cost” of a unit volume of water delivered.

“Full cost” includes all costs incurred in acquiring and processing the water through to its distribution, including all establishment and financial costs. In some extreme cases of scarcity, a value may need to be attributed to the environmental costs of using the water.

The “marginal cost” of water is effectively the savings in cost that would be made were a unit volume of water not to be produced and distributed. This is, frequently taken to be confined to the cost of the energy, chemicals and additional labor needed to produce that m³ of water.
Water saved from leakage that can be sold to customers can be valued at its full cost. The same value can be attributed to water that is charged to customers who were previously unauthorized but have become registered customers.

However, water which is saved from leakage but which cannot be sold, that is, where there is no demand for it, is valued at its marginal cost.

Although very rarely charged by water service providers, it is considered that an O&M cost recovery charge for water in India would range from Rs. 5 to 15 per m³ – principally dependent upon the cost of sourcing the water and power used in treatment, transmission and supply. Conservatively, therefore, the typical full cost for water might be Rs. 9 per m³ and its marginal cost approximately Rs. 3 per m³.

Much of the cost of conversion to 24-7 supply is incurred in replacing customer connections – the pipe connecting the household to the distribution network and the customer meter. These are often both in very poor condition and, in most parts of the world, house connections are responsible for between 60 and 70 percent of the water lost from a system. The balance of the cost is incurred in replacing parts of the network in poor condition and in restructuring the system into DMAs with their associated metering and valves.

The actual cost of the work of conversion varies considerably from place to place, being highly dependent upon the state of repair of household connections and distribution networks. Diagnostic work carried out in Karnataka and other cities had indicated that conversion to 24-7 supply would cost between Rs. 7,500 and 11,000 per connection. In Karnataka, where the 24-7 pilot projects were implemented, the costs of connections actually worked out to Rs 14,000 per connection, since the old network was fully replaced with a new pipe network. It is considered possible for the cost range to be as low as Rs. 4,500 per connection, where the system is relatively new and customer meters do not have to be replaced.

Going back to the example of city XYZ cost and benefit analysis for the same indicated that for 1.4 million connections, the cost of converting the city to 24-7 supply would be Rs. 1,320 crore. However, on the benefit side, by converting to 24-7 supply, it was conservatively estimated that NRW would be reduced by a total of 772,000 m³/day and billed water would increase by 475,000 m³/day (valued at Rs. 9 per m³), giving a net 297,000 m³/day of NRW that would not be sold (valued at Rs. 3 per m³). The annual additional revenue and savings in costs would therefore total Rs.189 crore. The capital cost of conversion to 24-7 supply, Rs. 1,320 crore, is approximately seven times the financial benefit derived. This is better value than most water infrastructure capital projects, where the capital cost is commonly found to be between 10 and 20 times the benefit.

Conversion from intermittent to continuous supply is therefore an investment worth making on financial grounds alone, without even taking into account the substantial value
that can be placed on benefits to the health of the general public, customer convenience and the economy in general.

It may be clarified that all financial numbers in this and the previous section are illustrative estimates, and may vary from situation to situation.

In effect, the question “Can we afford to convert to 24-7 supply?” might have been better phrased as “Can we afford NOT to convert to 24-7 supply?”

Will Water Charges Rise as a Result of Conversion to 24-7 Supply?

In all but a handful of cities, water charges all over India are amongst the lowest in the world. These charges do not reflect the cost of providing the service and have to be supplemented by substantial subsidies, whether by payment of regular subventions to cover operating deficits or by subsidizing capital investment through grants or debt relief in one form or another. This dependence upon government to sustain the service has a number of negative effects on the service provided:

- There is little incentive to improve the performance, efficiency and effectiveness of the service as the service provider knows that government will “bail it out” of any financial difficulties; and
- It may leave the management of the water service provider susceptible to outside involvement in its affairs.

Water service revenue collected by most local governments and utilities generally covers only a small proportion of the operational costs of the service and frequently leads to inadequate maintenance, repairs or extensions to the infrastructure. Government subsidies of the water service are therefore significant.

One of the substantial benefits to be derived from conversion to 24-7 supply is that, for the first time, water service providers can control their costs through the practice of proper supply and demand management practices and techniques. However, as has been explained in Section 1.11, conversion to 24-7 supply has a cost attached to it.

To take full advantage of the potential to improve performance and efficiency, offered by conversion to 24-7 supply, a water service provider needs to reduce external interference in its operations by becoming financially self-sustaining. This can only be achieved through increased water charges.

With reduced involvement in water service operations, government can take on the role of regulator of financial and service quality, without conflict of interest issues.

Market research has shown that urban populations are willing to pay higher prices for a piped water supply than they presently pay when this is related to an improvement in service; and 24-7 supply provides that improved quality and performance.

Section 1.11b of this Guidance Note mentions what constitutes the “full cost” of a water service and in Guidance Note 2, Section 2.3.1, “full cost recovery tariff” is demonstrated.
diagrammatically. The pace at which water tariffs are increased from their present low level to a full cost recovery level is a matter for discussion by each government in consultation with customers of the service. In some urban situations, it may be possible for a water service provider to move rapidly to full financial self-reliance and sustainability, in others it may take many years. However, application of full cost recovery tariffs should be an objective of the 24-7 conversion plan. Affordability concerns for the poor can be addressed through connection facilitation, cross-subsidies built into tariff regimes and, in difficult cases involving high cost of service provision, through targeted subsidies.

An interim objective of increasing tariffs might be to cover all operational costs with financial costs incurred through capital expenditure, a second, longer-term objective. Presently, it is common for households to pay a monthly charge of between Rs. 45 and 100 for their water supply. In Section 1.11a, it is described how recent analysis of proposed 24-7 supply projects had indicated that, applying full cost recovery tariffs for a 24-7 supply service, monthly water bills, in the situations studied, would vary from Rs. 120 to 225 where per capita usage was 100 l, rising to between Rs. 160 and 300 for a per capita daily use of 135 l. However, these increased unit costs for water result in monthly charges that compare well with the current costs of coping with intermittent supply of between approximately Rs. 200 and 460, respectively, for poorer and better-off households. (These numbers are indicative and illustrative estimates and may vary from situation to situation.)

The introduction of 24-7 supply permits accurate measurement of customer usage for the first time and permits government to design and introduce tiered tariffs, including possibly:

- A low-cost tier for the supply of a “lifeline” volume of water for initial volume used;
- An intermediate tier for all “reasonable” use; and
- A “luxurious” use tier for all water used in excess of what is deemed reasonable.

In addition, for poorer households that do not have capital sums available to pay for connection to the piped supply, the burden can be eased through easy payment terms, cross-subsidies from the tiered water tariff or a mix of both.

Financial sustainability, based on conversion to 24-7 supply and recovery of normative costs through improved operating efficiencies and tariff rationalization, can be achieved without sacrificing affordability for all sectors of society, even the poorest.

**Why are we Unable to Provide a Continuous Supply Service Today?**
A combination of several institutional, financial and technical reasons do not allow, water service providers in most parts of India to provide continuous supply today.

The principal institutional and financial shortcomings are common to most water service providers in the country:
The terms of employment of water service managers and staff are those of the civil service – or related to them. Advancement in the water service organization owes more to length of service than to performance in the post. There is, therefore, limited incentive to achieve high performance in their posts and, as a result, most water service providers operate inefficiently and ineffectively, and service quality is very poor;

While water charges are low, the poor, who are largely unconnected or nominally connected, are not benefiting from them. Consequent budgetary subventions to shore up service provider finances are supporting regressive (pro-rich/middle class) tariff structures and the overall inefficiency of the service provider, and largely benefiting the connected middle and rich classes. These governmental subventions, mainly for capital works, result in insufficient revenue (and even less organizational emphasis) to effectively operate and maintain the system or restructure it so that it can be made manageable. The inadequacy of revenue is compounded by the high incidence of non-payment by customers due, mostly, to the poor quality of the water service provided. Low tariffs are thus a reflection of the adverse institutional incentives inherent in the financing arrangements and accountability structures applicable to the sector, rather than a reasoned policy stance on social and equity considerations;

Partly due to lack of available funds, or lack of knowledge of modern management systems, most water service organizations lack systems, technology, and computer hardware and software to operate the service efficiently and effectively;

Even if funds were available, managers and staff of operational areas have no time to plan and implement the restructuring of their system to render it manageable. They are fully employed operating valves needed to schedule supplies and “fire-fighting” the numerous problems that occur on the distribution network every day due to its generally poor state of repair. There is no time to restructure their system to render it manageable; and

In the main, managers and “owners” of water service providers do not feel the need to convert from intermittent to 24-7 supply. They do not understand the limitations that this places on their operational efficiency, nor the magnitude of the risk to health of the practice.

The following are the principal technical reasons for the inability, at present, to achieve 24-7 supply:

In most cities, reliable data on distribution networks and customers do not exist. Knowledge of pipelines, their diameter, material, location and state of repair depends heavily upon the experience and memories of line inspectors;

Most – in many cases, all – pipelines comprising the distribution system are totally interlinked. This means that water pumped into the system at any point affects the dynamic balance of the entire network to a greater or lesser extent. As water enters the network at a number of points and is consumed with an irregular pattern, the direction and volume of the flow of water at any point in the system are virtually unpredictable. Clearly, this renders the management of the water distribution system impossible. In some cities, transmission pipelines, the sole
purpose of which should be to transmit bulk water to Operational Zones (OZs) for
distribution, are themselves used as part of the distribution network;

- There is virtually no metering of bulk water produced and distributed within
  the operational areas; neither is it metered at any point in its transmission
to operational areas for distribution to customers. Without metering, the main
operational parameter of a water service provider, it is impossible to effectively
manage the system;

- Without reliable plans or knowledge of pipelines or valves – combined with the
totally interlinked nature of systems – control of leakage on a routine, planned
basis is virtually impossible. It is rendered even more difficult under intermittent
supply conditions as modern, efficient detection methods work effectively only
when the system is pressurized. Without the possibility of the repair of the
multitude of “hidden” leaks that occur in every distribution system in the world, a
water supply system must inevitably be in a continuous state of deterioration;

- It is unusual for a water utility to measure pressure within its distribution
  system. An ability to control system pressure is essential to the management and
reduction of leakage from systems. In general, pressures are higher under
intermittent supply systems – at least at entry to the points of distribution and in
their immediate surroundings – as it is necessary to “push” a large amount of
water into and through the system in a short space of time. These pressures also
often peter out to nothing at the ends of the system supplied; and

- It is a little recognized point – but a major one from the point of view of system
management – that customer meters do not function with any predictable
accuracy under intermittent supply conditions. This is in part due to the sand
and grit that enters the system but also in great part due to the fact that the meters
measure the flow of air – in both directions – at each period of intermittency and
this, in turn, also leads to a rapid burn-out of meter bearings.

Laboring under these conditions, urban water service providers throughout the country
find it impossible to achieve 24-7 supply.

The situation is recoverable. Guidance Note 2 deals with the principles of good
governance relating to water service provision and Guidance Note 3 sets out the basic
building blocks needed to plan and implement 24-7 supply. These therefore point the way
to the institutional, technical and economic restructuring that is needed to achieve it.

Is There a Role for Small-scale Private Service Providers under a 24-7 Supply
System?
Small-scale private providers (SPSPs) of water fall into two main categories:

- Small-scale operators (SSOs): These are companies to which specific activities of
  a water service are outsourced by the water utility, for example, pumping station
  operation and maintenance (O&M); meter-reading; customer billing and
  collection, etc; and

- Small-scale private providers (SPSPs): These are entrepreneurial individuals and
  small companies, for example, water carriers (whether on foot, cycle carts or
  motorized vehicles), private water tankers, private outlets through a connected
property or privately-owned standpipe or pipelines of limited length drawing from
the network, spring or groundwater.

SSOs have a long-term future where outsourcing is shown to be cost-effective, whereas
SPSPs can generally only flourish while coverage by the water utility is inadequate.
However, certain synergetic relationships involving coexistence can be explored, while
addressing potential shortcomings discussed below, for example, cooperative or
community-base organization (CBO) structures engaged to manage distribution and
O&M in a discrete, say, low-income community from the point of bulk supply by the
utility, under strictly regulated service standards.

Small-scale operators (SSOs): Outsourcing of specific water service activities to SSOs
can be a cost-effective approach to operation. It is quite common for ex-employees of the
water service entity to form the companies that then compete for this work. Conversion to
24-7 supply can provide additional opportunities for this category of small-scale service
provider, for example, term contracts for leakage detection and repair, maintenance of
pressure valves and control systems, etc.

Small-scale private providers (SPSPs): In all urban situations where there is inadequate
coverage by water distribution networks, SPSPs provide a vital service to those unable to
connect to the networked system. These private suppliers will continue to provide a
service wherever there remains a commercial opportunity, provided by lack of a public
network.

However, water purchased from SPSPs has a number of disadvantages in comparison
with water obtained from a network operating under 24-7 supply conditions:

- The price of water per unit volume is frequently considerably higher;
- The quality of water supplied is rarely checked or controlled and is generally
  subject to high risk of contamination due to its source or in its handling;
- Purchasers are generally restricted to purchase of far smaller volumes than would
  be available from the public network, limitations being imposed by price, ability
to carry or storage capacity; and
- SPSPs are notoriously unreliable and impermanent.

The usefulness of SPSPs is therefore usually limited to such time as the network provides
a reliable service and its coverage extends to most of the urban area, such that it is no
longer commercially viable to supply water to small pockets of development. The
introduction of a reliable 24-7 supply to 95 percent plus of the urban households will
generally lead to the disappearance of SPSPs.
Guidance Note 2
Institutional and Financial Issues
Guidance Note 2: Institutional and Financial Issues

2.1 Why are Institutional and Financial Issues Relevant to 24-7 Supply?
Why is it that some water service providers are better able to meet the needs of their customers than others? Certainly, it helps if there is an affluent customer base, but there are examples of well-run water and sewerage providers in developing environments. The common ingredient to all successful organizations is that they operate within a clear, well-functioning, institutional environment. Conversely, consistent under-performance can often be traced back to endemic weaknesses in the institutional framework.

Continuous supply and institutional reform are inextricably linked. A good institutional framework can ensure that a 24-7 conversion program is successful and sustainable. Experience has shown that capital investment alone has not always led to sustained improvements in service. Without a reformed institutional and financial environment, there would be a serious risk that the integrity of the network would decline, discipline in billing and collection would be eroded, and the fine balance between supply and demand would be undermined. Eventually and inevitably, areas converted to 24-7 would revert back to intermittent supply.

The aim of institutional reform is to improve the way in which the sector is governed and financed. Reforms must be guided by an understanding of existing institutional weaknesses, and by a vision of what the future water sector could look like. Financial performance is also discussed in this Guidance Note because, to a large extent, it is dependent on the prevailing institutional framework. A good institutional environment will promote realistic tariffs, improved efficiency, and long-term financial self-sufficiency.

2.2 Reforming the Institutional Framework

2.2.1 How do I know whether institutional arrangements need reform?
In an ideal institutional environment, the water and sewerage service provider would be:
- Accountable and transparent;
- Financially self-sufficient and sustainable;
- Efficient in its operations and provide value for money to its customers;
- Responsive to the needs of the population it serves, including low-income groups;
- Led by a capable and empowered management; and
- Able to access capital to invest in maintaining and extending the network.

The best test of whether or not an existing institutional framework is working well is to look at end-results delivered by the sector. Table 2.1 show that services in India fall short of the ideal.
Table 2.1: Service Standards of the Indian Water and Sanitation Sector

<table>
<thead>
<tr>
<th>Service delivery</th>
<th>No city or town in India provides 24-7 water supply Declining hours of service in many cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial performance</td>
<td>Cost recovery is typically in the range of 20-30% Subsidies tend to favor upper- and middle-income groups, rather than the unconnected poor</td>
</tr>
<tr>
<td>Collection efficiency</td>
<td>Average collection period is very high (often &gt;12 months); this period will be less in those cases where uncollectible debts are written off but, in general, still longer than would be considered acceptable performance</td>
</tr>
<tr>
<td>Non revenue water</td>
<td>In most cities NRW is over 40%. Limited reliable data are available because of the lack of both flow meters and consumer meters</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Poor network coverage (especially for the poor) Weak maintenance Declining condition and serviceability</td>
</tr>
</tbody>
</table>

It is clear from Table 2.1 that existing institutional arrangements in India are not meeting the challenge of delivering a safe and reliable water service to the population. Indeed, there is evidence that the number of hours of supply is deteriorating in many cities.4

Water services are caught in a vicious cycle of low revenues, deteriorating infrastructure, declining service, and declining willingness to pay.

Evidence suggests that most customers are willing to pay more, provided that increased tariffs are accompanied by better service. A program to introduce 24-7 supply would provide a one-off opportunity to replace the vicious circle with a virtuous circle of improving services and a growing revenue base.

2.2.2 The current situation in India

Under the 74th Amendment to the Constitution, the responsibility for water and sanitation services may be transferred from the state tier of government to the municipal tier of government. The aim of the Amendment is to bring the management of water and sanitation services closer to the community by vesting responsibility for service provision with Urban Local Bodies (ULBs).

The transition to the ULBs represents work in progress. Several Indian states have moved towards ULB provision, while others still retain centralized delivery organizations such as public health and engineering departments (PHEDs) and water boards.

Even in states where water and sanitation responsibilities have been legally transferred to ULBs, the reality has been that the ULBs have not become fully empowered, for instance:
- The state retains responsibility for the appointment of key staff, who are often employees of centralized state organizations;

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Decision making and implementation for capital expenditure remains largely under state control; key decisions on tariff remain at the state level; and arrangements for fiscal transfers between state and ULBs are complex, and do not provide incentives for improved financial performance.

In effect, responsibility for the services is split between the ULB and the state. Inevitably, there is role confusion and a lack of overall accountability to the consumer.

There is clearly a need to put in place a simple, less ambiguous relationship between the states and ULBs. To bring the 74th Amendment into effect:

- ULBs should be made fully accountable for the services;
- There should be a clear division of responsibilities between the state and ULBs; and
- The state’s role should be that of an enabler, responsible for creating a clear and supportive legal and regulatory environment, enforcing budgetary responsibility, and establishing a financial environment which provides incentives for commercial efficiency, and promotes financial independence in the sector.

In states where the 74th Amendment has yet to take effect, the question remains as to what will happen to the existing service delivery organizations once service delivery responsibility is handed over to the ULBs. It may be possible to find a new role for a “successor” organization, for instance in providing technical assistance and asset management support (that is, professional support for financing, planning and implementation of investment projects) to ULBs.

In choosing a way forward, it may be borne in mind that large established organizations (in both public and private sectors) tend to carry a certain amount of historical and cultural “baggage” which makes them ill-equipped to adapt to a changed role and different circumstances. So it may be better to consider establishing “fresh start” organizations rather than attempt to adapt existing organizations.

2.2.3 The four key principles that shape accountability

There is no universally applicable template for creating accountable service delivery institutions. Every country operates within the context of unique physical, legal, cultural and historical conditions. There are, however, some general principles that can be applied to most, if not all, situations. These are:

- Principle 1: Separation of roles;
- Principle 2: Commercial orientation;
- Principle 3: Financial sustainability; and
- Principle 4: Social and environmental sustainability.

Principle 1: Separation of roles

Under traditional public ownership arrangements, the state and municipal authorities determine sector priorities, set the tariff, plan and finance investment, operate the
systems, and provide the water and sewerage services to customers. The difficulties with such arrangements are well-known and include:

- Lack of transparency or accountability;
- Absence of clear objectives;
- Unfocussed management;
- Weak commercial incentives; and
- Budgetary restraints and red tape.

These realities will apply regardless of whether the responsibility for service delivery is vested in the state or the ULB.

While sector policy making is the natural preserve of the government, there is no reason why government (whether it be state government or the ULB) needs to be directly involved in O&M of the water and sewerage systems. It is a widely accepted principle of best practice governance that the role of service provision should be clearly separated from other functions of government. Thus the role of the service provider is to meet the objectives set for it by the ULB. The service provider is accountable both to the ULB, and to its customers. The service provider may be publicly or privately managed, but must be a ring-fenced, operationally autonomous, professionally managed and run a corporatized organization with a clear mandate and well-defined responsibilities; and the role of government is to determine policy, to ensure that the sector is healthy and properly financed, to set standards and objectives for the service provider, and to oversee performance of the service provider.

The advantages of creating a separated water and sanitation provider are that:

- Government is no longer both player and referee;
- The service provider is held accountable for meeting targets/objectives set by government;
- The service provider is made accountable to customers;
- A constructive tension is established between government and the service provider;
- Financial accounts are ring fenced; and
- There may be greater freedom from government and civil service rules and regulations.

The 74th Amendment stipulates that the ULBs are responsible for providing water and sanitation services. So the autonomous, ring-fenced service provider will be accountable to the ULB, that is, politically accountable but insulated from political interference in operational matters. In the operational sphere, it shall function professionally and autonomously within the framework established by higher tiers of government through transparent policy and regulatory guidelines and compliance mechanisms. Thus, the state tier of government will continue to play an important role. For instance, the state may be responsible for developing regulations and legal standards, providing funding and resources on a norms- and outcome-linked basis to ensure a hard budget constraint, and potentially also in regulating the services. The precise role of each tier and arm of government needs to be clarified and clearly specified in law.
Principle 2: Commercial orientation
Having established a ring-fenced service provider, it is important that the provider should be commercially orientated. That is, the organization should be run as a commercial business, with appropriate incentives to improve performance both in terms of better service and efficiency.

In the private sector, profit is a key driver of greater efficiency. Public sector organizations tend not to be motivated by profit and, therefore, the incentives to strive for greater efficiency are weaker. Furthermore, many of the existing incentives in the Indian water and sanitation sector are directed towards capital investment rather than better service provision.

Incentives in the sector need to be realigned to promote a commercial approach in the service delivery organization. Performance-related pay schemes aimed particularly (but not exclusively) at senior and middle management are key to aligning management behavior with the overall objectives of the sector. Incentives can be directed at cutting out waste, raising productivity, growing revenues, motivating staff, and improving services.

The performance of public sector institutions is often constrained by civil service rules and regulations which may, in particular, affect procurement and human resources (for example, training and development, recruitment, retrenchment, terms and conditions). It is important that service providers should have the freedom to develop their own distinct culture, systems, rules, and procedures.

Commercialization can be promoted further by ensuring that:
- Investment decisions are always supported by a business case appraisal; and
- The organization employs managers and staff with commercial awareness and financial skills.

Commercialization does not prevent a service provider from fulfilling social objectives. However, social objectives must be met within the context of affordability.

Principle 3: Financial sustainability
In India, revenues from water and sewerage services typically cover less than 30 percent of operating costs. As a result, water and sewerage services have to be heavily subsidized by government.

Weak financial performance has a debilitating effect on the Indian water sector:
- It weakens the capacity of the organization and its ability to provide services (particularly to the poor);
- It creates dependence on government resulting in loss of accountability, management autonomy and commercial incentives;
- Indian and international experience has found that operating subsidies tend to entrench inefficiencies within the organization. Few benefits of the subsidy flow through to the customer. Furthermore, low tariffs are ineffective redistributive...
mechanisms as they tend to benefit middle- and high-income customers more than the poor; and

- The exceptionally low tariffs prevalent in India have the effect of distorting customer consumption behavior. Water tends to be used wastefully if it is undervalued.

It may be unrealistic to expect to transform the sector in the short term, but eventually the water and sewerage sector should aim to achieve financial self-sufficiency, at least in terms of operating cost. It should be a clear objective of any reform to progressively reduce dependence on State subsidy. Several innovations such as lifeline initial tariff blocks are available to address affordability needs through cross-subsidies implicit in these arrangements. Subsidies, where necessary for connection facilitation, etc., for the poor, must be clearly targeted.

**Principle 4: Social and environmental sustainability**

Access to a safe water supply and adequate sanitation are essential for health and well being, and it is a duty of government to widen access and improve levels of service. The United Nations Millennium Development Goals (MDGs), agreed in Johannesburg in 2001, include a target for all countries and development institutions to "Reduce by half the proportion of people without sustainable access to safe drinking water" by 2015. The institutional framework must, therefore, provide mechanisms through which government can meet its social and environmental agenda.

Clearly, there is a tension between these wider social and environmental concerns, and the goal of financial sustainability described earlier. The way forward is through reform of the subsidy system. Existing subsidies to the sector tend to benefit upper- and middle-income families rather than the poor, who may not be connected to the network or may use less water. Alternative subsidy approaches, such as connection subsidies, output-based aid, and lifeline entry-level tariff blocks, can be designed to deliver subsidy to those most in need. These are discussed later in this Guidance Note.

Environmental sustainability can be promoted through legislation, improved regulation and better planning.

**2.2.4 What are the options for institutional reform?**

While there is no standard blueprint for institutional reform, there are a number of "institutional variables" which can be considered. These institutional variables can be broadly divided into the following categories:

- Public sector reform options: Should the services be provided by municipal water and sewerage departments, parastatals, or publicly owned companies?
- Private Sector Participation (PSP) options: Should the private sector be involved in aspects of the management or operation of the water services?
- Scale and scope reforms: What is the optimal size of a utility, and should it be responsible for all aspects of the production chain?
It is important to understand that the institutional variables are not exclusive to each other. They can be considered either on their own, or in combination. They are discussed further below.

Institutional reform is invariably controversial. Success is more likely if the institutional solution is arrived at through a participatory process, involving consultation with community groups and other stakeholders.

2.2.4.1 Public sector ownership reform options

Water and sewerage services in India are likely to remain under public ownership for the foreseeable future. Centralized State-owned departmental and parastatal entities like PHEDs and water boards which continue to exist in many states are inconsistent with the mandate of the 74th Amendment. They also fail to meet the key ingredients that go towards accountable service delivery, and are unaccountable to, and distant from, their customers. The 74th Amendment envisages decentralized service delivery arrangements that bring key service delivery related decisions closer to communities and potentially give them an effective role in this aspect. In light of this position, in this section, three models of public service provision at the municipal level are discussed:

- The municipal water and sanitation department;
- The municipal parastatal; and
- The publicly owned corporation.

Municipal water and sanitation departments

Under this model, the services are provided by a department of the municipal authority. It is a common model within India and internationally.

Advocates of this model point to the fact that, in a democratic environment, the municipal authorities are accountable to their electorates. Voters will reward good stewardship of the water and sanitation services by re-electing those responsible. While there is some merit in this argument, the international reality is that municipal services suffer from most shortcomings associated with traditional public provision. For instance:

- There is no separation of roles (the government, in this case the ULB, is both policy maker and service provider);
- Departments are prone to government involvement in the day-to-day management of the service, and in investment decisions (particularly in the case of decisions affecting expansion of services);
- Departments tend to be bureaucratic in their approach and culture, rather than customer-focused;
- Services are rarely run efficiently, or on a commercially sustainable basis;
- Departments are rarely financially or institutionally ring-fenced from other municipal functions; and
- In many cases, managers have responsibilities for services other than water and sewerage, resulting in unfocussed management.

Municipal parastatals

In the municipal parastatals model, parastatals are public organizations established under statute and mandated to provide services on behalf of the ULB, and in accordance with
objectives determined by the ULB. They are institutionally similar to the existing water boards and PHED departments, except that they are accountable to a ULB rather than the state government.

The municipal parastatal model fulfils one of the key principles of good governance discussed earlier in that the parastatals are ring-fenced from other functions of government. The model would, however, suffer from many institutional disadvantages associated with the existing water boards and PHEDs. For instance:

- Parastatals tend to run as an arm of the government rather than as autonomous, commercially orientated businesses; and
- Senior management and board positions are often government appointments, with attendant risks associated with patronage.

Corporatization

Corporatization (of municipal service delivery departments/parastatals) is the process whereby a special purpose company is created to undertake the water and sanitation services. The company is publicly owned but, in all other respects, operates as if it were a commercial company operating in the private sector.

Figure 2.1 shows a possible institutional arrangement for a corporatized utility. In this example, the corporatized utility would be 100 percent owned by the ULB.

Figure 2.1 Possible Institutional Arrangements for a Corporatized Utility
A variant of this model would be a regional corporatized utility that would provide water and sanitation services to a cluster of local bodies. The Board would then accordingly have representation from the local bodies being serviced.

It is usually a precondition for corporatization that the organization should be approaching the point of financial self-sufficiency, at least in terms of operating costs. If not, then it will lose both autonomy and accountability as a result of its long-term dependence on the government for subsidy.

The advantages of corporatization can be that:
- It provides a basis for ring-fencing the services and separating government from direct involvement in services provision;
- It creates an organization which is both accountable and transparent;
- Incentives can be established to encourage managers and staff to be more commercially orientated;
- It may, subject to the legal environment, free the organization from civil service constraints in relation to procurement or human resources management;
- It is often easier to build consensus for corporatization (relative to private sector participation options), because the ownership and management of the sector remains in public hands; and
- It provides operational autonomy.

As the sole shareholder, government appoints the members of the board of a corporate utility. The key to success of the corporatization model is to create a board that is both capable and substantially independent from government. In most countries where corporatization has been pursued, boards have included directors drawn from outside the public sector (for example, from successful private businesses, or from academia). The purpose of these external appointments is to broaden the pool of expertise and to promote autonomy from the sole shareholder (that is, the government).

Maintaining the arm’s-length relationship between the government and the corporatized utility is difficult in any country but will be particularly challenging in India, given the government’s historical involvement in the sector. It may be appropriate to establish mechanisms to bring greater transparency and independence to the process of appointing board members. For instance:
- External recruitment consultants can be used to search for suitable external candidates for board membership; and
- An independent “board appointments panel” can be created which would be tasked with selecting board members.

Careful thought must be given to the conditions of tenure and incentives that are put in place for directors and managers to improve the performance of the new corporations.

International experience with the corporatization model has been that initial outcomes can be highly positive. However, over a period of time, performance tends to flatten out; potentially as a result of the gradual erosion of the institutional separation between the
corporation and the government, and the weakening of commercial incentives and freedoms.

**The role of the private sector**

PSP is often controversial. For many years, PSP was regarded as a “quick-fix” for all the sector’s ills. However, while there have been many PSP successes around the world, there have also been some high profile disappointments.

PSP does not imply abdication of fundamental responsibilities of public authorities. On the contrary, it provides a contractual means of achieving public policy objectives on an accountable basis and in a way that seeks to get better value from limited public resources.

If used well, PSP has the potential to enhance the sector by:

- Sharpening incentives for improving commercial performance;
- Reinforcing the “arm’s-length” relationship between the service provider and the government (that is, enhancing role separation);
- Providing access to expertise and know-how, such as modern management practices and systems, improved commercial and financial management, access to new technologies, and improved capital works management;
- Building capacity in an organization, particularly amongst senior and middle management;
- Improving the transparency of an organization and the accountability of the management; and
- Under certain circumstances, providing better access to funding of capital works.

There are many different forms of PSP, not all of which may be suitable to the Indian environment. The main generic options for PSP are listed below and summarized further in Annex 3.1:

- Technical assistance/specialist support contracts;
- Outsourcing contracts/service contracts;
- Alliance contracts;
- Management contracts, either with or without a capital works component;
- Lease contracts (sometimes called Affermage);
- Build-Operate-Transfer (BOT) contracts;
- Concession contracts; and
- Divestiture (sometimes referred to as privatization).

The most suitable PSP model is the one which best meets the objectives of the government. If the government is looking for private capital then divestiture, concession and BOT options might be considered. If the purpose is to improve the management of a utility, then lease contracts, management contracts or technical assistance contracts might be appropriate. If the objective is to open up the sector to more competition, then an outsourcing approach might deliver the best results.
Not all the above options are currently viable in India. An analysis of PSP options will need to consider issues such as:

- Financial viability of the options;
- Legal and regulatory issues;
- Availability and conditionalities associated with government funding;
- Attractiveness to the private sector; and
- Stakeholder acceptability.

Further discussion on private sector options -- their relevance to the Indian environment, and how they can assist the public sector in converting to 24-7 supply -- is provided in Guidance Note 4.

2.2.4.3 Scale and scope reforms

Unbundling (horizontal disaggregation)

India is becoming increasingly urbanized. There are now more than 40 cities with populations greater than 1 million. Delhi, Mumbai, and Kolkata all have populations greater than 10 million.

The organizations involved in managing water and sewerage services in large conurbations can often be large, unwieldy and difficult to manage. A recent study\(^5\) undertaken for Ofwat (the UK regulatory body) found that there were distinct diseconomies of scale in water and sanitation services in England and Wales. That is, larger companies (with millions of connections) tended to be less efficient than medium-sized companies (with hundreds of thousands of connections). This result is perhaps not so surprising. After all, water is by necessity a localized industry.

Some cities around the world have divided their services geographically (that is, the service areas have been disaggregated). For example, in Melbourne, Australia (population 3.5 million), water services are provided by three corporatized water and sewerage retail companies each serving a different area of Melbourne. Similarly in Manila, the Philippines (population 11 million), the city was divided into two separate service areas when the water and sanitation services were concessioned in 1997.

Unbundling a large city into multiple service providers may have a number of advantages:

- Smaller providers may be easier to manage and more efficient;
- Unbundling can promote comparative competition between the service providers. This may be through formal comparisons by a regulating authority, or less formally through mutual benchmarking exercises and reputational competition; and
- Areas in which 24-7 supply is introduced can be ring-fenced in order to make them sustainable in the longer term.

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\(^5\) Investigation into Evidence for Economies of Scale in the Water and Sewerage Industry in England and Wales, January 2004, Stone and Webster Consultants.
The decision as to whether or not to unbundle the services will depend on more than just considerations of scale. Other factors include:

- The physical characteristics of the water and sewerage systems (systems that are heavily interconnected are more difficult to disaggregate);
- The capacity of management at a local level;
- The legal and regulatory environment; and
- Financial sustainability issues.

**Bundling (horizontal aggregation)**

The discussion above on unbundling is relevant to larger cities. At the other end of the scale, smaller service providers are likely to be less efficient both because of their small size and because they often lack the management capacity and resources necessary to provide an effective service. By bundling smaller utilities together, it may be possible to build a more efficient and capable organization.

The threshold at which bundling should be considered will vary according the circumstances. Evidence from other countries suggests that service providers with less than 35,000 customers become noticeably less efficient, and may be suitable for bundling.

Decisions as to whether or not to bundle systems together need to consider factors such as:

- Legal jurisdiction;
- Financial sustainability and access to funding;
- Economies of scale (synergies) and/or additional costs associated with bundling;
- Geography (proximity of areas to be bundled and quality of communications between them);
- Physical characteristics of the systems (whether complex or simple) and the water resources (whether water resources are shared);
- Whether water and sanitation services will be combined, or treated separately;
- Income profile of the customers;
- Tariff harmonization issues; and
- Soft issues such as cultural compatibility.

Aggregation may be driven from the bottom up (for instance, if two or more ULBs voluntarily decide to merge their services) or could be “promoted” by a state government. It may be the case that the optimum service provision arrangement in a state would be to establish a series of contiguous regional utilities, each serving several ULBs (or more). The 74th Amendment establishes that responsibility for water and sanitation services should be transferred to the ULBs which would make it difficult for a state to impose a regional utility solution. However, bundling could still be possibly achieved through a voluntary approach linked to appropriate incentives, without diluting ULB control at a collective level.

A number of issues need to be addressed when bundling ULBs together:

- Defining the institutional form for the aggregated organization;
• Defining governance arrangements especially methods for allocating ULB and state voting rights in order to provide fair representation, maintain internal cohesion and limit political interference;
• Determining whether assets should be transferred to the aggregated organization;
• Staff transfer issues;
• Establishing entry and exit conditions for ULBs so that the group is not destabilized if an existing member leaves or a new member joins; and
• Establishing whether tariff and service level harmonization should be introduced and, if so, in what ways and over what transition period.

Vertical disaggregation

Figure 2.2 shows a typical water service production chain.

Figure 2.2: Indicative Production Chain

Should all these processes be undertaken by the same organization or can they be undertaken by different organizations (so-called vertical disaggregation)? Indeed, there are many countries where bulk water supply (which includes abstraction, treatment and primary transmission) is undertaken by a separate organization from that handling distribution and retailing.

There is, however, no evidence to suggest that vertically disaggregated arrangements are inherently more efficient. If anything, they lose efficiencies of scope. The decision as to whether or not to disaggregate is more likely to be made on technical, legal or institutional considerations. Examples of situations in which a separated bulk service provider might be appropriate would be:

• Where two or more municipalities or service areas are served by a single bulk water supply system;
• In conditions where it is not yet possible to establish a fully financially self-sustaining corporatized utility but where, by separating the functions, a financially self-sustainable water distribution and retailing company can be created;
• Where new bulk water infrastructure is developed and operated through a BOT or Build-Own-Operate-Transfer (BOOT) arrangement with a private company; and...
Where the responsibilities for bulk water supply fall under a separate jurisdiction to those for water service provision (for example, if water distribution is a municipal responsibility while water resources, abstraction and treatment is a State or federal responsibility).

2.2.5 Regulation

There are three different types of regulation applicable to water and sanitation providers:
- **Water quality regulation**, which regulates the quality of water delivered to customers to ensure that it is fit for human consumption;
- **Environmental regulation**, which concerns the protection of water resources and regulates the impact of effluent discharges into the environment and other forms of pollution; and
- **Economic regulation**, which regulates tariffs and performance standards.

The design of the regulatory framework for water and sanitation services should consider:
- **Legal jurisdiction**: Which tier of government should undertake regulation? If the state government is best placed to undertake economic regulation of the ULBs, does it have the necessary powers under the constitution?
- **Independence**: Should the regulators be independent? Will regulation be undertaken within government or will new regulatory institutions be set up? If new institutions are set up, how much independence will they have from the government, and how will that independence be provided? How will the regulator be governed and how will the members of the governing body be appointed?
- **Capacity and resources**: Does the proposed regulatory design provide an environment for building a cadre of professional staff with sufficient resources to fulfill their monitoring and regulatory functions effectively? How will the regulators be funded?
- **Powers of the regulator**: Will the regulators have teeth, or will they act mostly in an advisory capacity?
- **Regulatory discretion**: How much discretion should the regulators be given? To what extent should legalization bind regulators to certain objectives and processes?

These are general considerations applicable to all forms of regulation. Issues of regulatory independence are particularly relevant to economic regulation. If the government is responsible for setting performance standards and evaluating performance, there is clearly a potential for conflict of interest. Can any organization, public or private, regulate itself effectively and impartially? Furthermore, will the public have confidence in a self-regulating arrangement? For these reasons, some countries have established independent regulators. One of the benefits of independence is that key decisions on tariff and performance may become less politicized. If managed well, specialist regulators may be in a better position to create a stable financial environment which will enable the sector to grow in a sustainable manner, to become more efficient, and to raise levels of service.
Regulators can be sector-specific (an example being Ofwat in the UK), or can work across sectors (multi-utility regulators).

2.2.6 How can institutional reform be initiated?
Having decided in principle that reform is necessary, what are the next steps? There are three basic phases common to all institutional reform processes:

1. **Study phase:** The first task is to undertake an analysis of options for institutional reform. Usually, this will be undertaken by specialist consultants. The analysis should consider legal, regulatory, technical, institutional and commercial aspects;

2. **Discussion and decision phase:** The findings of the study are discussed and debated amongst key stakeholders, following which a preferred institutional solution is agreed upon; and

3. **Transition phase:** The political decision to move forward is followed by the transition phase. A transition program is developed and implemented covering all aspects of the process which may include:
   - recruitment of legal and consultancy support team;
   - legislative changes;
   - preparation of contracts/project agreements if required;
   - staff migration;
   - agreements on labor terms and conditions;
   - internal and external communications strategies;
   - financial ring-fencing;
   - office relocation; and
   - setting up financial arrangements (bank accounts, on-lending arrangements, etc.).

2.3 Developing a Financial Turnaround Strategy
In Section 2.2, financial sustainability was identified as a core principle for shaping a more accountable water and sanitation service. This section describes how a financial turnaround strategy can be developed and successfully implemented.

In India, water and sanitation services fall so far short of financial sustainability levels that the goal of self-sufficiency may at first seem unattainable. Undoubtedly, the road to financial self-sufficiency will be a long and difficult one. The key to success lies in:

- Developing a well-functioning institutional framework with clear allocation of responsibilities, and a supportive legal and regulatory environment;
- Managing the change process by building consensus;
- Developing an integrated strategy for financial turnaround based around the Strategic Business Plan (SBP); and most of all
- Sustained political commitment.

2.3.1 What is meant by financial sustainability?
Figure 2.3 shows the components of the cost of water and sanitation service provision. To be truly self-sufficient, water and sanitation tariffs should be set at full cost recovery levels. That is, tariffs should be sufficient to cover day-to-day running costs (O&M costs plus the costs associated with financing and building the water and sewerage infrastructure, that is, “debt and depreciation”). In India, revenues from water and
sewerage services typically amount to 30 percent or less of operating costs. They fall a long way short of full cost recovery levels.

Figure 2.3: The Components of Cost and Tariff

The most immediate target for Indian utilities is to achieve recovery of O&M costs. This will probably be achieved through a combination of efficiencies and higher average tariffs. The longer-term objective should be to achieve full cost recovery.

2.3.2 Strategic Business Plans
The process of moving to self-sufficiency starts with a policy decision to move towards financially sustainable services. The next step is to develop an integrated financial turnaround strategy, based on a combination of:

- Tariff and subsidy reforms, including changes to the tariff structure, better targeting of government subsidies and, if necessary, general tariff increases (tariff normalization);
- Improvements in utility performance, including -- particularly -- revenue collection, NRW and operating costs efficiency; and
- Better targeting of investment, including targeting investment towards better commercial management, and fixing the network.

The main tool in the development of a financial turnaround strategy is the SBP. The SBP allows utilities and regulators to move away from annual budget and tariff reviews towards longer-term planning horizons of 10 to 20 years.

The SBP uses a detailed multi-year financial model for testing scenarios for financial turnaround. The model enables users to develop an analytically-based cost recovery strategy. The model includes all the components that contribute to cost or revenue, such as:

- Operating costs;
- Investment;
Demand growth;
NRW;
Improvements in levels of service;
Tariffs and tariff progression;
Production capacity;
Sources and availability of funds; and
Affordability.

The outcome from the model may be a strategy based on a combination of efficiency improvements (leading to lower unit costs), tariff increases and lowering subsidy requirements. The indicative Figure 2.4 shows how tariffs could be progressively normalized to achieve operating cost coverage within seven years and full cost recovery within 15 years.

Figure 2.4: Indicative Illustration of the Progression to Long-term Financial Sustainability

A typical SBP document will include:

- A statement of objectives and targets;
- A series of functional strategies for meeting targets, for instance:
  - levels of service (for example, 24-7 roll out);
  - water quality;
  - environmental compliance;
  - NRW;
  - human resources;
  - commercial/customer issues; and
  - asset management;
- Investment projections; and
- A financing plan (user charges, subsidy, loans, etc.).

2.3.3 Tariff and subsidy reforms

2.3.3.1 Tariff normalization
At a superficial level, low tariffs might be seen as a sign that customers are benefiting from subsidized services. In reality, although they are well meaning, low tariffs can be damaging for a number of reasons:

- They distort customer behavior, causing higher customer demand and encouraging waste while at the same time reducing a water provider's ability to provide new infrastructure to meet the demand;
- They are ineffective mechanisms for subsidizing the poor. They tend to benefit middle- and upper-income households most, rather than the poor who may use relatively little water or who may not be connected;
- They create a disincentive for the service provider to improve services, because improving the service will add costs, but will not generate more income;
- They undermine a service provider's ability to provide a good quality reliable service; and
- They undermine the autonomy and commercial orientation of service providers by creating a long-term dependence on government subsidy.

So reform of tariff levels and tariff structure will be an important part of any financial turnaround strategy.

Willingness and ability to pay studies\(^6\) have indicated that:

- Existing tariffs in India are currently very affordable, and can be increased without significantly affecting affordability of the poorest;
- Tariffs up to Rs. 10/m\(^3\) (US$0.2/m\(^3\)) are affordable for the vast majority of population; and
- Customers would be willing to pay higher tariffs for better service.

By international standards, tariffs in South East Asia are very low indeed, as can be seen from Table 2.2.

Table 2.2: Standard International Tariffs

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean Tariff (USD/m(^3))</th>
<th>Mean Tariff (Rs/m(^3))</th>
<th>Proportion of cities covering O&amp;M costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>1.04</td>
<td>46.8</td>
<td>94%</td>
</tr>
<tr>
<td>Global</td>
<td>0.53</td>
<td>23.85</td>
<td>61%</td>
</tr>
<tr>
<td>South Asia</td>
<td>0.09</td>
<td>4.05</td>
<td>0</td>
</tr>
</tbody>
</table>

The question often asked is: *When is the right time to implement tariff increases?* Tariff increases will never be popular, but there are ways to make increases more palatable:

- **Indexation:** tariffs should be routinely adjusted (either very six months or annually) to account for the effects of inflation. A standard indexation formula can be developed and agreed which adjusts the tariff to account for inflation. A simple indexation formula would link tariffs to a pre-specified consumer price

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\(^6\) Water, Tariffs & Subsidies in South Asia, Paper 1-6.
index. More complex formulae can be developed which take account of inflation in labor, energy and chemicals costs. The application of the indexation formula would be automatic, and would not require political or regulatory approval.

This automatic adjustment approach is good for customers because it means that increases are in small regular increments that are easier to budget for.

- **“RPI + X” formulae**: in most Indian utilities, indexation on its own will not bring the goal of financial self-sufficiency any closer. Tariffs will need to be raised above the rate of inflation. The transition to full cost recovery can be managed by using an “RPI + X” formula, where RPI is the “retail price index” (or another indexation formula) and X is the percentage real terms increase. The value of “X” will normally be set three to five years in advance. Once agreed, the RPI + X formula would be applied automatically, and would not require any further political or regulatory approval; and

- **Linking tariff increases to improvements in service**: customers are much more likely to accept the need for tariff increases which are accompanied by improvements in service. The introduction of 24-7 supply is an example of a service improvement which provides a window of opportunity for tariffs to be adjusted. In most cases (subject to the assessments of affordability and willingness to pay), tariffs for customers receiving 24-7 supply should be set at least at O&M cost recovery levels, and preferably at full cost recovery levels.

### 2.3.3.2 Tariff structure

The ideal tariff structure would be one which is:

- Economically efficient, such that the price reflects the true costs of the service, and the price structure promotes rational water use and discourages wastage;
- Equitable;
- Affordable;
- Targets subsidy to those most in need;
- Easily understood by customers; and
- Simple and cheap to administer.

In India where the social welfare systems are relatively underdeveloped, governments have seen the tariff structure as an alternative means for helping the poor. Studies have indicated that, in general, existing tariff structures do not target subsidies at the poorest. Too often, it is the better-off that get the benefits of government subsidy.

Tariff reforms can be used to target subsidies more effectively. Some of the issues that need to be considered are discussed below.

**Measured and unmeasured tariffs**

There is a wide variety of different charging practices within India. Most cities operate a mixture of measured and unmeasured tariffs.

Unmeasured charges include flat rates, assessed volume charges, charges based on connection (or ferrule) size, and water rates. The advantage of this type of charging basis
is that there is no need for meters or meter readers with their attendant costs and complications, so billing systems are relatively simple to administer. Unmeasured charges also provide a reliable base income for the utility, and in case of a shortfall in water resources, the utility’s income is not, in theory, affected.

There are, however, a number of very significant disadvantages:

- **Fixed charges encourage wasteful use**: there is no link between cost and consumption so there is no incentive for customers to conserve water;
- **Fixed charges are indiscriminate**: customers who use very little water subsidize high volume users; and
- **Fixed charges prevent effective management of the water network**: water consumption is not measured and therefore the utility does not know where, or how much, water is being consumed. Therefore, the utility cannot easily or effectively manage its NRW.

The alternative to fixed charges is volumetric charging. This type of charging requires customers to be metered, and inevitably requires more sophisticated and disciplined billing arrangements. The advantages of volumetric charging are that:

- Charges are linked to consumption, so there is an incentive for customers to use water wisely;
- Payment by volume is equitable and transparent for customers;
- There is a mechanism for balancing demand and supply; and
- Complications associated with shared connections can be overcome.

Most service providers in India suffer from a shortfall in water resources, so volumetric charging will be critical to managing the balance between demand and available supply. It is unlikely that 24-7 could be introduced and sustained without volumetric charging, other than in a few rare cases where there is surplus water production capacity.

Two-part tariffs, which include a fixed charge plus a volumetric charge, are very common internationally and should also be considered. Two-part tariffs are potentially the most economically efficient tariffs because the pricing structure reflects the actual costs more accurately.

**Increasing block tariffs**

Increasing Block Tariffs (IBTs) are widely used in Indian cities. An IBT is a step-wise tariff structure where consumers pay a low volumetric charge up to a specified quantity (or block), and pay a higher rate up to the limit of the second block, and so on. IBTs provide incentives for customers to use water carefully, and can provide a mechanism for a government to provide a lifeline amount of water at a subsidized rate.

The design of IBTs can be improved by:

- Using shorter initial tariff blocks: The initial tariff block in the studied cities applied to consumption up to 10-25 m³ per month. These figures are well above what might be considered a lifeline volume (for comparison the lifeline tariff in South Africa applies up to 6 m³/month);
• Using steeper gradients in order to achieve O&M cost recovery;
• Making adjustments if necessary where there are shared connections; and
• Using fewer blocks: IBTs with a large number of blocks are seen as opaque by customers.

The study found that the cost of production is much higher than the amounts billed even for customers in the higher blocks. So, virtually all customers are being subsidized, regardless of their needs.

IBTs require working meters to be effective. Some cities which use IBTs have not adequately maintained their meter stock.

Tariffs differentiated by service level
There are good arguments to support the introduction of a differentiated “continuous-supply” tariff in which customers who receive continuous supply pay a higher tariff than those who do not. The tariff would be justified on the grounds of:
• **Equity:** it is reasonable to expect customers receiving better services to pay a higher price;
• **Sustainability:** areas converted to continuous supply would be made sustainable in the longer term, and would not be dependent on external subsidy;
• **Supply demand balance:** customer demand distortions caused by heavily subsidized tariffs would be reduced; and
• **Willingness to pay:** customers are more willing to accept higher charges if the increase is accompanied by an improved service.

Tariffs for non-domestic customers
In many cases, the majority of a utility’s revenue may be generated from commercial, industrial and government customers. These categories of customer are usually charged on a different tariff structure than domestic customers.

It is rarely appropriate to subsidize non-domestic customers so non-domestic tariffs should be at full cost recovery prices as a minimum. Some municipalities have fixed industrial tariffs at punitively high levels (eight times domestic tariffs or more) and this can be counterproductive. New businesses may locate elsewhere and existing businesses may seek alternative supplies or may relocate.

Although some businesses are particularly sensitive to water price, many are likely to be more concerned with service quality and reliability. Municipalities which convert to a 24-7 supply will clearly have an advantage in attracting new businesses.

Charges for public taps
Public standposts are widely used throughout India. They are usually unmetered and users are not charged for the water they consume.

Free water creates potential for abuse and waste, a problem that would be exacerbated if the system is converted to a 24-7 supply. The introduction of metering and levying water
charges could help to maintain the supply-demand balance and will contribute to the sustainability of the utility. Importantly also, it sends the message to users that water is a scarce and valuable resource.

Charges would be set at levels considerably below those prevailing in the secondary market. Water purchased from informal vendors is typically between 10 and 500 times more expensive than municipal supply.

**Connection charges**
The issue of connection charges is discussed under Section 2.3.3.4. An alternative to subsidized connections is to allow customers to pay connection charges in installments.

**Meter rental fees**
Customer meters are usually owned by the utility. They need to be checked regularly and replaced if necessary. Typically meters should be replaced every eight to 15 years. The utility can recover the costs of checking and replacement either through its day-to-day tariff, or through a meter rental charge.

The costs of the initial meter installation are sometimes included in the initial connection fee.

**Infrastructure charges**
When a new customer connects to the network, she/he gets the benefit of past investment in the water infrastructure, and creates new demand which will in time require new capacity to be built.

These indirect costs can be recovered either through day-to-day user charges (in which case existing customers are, in effect, subsidizing the growth of the system) or through an upfront infrastructure charge.

It may not be appropriate to levy infrastructure charges where existing houses connect to a pre-existing network, as this would conflict with the wider social objective of expanding network coverage to the entire population. However, infrastructure charges may be appropriate for new industrial and residential developments.

Infrastructure charges may be determined either on the basis of standard schedules or formulae, or can be calculated on the basis of actual costs associated with the specific development.

**Incentives and penalties**
Incentives and penalties can be used to encourage responsible customer behavior. An example of an incentive would be to provide customers with a discount if they pay promptly. Penalties may be levied for late payment, or in the case of tampering, bypassing or vandalism of a meter.

2.3.3.3 Tariff reform process
Tariff structures are often designed in an information vacuum. Data on customer numbers, water consumption patterns, customer incomes and affordability may not be available or may be unreliable. The key to effective tariff design lies in generating better data combined with developing a more analytical approach to tariff evaluation.

The tools for developing a tariff reform strategy include:

- Willingness and ability to pay studies to assess:
  - customer incomes and affordability;
  - customer willingness to pay for better services;
  - customer priorities; and
  - impact of increases on household budgets; and

- Tariff studies to assess:
  - the feasibility of different tariff structures, and
  - the impact of different structures on the income of the utility.

A full discussion of all available options for tariff structure is beyond the scope of this Guidance Note. Careful consideration would need to be given to the effect of tariff structures on low-income families. Prepayment meter technologies are improving, and these may have a role in helping customers manage their budgets more effectively.

### 2.3.3.4 Subsidy reform

Government subsidy arrangements within India suffer from all the traditional weaknesses associated with direct subsidy arrangements. Not only do they not target the poor effectively, but they have tended to entrench inefficiencies in the sector.\(^7\)

While the overall objective is to develop a financially independent sector, inevitably water and sanitation services in India are likely to require government subsidy for some time to come. The financial turnaround strategy should consider ways in which the subsidies provided to the sector can be better designed.

**O&M subsidies**

In general, the recommendation of these Guidance Notes is that direct operating subsidies should be phased out.

The absence of hard budget barriers has allowed utilities to become progressively less efficient. Apparently, the more inefficient a utility becomes the more subsidy is provided. In effect, subsidy becomes a bail-out for financial indiscipline. Future operating subsidy arrangements should be restructured to address existing weaknesses and to wean the sector off its reliance on government support.

The best subsidies are transparent, targeted at those most in need, supportive of rational behaviors, and time limited. In particular:

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Water, Tariffs & Subsidies in South Asia, Paper 1-6
The amount of subsidy should be normatively determined. That is, it should be determined on the basis of predetermined criteria such that worsening financial performance does not trigger higher subsidy provision in the future;

- Subsidies should be predetermined several years in advance and fixed on a declining basis. This allows utilities to plan the transition and adapt to lower subsidies. The utility must make good the subsidy shortfall through greater efficiency and, if necessary, through higher tariffs. However, simply starving the utility of funds, without addressing other fundamental institutional shortcomings, may not result in a more efficient organization. In most cases, greater efficiency in the utility may require investment in new systems, new equipment, better maintenance, or more and better training. All these issues have to be considered within the Strategic Business Planning process described earlier;

- Subsidies can be performance linked – [so-called Output Based Funding (OBF)] - so the amount of subsidy is conditional on the achievement of predetermined outcomes; and

- The subsidy structure should provide incentives for utilities to become more efficient and perform better. So a well-performing utility would be rewarded, for instance, by being able to keep the savings that it makes.

There are economic arguments for governments to subsidize lifeline amounts of water (for instance, on the grounds of improved health). The level at which lifeline tariffs are set should be based on the results of willingness to pay studies.

**Connection subsidies**

Operating subsidies only benefit those that are connected to the network. In India, these are likely to be predominantly the better-off income groups.

The best way of helping low-income families is to provide them with access to the municipal network because water from the network is generally of better quality and much cheaper than the water available from informal vendors. This barrier can be removed by subsidizing connection charges.

A subsidized connections strategy presupposes that effective metering and billing systems as well as rational tariff structures have been established. If a subsidized connection policy is established without these changes, the inevitable result would be to create higher demand, reduce the amount of water available to existing customers, and further undermine the financial sustainability of the utility.

**Capital investment subsidies**

Government support for capital investment is likely to continue for some time. Capex subsidy mechanisms include:

- Grant funding, low interest loans and government guarantees for infrastructure projects such as water resources, water treatment, sewage treatment; and

- The use of public funds to leverage private finance for BOTs and BOOTs (the so-called viability gap funding).
2.3.4 Improvements in utility performance

2.3.4.1 Collection efficiency

Collection efficiency relates to the ability of the service provider to receive payment promptly and, if necessary, enforce payment of water and sewerage bills. Internationally, the simplest and most common measure of collection performance is the collection ratio (amounts collected/amounts billed). The collection ratio should be at or near 100 percent in a well-managed utility. Collection performance in India tends to be much lower than this.

Instilling a culture of payment is a crucial component of any financial turnaround strategy. The following list discusses the components of good commercial practice:

- **Designing solutions for the culture**: commercial practices should be compatible with cultural and social norms; what works in one country or city may not work in another;
- **Commercial systems and procedures**: customers will be more likely to pay if bills are accurate and timely. Computerized billing is essential;
- **Appeal process**: however good the billing system, there will inevitably be billing errors from time to time. The utility should establish procedures through which errors can be investigated and quickly corrected;
- **Providing a good service**: self evidently, if customers receive good quality reliable service, they will be more willing to pay;
- **Payment options**: the utility should provide customers with a variety of user-friendly payment options. Examples that may be considered include payment at local retail banks, setting up local payment centers, allowing customers to pay amounts in advance, and allowing them to pay by direct debit or standing orders;
- **Fines, penalties and incentives**: prompt payment and good customer behavior can be encouraged through the application of fines and incentives. For example, customers who pay within 15 days can be given a discount;
- **Legal environment**: the legislation governing enforcement of payment needs to be clear, and the courts must be supportive;
- **Recognizing genuine hardship**: the utility should establish procedures to address instances of genuine hardship. For instance, the utility could agree to a payment plan with the customer, or install a flow restrictor (which allows the customer to receive a lifeline flow), or provide the customer with a prepayment meter;
- **Enforcement**: if enforcement action is applied infrequently or inconsistently, customers will be tempted not to pay and to run the risk. So for those that can pay but choose not to, enforcement action should follow automatically and predictably. Enforcement actions will usually take place after a notice of disconnection has been issued, and include disconnection, followed if necessary by court proceedings to recover the outstanding amounts. Partial disconnection, which involves the use of the flow restrictors mentioned above for delivering a very small lifeline amount of water, can also be considered as part of an enforcement approach;
- **Follow-up**: the utility should establish procedures to routinely check that customers who have been disconnected do not reconnect themselves illegally; and
Reconnection: it is important that the connection is re-established promptly after the customer has paid his/her arrears.

With the introduction of a 24-7 supply, prepayment meters may become viable. Self-evidently, prepayment meters ensure full payment, and may be preferred by some customers as they facilitate easier household budgeting. However, they are more expensive than conventional meters.

Poor payment discipline often becomes entrenched within the culture, and it can be very difficult to change customer behaviors. Information campaigns can help in building customer awareness.

Different challenges are presented when government institutions do not pay their bills. It may not be realistically possible for a utility to enforce payment by hospitals or by the military. Some countries have established compensation mechanisms whereby the central government reimburses the utility and adjusts the budget of a non-paying department accordingly.

2.3.4.2 NRW
NRW is made up of real losses and apparent losses. Real losses include leaks and bursts from the network. Leakage in the network needs to be addressed in order for 24-7 supply to be viable. Reductions can be achieved initially through a mains rehabilitation program, and as a result of lower system pressures needed for continuous supply. Furthermore, 24-7 supply provides new opportunities to dramatically improve routine leakage monitoring and control. Experience shows that a combination of these benefits can offset the effects of increasing the hours of supply.

Lower leakage can lead to improved financial performance in a number of ways. In situations where supply exceeds demand, it can result in lower treatment and energy costs. In situations where demand exceeds supply (a more common situation in India), it can result in higher revenues (as water that it not lost through leakage can be sold to other customers), and deferred investment in new resources.

Apparent losses include:
- Metering inaccuracies;
- Theft (arising from illegal connections), meter tampering and fraud;
- Losses arising from use of deemed consumption (for instance, where there is no meter, or the meter is broken);
- Errors and omissions in the billing database; and
- Legitimate unbilled water uses (for instance, pipe flushing).

Water meters are designed to be used under conditions of continuous supply. Under a 24-7 supply, customer meters will be more accurate and reliable than they have historically been under intermittent supply. At the time of conversion to 24-7, there would be an initial investment in new meters. Thereafter there should be a program of routine checking and calibration to ensure that the meter stock is well maintained. Meters of
large industrial customers should be checked more often than those of domestic customers.

There are very large numbers of illegal connections throughout India. Not only does theft undermine financial sustainability but illegal connections can be a major source of physical leakage because of the poor quality of materials and workmanship. Illegal connections can be identified through physical customer surveys, and by comparing the customer database with other services such as gas and electricity. Rather than simply disconnecting illegal connections, utilities should develop programs for regularizing illegal connections and bringing illegal users onto the formal customer database.

Further improvements in commercial efficiency can be achieved with new billing systems, improved meter reading procedures, periodic customer surveys, and database cleaning exercises.

2.3.4.3 Operating costs efficiency

The two largest components of operating cost in most water and sewerage utilities are energy and staff costs. Chemical costs may also be significant, depending on the types of water resource and treatment provided.

Whilst energy consumption is largely dependent on topography, it is often possible to significantly reduce the energy bill. Energy audits can be undertaken to assess the efficiency of pumps. There may also be opportunities to reduce the unit cost of electricity, for instance, by using off-peak tariffs, or by negotiating preferential rates with the electricity utility. Continuous supply may also help to bring down energy bills as lower network pressures lead to lower pumping costs.

The other major cost item is manpower. Labor productivity in the Indian water and sewerage sector is poor when compared to international norms. An averagely efficient water provider in a developing country environment should require no more than five staff per 1,000 water connections. A few utilities in the country are believed to meet this threshold. In some cities, the ratio is as high as 18 staff per 1,000 connections.

There is clearly a need to raise productivity in the sector in line with international norms. This can be done through staff training and development programs, and by improving labor flexibility. The most efficient organizations are likely to be ones in which the workforce is multi-skilled, and which are able to adapt their workforce, in terms of skills and numbers, to match their needs effectively and efficiently.

Improved productivity may not necessarily require compulsory retrenchment. Recruitment freezes, early retirement programs and voluntary redundancy initiatives can all be considered. Of course, the least painful way to improve productivity would be to expand the services without increasing the number of staff, but this may not always be sufficient on its own.
There may be some expenditure areas where spending has historically been inadequate. For instance, it may be necessary to increase spending on maintenance or on new equipment and management systems. Furthermore, notwithstanding that overall manning levels are high, there may be some areas where there are skills shortages, requiring additional staff to be recruited.

**Human resource development**

In part, the poor state of the water and sanitation services throughout India is the result of staff working under civil service rules and procedures formulated for the process of governance and not for a service industry. There is little incentive for staff to perform well as no part of their pay is dependent upon performance – and advancement through departments is generally based on seniority, not merit.

Water and sanitation services are frequently just two of the responsibilities of a single public works department (PWD), in which all of the various sub-departments vie for the same staff and where sanitation is the poor relation of water, itself not very high on departmental priorities. Mobility of staff between the various technical service responsibilities of a municipal department, such as a PWD, generally means that few become sufficiently experienced in the sanitation service to manage it well.

In addition to the problems of over-staffing discussed earlier, there is need to address morale by encouraging and rewarding managers, technicians and craftsmen who perform well; and to ensure that staff is adequately-trained for the tasks it is required to undertake.

To attract, motivate and retain well-qualified managers and staff and improve productivity, an urban sanitation service will need to:

- Ensure that it is possible to make a rewarding career within the water and sanitation services;
- Increase the emphasis on training and development to raise the level of skills and to keep staff abreast of sector developments;
- Develop incentive arrangements which reward good performance with promotion and bonuses;
- Improve labor flexibility (the most efficient organizations are likely to be ones in which the workforce is multi-skilled, and which are able to adapt their workforce, in terms of skills and numbers, to match their needs effectively and efficiently);
- Make staff appointment, employment and promotion transparent; and
- Provide conditions of employment commensurate with those available in the private sector.

**2.3.4.5 Management systems and procedures**

Improved performance can come by improving the management systems and processes within the utility. For example by:

- **Improving incentives:** performance-related pay schemes and similar incentive arrangements can be introduced for management and staff to encourage them to achieve targets, and to give them a stake in the success of the organization;
• Improving Management Information Systems (MIS): the adage that “if you don’t measure it, you cannot manage it” holds good for water and sanitation utilities as much, or more, as any other business. Many utilities do not have reliable data on the volume of water produced or consumed, or on their billings or revenues. Records of the network and facilities are often incomplete and sometimes non-existent. Knowledge of the systems may be held by a few staff members. New reporting and information systems (such as a Geographical Information System - GIS) take time to set up and become established. All information systems, not merely financial systems, should be audited from time to time to check their robustness and the accuracy of the data they produce:
  - Benchmarking performance against others: benchmarking studies can be used to identify the strengths and weaknesses of an organization relative to others;
  - Addressing corruption: corrupt practices can become entrenched in an organization. Corruption can be tackled by establishing checks and controls, by external audits, and by encouraging staff and the public to expose practices on a confidential basis. The issues are discussed in more detail later in this section.
  - Considering automation: Supervisory Control And Data Acquisition (SCADA) and telemetry systems are used extensively in the developed world. The principle benefits are that they provide utilities with superior system monitoring and control capability, and can improve manpower productivity. SCADA systems are less likely to be justified on purely cost grounds in India because of the relative lower costs of employing staff;
  - Outsourcing activities: outsourcing provides access to a wider pool of expertise, and can be used to open up non-core activities to competition;
  - Using smarter procurement: are the existing procurement practices delivering best long-term value for the utility? Conventional competitive approaches do not always get the best out of the supplier or contractor. Less confrontational approaches (the so-called partnership contracts) could potentially deliver a better result for both parties. Further, many capital projects could be implemented more quickly and efficiently if the scope of the contractor is expanded to include planning, design and construction;
  - Setting up a low-income unit: many utilities have established successful specialist low-income units. The purpose of such units is to develop practical approaches for providing low-income groups with reasonable services on a sustainable basis; and
  - Creating a learning organization: organizations that do not learn from their mistakes are destined to repeat them. Post-project assessments are useful tools for analyzing what went well and what could be done better.

2.3.4.6 The use of small-scale operators
There is always a tension between whether a water and sanitation provider should be centralized or decentralized. The essence of the business is delivering an essential service to people’s homes and businesses, which requires a localized approach. However, many activities involved in providing the service (such as planning and water production) require a centralized approach.
Some difficulties associated with over-centralized utilities include:

- Managing the activities of operations staff: many cities suffer from petty corruption amongst valve operators who control the timing and frequency of supplies to localities;
- Enforcing payment, particularly in low-income areas;
- Inadequate knowledge of the condition and performance of the distribution system at a local level and slow reaction times to address operational problems; and
- Insufficient awareness of local needs and expectations.

One way to improve accountability at a local level is to outsource certain aspects of the service to local community organizations or to SSOs. The type and scope of the outsourcing arrangement would be designed to suit the situation. For instance:

- At its simplest, instead of being engaged by the utility, the valve operators would be engaged by local community bodies, and made accountable to them;
- Community associations could be made responsible for operating and maintaining the network, and for billing and collection activities in a particular area. The associations could do this directly, or by engaging SSOs who would be accountable to the associations; and
- The utility could itself employ SSOs to operate and maintain the network and undertake billing and collection activities in a particular area. The contracts could include incentives for reducing NRW and increasing the amount of collected revenue.

### 2.3.4.7 Customer orientation

All too often, water and sanitation service providers are seen as servants of government rather than of their customers. There are a number of ways in which a customer service culture can be nurtured:

- **Customer contracts:** simple contracts of service should be established with each customer (customer contracts) which set out the obligations of the utility to provide a supply, and the rights and obligations of the customer;
- **User groups:** consumer groups can be set up to provide a voice to customers, and to articulate their views. The groups would be made up of representatives from a cross-section of customers;
- **Guaranteed service standards:** these set out the minimum standards which the utility guarantees to provide to the customer (for instance, the utility might guarantee to provide continuous supply for a minimum of six days per week). If the utility fails to meet the guaranteed standard, it must pay compensation to the customer;
- **Customer-friendly procedures:** charging and payment arrangements can be made more responsive to customer needs;
- **Customer service centers and customer call centers:** centers can be established so customers have somewhere to visit or call if they have a technical or billing query;
- **Communication:** leaflets can be circulated to customers setting out their rights and obligations, and to keep them informed of new initiatives from the utility; and
• Staff training: training will be needed to provide staff with customer service skills.

Fraud and corruption
Corrupt practices are likely to develop wherever opportunities arise, and where the chances of being caught are slim. After a while corruption and fraud become entrenched in an organization and are very difficult to root out. Every large organization must develop systems and procedures that limit the opportunities for fraud, and that expose fraud where and when it occurs.

Fraud and corruption can be addressed through:
• Financial checks and controls: the utility should review its controls to confirm that they are consistent with best practices. Are financial cross-checks and reconciliations undertaken wherever they can? Are random audits carried out to check each stage of the billing, collection and enforcement process? Where are the weaknesses in the procedures? For instance, do the procedures for addressing errors in customer bills provide opportunities for corruption?
• Forensic audits: specialist auditors can be engaged to undertake diagnostic audits, to identify weaknesses and threats, and to suggest remedies;
• Whistle-blowers: the utility can develop incentives and initiatives to encourage its staff and customers to expose fraud;
• Staff rotation: Meter readers and cashiers can be regularly rotated to minimize the potential for collusion with customers;
• Monitoring of staff: how closely is staff monitored? Staff members who handle money may need to be monitored more closely, for instance with closed-circuit TV;
• Staff accountability: what sanctions are brought to bear on a staff member (or a customer) who is found out? Are law enforcement agencies involved if serious fraud is suspected?
• Recruitment of staff: some types of staff may be inherently more reliable than others (for instance, women or older employees). What is the ideal staff profile? How can the organization make sure it is recruiting honest staff?
• Protection of staff: is the utility’s staff exposed to intimidation? If so, how can this be countered?
• Outsourcing: outsourcing does not necessarily prevent corruption, but it does allow the utility to hold the outsource contractor properly accountable. If necessary, the contractor can be replaced if it does not maintain effective checks and controls; and
• Using technology: technology can be used to reduce the opportunity for fraud. For instance, Automatic Meter Reading (AMR) technologies and prepayment meters can overcome meter reading errors and fraud. Billing systems can be used to control access to data, and to flag unusual results.

Better targeting of investment
Financial turnaround can rarely be achieved without investment. However, investment funds must be prioritized on the basis of a business case. Procedures should be
established to ensure that every project fits within the functional strategies defined in the SBP and that for each project, a series of alternative options are considered and evaluated on the basis of those with the lowest net present value.

The quickest returns are likely to come from investments targeted at improving commercial performance. These include investments in:
- Meters, particularly for industrial and commercial customers;
- Improved billing systems and practices; and
- Cleaning the customer database.

Other investments which may offer quick returns include:
- NRW reduction projects: water losses, whether real or apparent, result in either a loss of revenue or increased costs. Consequently any improvement in NRW performance quickly feeds through to the bottom line; and
- Investment in energy efficiency improvements: often pumps are poorly matched to their loads, or have not been adequately maintained.

In most cases, network rehabilitation is a necessary precondition for conversion to a 24-7 supply. Wholesale replacement of the network would be expensive. Consequently, investment funds need to be targeted at the mains in the worst condition to get best value.
Guidance Note 3: Building Blocks for a 24-7 Water Supply Service
Guidance Note 3: Building Blocks for a 24-7 Water Supply Service

Strategies for conversion from intermittent to 24-7 supply will vary in their details between cities. However, their essential building blocks will be common to all. In this Guidance Note, the building blocks upon which conversion to 24-7 supply is planned and implemented are described under three headings:

- Institutional;
- Technical; and
- Commercial.

Many building blocks upon which 24-7 supply must be based do not yet exist in Indian urban administrations and water service utilities.

Before reading this Guidance Note, it is recommended that Section 1.13 of Guidance Note 1 be read. This sets out why 24-7 supply would be difficult to achieve under conditions that prevail in India at the present time. These underline why the essential and basic building blocks have to be prepared before embarking upon planning and implementing a 24-7 supply scheme. Efficient and effective operation of an urban water service is impossible without having these basic building blocks in place.

3.1 Institutional

3.1.1 Technical and managerial skills

Planning, implementing and operating a water service under 24-7 supply conditions require technical skills and a higher degree of managerial control than have previously been employed in virtually any water service undertaking in India for many decades.

Guidance Note 1 has set out why operation under intermittent supply conditions renders efficient and effective operation of a water service practically impossible. Pipelines and networks that empty down just cannot provide the operational data needed to maintain close control over operations and other vital data required to practice supply and demand management cannot be collected.

Conversion to a continuous water supply service provides an opportunity to considerably improve managerial control and operational efficiency and effectiveness. However, to achieve this, the water service undertaking will need to significantly improve and supplement its managerial and technical skills because hitherto its skills have been oriented towards maintaining an intermittent supply.

The technical skills and technology that are required to plan, design, implement, operate and maintain a distribution system operating under continuous supply conditions – but which are not usually available within present staff complements of water service providers – include:

Planning, design and specification of:
water infrastructure – from entry into the transmission system through distribution to the customer – structured to be operated under continuous supply conditions, including the concept and establishment of DMAs; restructuring of existing systems, presently operated under intermittent supply conditions, to continuous supply at minimum cost and while maintaining a water supply service through the conversion process; appropriate hydraulic models and their application to planning, design and operation; all aspects of water distribution system pressure management, including the specification of appropriate types and sizing of pressure control valves; and design, specification and choice of flow and pressure measurement and control devices for the management of a continuous supply service.

Operational skills and technology:
operation under continuous supply; pressure management; proactive detection, location and repair of hidden leaks; proactive detection of unauthorized connections; and mapping of water service infrastructure on GIS platforms linked to operational systems, maintenance programs and customer service tracking.

In addition to these basic skills, it should be self-evident that there will need to be managers capable of directing these skills and technologies to make the best use of them. The application of these additional skills and technology has to be effectively managed. However, in addition, the introduction of continuous supply offers the conditions and opportunity to considerably improve the overall performance of a water service undertaking. This improvement of efficiency and effectiveness requires the employment of additional management skills:

Supply management:
- prioritization of leakage reduction operations to obtain greatest reduction for least effort;
- prioritization of distribution system replacement to obtain greatest reduction in losses;
- water production to meet metered demand; and
- the transfer of bulk supplies to where operational data show they are needed.

Demand management:
- management use of customer data to control demand due to universal metering of customer use of water within the design accuracy of the meters installed (impossible under intermittent supply conditions);
- design of appropriate volumetric tariff structures which encourage prudent use of water; and
- management control of system pressure at customer connections.
Performance management:
- introduction and routine use of water utility management information systems;
- routine, frequent and regular monitoring and management of:
  - operational performance; and
  - managers and staff;
- manager and staff performance incentive schemes; and
- manager and staff advancement based on measured performance.

Financial management:
- optimization of operational and staff costs; and
- conversion of unauthorized use to revenue-generating use.

Customer care management:
- improved transparency -- publication of operational performance compared with required service levels; and
- response to complaints based upon operational data.

The supervisory bodies and management of every water service undertaking must analyze the skills, experience and numbers of their existing managers and staff and their in-house management and technological systems to determine whether they are able to respond to the needs listed above. Almost certainly, in the majority of cases, water service undertakings will need to develop or employ almost all of the necessary skills and systems. A key decision will be how to obtain the supplementary skills and systems, the options being to:
- Train existing managers and staff;
- Recruit new managers and staff; and
- Procure the services of one or more appropriately-qualified organizations.

It is often difficult for supervisory bodies and management of water service undertaking to bring sufficient objectivity to the assessment of their existing managers and staff, to frankly assess their capabilities and to specify the true needs of their organization. The assistance of appropriately-qualified companies to act in an independent capacity for this basic assessment is strongly advised.

3.1.2 Permanence of managers and staff
The efficient management of a water service undertaking is complex and its operation requires dedicated managers and staff with specialist skills.

There is a lack of continuity in posting in some areas of government that adversely affects water services at two levels:
- The most senior managerial positions in regional government and the larger water service providers are filled with staff from the state cadres and are moved between positions – in a variety of sectors – with an average frequency of two years; and
- It is a common practice for managers and staff to be moved around departments where a municipal water service is managed as part of a general PWD – at one
time staffing the water undertaking, the next moving to highways and roads management.

The former has negative impacts on the formation of sector policy and its application as well as on the most senior management of the larger water boards. The latter affects the quality of O&M in larger and smaller PWDs. Within the short period at the posting, it is extremely difficult to grasp the problems faced by an entity, formulate policies and an approach to their application, and to have them implemented.

The latter, relating to PWDs, tends to result in generalist managers and staff which dilutes skills and experience and impedes generation of the specialist knowledge needed to manage water services efficiently and effectively. Although there is benefit to be derived from circulating young staff between departments, so that they may determine where they would best employ their skills in the future, all key managers and staff – as well as a core of general staff - should work permanently within the water service department.

3.1.3 Staff incentives – performance assessments, performance-based bonuses and promotion

The present system of bonuses and promotions, based on length of service, is a constant source of irritation and acts to demotivate the younger, ambitious staff in the public administration, particularly those working at the municipal level and in public water undertakings.

Under the present system of staff advancement, it is not uncommon to find managers and staff in positions for which their capabilities are totally unsuited, having moved to their position solely because their length of service warranted the promotion. It is not possible to operate an efficient and effective water service in this way.

Operation of a 24-7 water supply service provides the data and records that offer an opportunity to assess the capabilities of managers and staff, according to their performance. The status of operations at any time is known and quantified, and reasonable targets can therefore be established for improving that performance over a year. The individual roles and responsibilities of each manager and staff member in achieving improved performance can be readily defined and set out for the personnel involved. Their individual contributions and success in achieving the performance targets set and agreed with them at the beginning of every year can be determined by monitoring their performance targets. Performance can then be used to determine whether a bonus is due when targets are exceeded and when appropriate, relative performance of managers and staff can be compared when senior positions become vacant and could be filled by staff members.

In addition to retaining skills, technology and experience within the department, permanence of employment in a water service department also better renders it possible to assess staff performance and to offer rewards and promotions based on results rather than length of service.
3.1.4 Asset records
A register of the physical assets of the water undertaking should be compiled and regularly updated as changes occur.

The Asset Register should record the type of asset with a brief description, the date of its construction or acquisition, value at date of construction and present-day value, taking account of its state of repair. Records should also be kept whenever the asset has major work done to it, for example, major repairs, rehabilitation or replacement or a part or all of it.

Wherever possible, an asset referencing system should attribute a unique reference to each asset and this should be cross-referenced with the asset on GIS-based records of its location.

The physical infrastructure assets should be sub-divided in the register according to the OZ or other divisions of the water undertaking responsible for operating and maintaining them.

This form of asset record has a number of purposes:

- **Technical**: it is the repository of data that can provide inputs to a plan to prioritize rehabilitation and replacement work;
- **Contractual**: when a third party is contracted to operate and maintain a part of the assets, for example, an OZ, the register will provide a precise list of the assets passed to the contractor, a description of their state at hand-over and of their current value; and
- **Financial**: it provides the basis for a total valuation of the assets and for a calculation of depreciation.

3.1.5 Management information systems
An MIS takes operational data collected from those elements of the operations which contribute to an understanding of operational performance and transforms the data into a parameter which reflects that performance. The MIS then allows that parameter to be accessed by any manager or staff member responsible for the performance of that operation and authorized to access it.

A modern MIS collates data collected in real-time and, by means of a computerized program, transforms the data into a form immediately useable by managers to be able to assess performance. That performance might be of the water undertaking as a whole, a particular operational unit, a specific operation or of an individual manager or staff member.

In the vast majority of water undertakings, there is a total lack of metering of the volumes of water produced, transmitted, received, distributed and consumed at different points in their systems. This means that not even the most basic MIS is possible. Without an MIS – no matter how basic – performance cannot be measured, and in the absence of
performance measurement, targets cannot be set and operational efficiency -- or inefficiency -- can neither be monitored nor compared with past performance.

In short, in the absence of measurement of basic operational parameters and an MIS to disseminate and make use of those parameters, the basic duties and obligations of management cannot be competently fulfilled.

If conversion from intermittent to continuous supply is to be sustainable, and the benefits of the improved performance -- possible from such conversion -- achieved, the following needs to be done:

- Principal operational data, for example, water volumes and system pressures at critical points; power consumption by significant installations; NRW, customer consumption; bills issued; revenues received, etc, have to be metered or compiled;
- Data should be collected and recorded in a computerized form capable of transmission electronically to a central data storage system; and
- An MIS should then use the data collected to produce sets of parameters that can be used by authorized managers and staff to monitor performance; clearly, the sets of parameters accessible to any manager will depend upon his respective role and responsibility.

The degree of complexity or simplicity of the data collected and the MIS employed should reflect the size of the water undertaking. However, irrespective of size, effective management of any water undertaking requires a minimum of data to be collected. The processes involved in the operation of an MIS should never be such as to cause so much difficulty in its design, operation and dissemination of data that its cost outweighs the benefits that can be drawn from it.

However, water undertaking managers reading this Guidance Note should ask themselves what they would need to do were they to be asked for an estimate of reasonable accuracy of the value of NRW in their undertaking today. Indeed, they might ask whether any estimate at all could be given without considerable research being undertaken and, once that had been done, the degree of credibility that could be attributed to the data and values produced. This is just one example of many that could have been given of the type of vital operational parameter, reflecting today’s situation, that should be available at any time of the day at the “touch of a button.”

3.1.6 Effective inter-departmental communication and coordination

Necessarily, the various distinctive operations of a water undertaking are divided between different departments and divisions, for example, planning and design, capital works implementation, water service operations, wastewater service operations, finance and accounting, legal and administrative, customer relations, etc.

A program to convert from intermittent to 24-7 supply will involve every one of these departments. Successful implementation will only be possible if there is excellent communication and coordination between the departments or divisions involved. The command structure for the change process should be clear as should the contributions to
be made by the various departments and their respective roles and responsibilities in the process.

For the managements of some water undertakings, the above statements will appear obvious, and accepted as essential for success without the need to state them. However, unfortunately, there are other water undertakings where communication and coordination between departments is poor and almost non-existent. It is essential that this lack of communication, cooperation and communication be addressed and rectified before embarking upon the conversion process – not doing so will almost certainly result in a failure of the initiative at an early stage.

3.1.7 Cooperation and communications – internal and external

Agreement to proceed with a 24-7 supply conversion program, and its successful implementation, will depend heavily upon commitment, support and cooperation of diverse groups of stakeholders in the geographic area covered by the change program:

- People’s representatives;
- The media;
- Non-governmental organizations (NGOs); and
- Customers.

Crucial to success in planning and implementation of a 24-7 water supply program is the degree of commitment, support and cooperation given to the change program by the managers and staff of the water undertaking. Every process of change has the potential to be viewed as a threat by staff: a threat to their employment, to their position and to their income. It is absolutely essential that managers and staff be fully involved in the conversion process from beginning to end. The advantages to them should be clearly communicated and their fears addressed in the best possible manner.

Section 4.10 enters into greater detail on what needs to be considered when formulating a program of communications to each group of stakeholders. It is critical that the process of making key decisions around the available options for the reform is arrived at through broad internal and external stakeholder consultation.

3.2 Technical

Section 1.13 of Guidance Note 1 sets out the main reasons why urban administrations and water utilities throughout India would find it virtually impossible to achieve 24-7 supply given the conditions under which they are constrained to operate. These shortcomings have to be rectified if the intention is to convert from intermittent to a continuous supply. A summary of the principal technical shortcomings, as stated in Section 1.13, is:

- Reliable data on distribution networks and customers do not exist;
- There is virtually no metering of bulk water produced, its transmission or distribution at any point;
- Pipelines comprising the distribution system are totally interlinked;
- Control of leakage on a routine, planned basis is impossible;
It is unusual for a water utility to routinely measure system pressure; and
Customer meters do not function with any predictable accuracy under intermittent
supply conditions.
These points are each dealt with in the following sections.

3.2.1 Distribution system data – infrastructure and customer records
First and foremost, before any planning can be satisfactorily undertaken, there is a need
to accumulate a credible set of basic data. These include infrastructure plans and data on
the bulk supply and distribution infrastructure as well as accurate customer records.
These system data are a basic requirement without which no water supply system can be
operated efficiently and effectively. Unfortunately, such data are generally not available
in a credible and usable form for the water supply systems of most Indian towns and
cities.

Annexes 1A and 1B set out the data that should be collected with respect to
infrastructure and customers. To assist in prioritizing the work of data collection, the
two sets of data have been categorized into data which are “essential” and that which are
of a “lower priority.”

Annex 1A lists the essential basic data on the water supply and sewerage service
infrastructure that are needed to plan and introduce 24-7 supply. Where such data do not
already exist, the list may appear rather daunting. However, it is impossible to operate a
water supply system effectively and efficiently without such data. If the task of its
preparation is viewed as too huge to undertake, it would be better not to consider
embarking upon a campaign to introduce 24-7 supply than to attempt it without such
fundamental data.

Network plans may be produced as an output in isolation from other aspects of operation.
However, plans produced in this manner have only a limited benefit and do not make the
best use of technology now available.

Network plans prepared on a GIS platform provide the base from which many
management improvements and benefits can accrue. A GIS is a computerized mapping
system upon which layers of data can be overlaid. The data can be technical in nature, for
example, water service infrastructure, or administrative, for instance, customer records
for communications, billing and collection. Used in its simplest form, a GIS-based record
showing the physical characteristics and location of the distribution system provides
system plans for those operating, managing, upgrading and extending the system.
However, because multiple layers of different data can be superimposed one on top of the
other, the GIS system may be used, in combination with other software, to direct the
management of O&M activities, operate a spares ordering and warehousing system or
manage a customer complaint system. The use of a GIS is, in common with many other
public services, one of the foundations upon which modern water service management is
built.
Most water service providers in the country have an inadequate understanding of their customers with respect to their water and wastewater connections and the basic water service-related data attached to these. Accurate and comprehensive customer data – actual and potential customer data - are essential for any planning exercise as well as effective operations.

Annex 1B sets out the data that should be collected with respect to the customer base of a water utility.

Although it is not essential that customer records be reported on the GIS platform used for recording infrastructure details, there are advantages to ensuring that this can eventually be achieved. This can be exemplified by the customer who telephones in reporting a burst on a main. Before setting out to repair the break, the repair team or contractor would be aware of the size and material of pipe to be repaired which could ensure that they are equipped with the right materials for the job – considerably reducing the time that a supply would be stopped in the vicinity and the cost of the repair.

3.2.2 Flow metering

It is presently very rare for water service providers, anywhere in the country, to meter the amount of water that they are handling at any point in their operations, from acquisition through treatment, transmission or distribution. Bulk water movements are only metered where water is sold from one service provider to another.

Attempts are made to meter customer use but this action is rendered pointless for the manifold reasons listed in Section 3.2.7.

Given the absolutely fundamental importance of measuring water production and system flows to the efficient management of a water utility, the lack of any measurement is a major shortcoming in water service operations.

In the absence of production and flow measurement, it is impossible to:

- Measure the efficiency of treatment processes;
- Know how much water is being fed to which parts of the system;
- Quantify leakage in the transmission and distribution systems;
- Measure NRW and performance in reducing it; and
- Practice supply and demand management, and be in a position to know baseline values and measure success or failure of control measures.

In the absence of metering, all current statements quantifying NRW, including leakage, can only be broad estimates, subject to a wide margin of error.

The above list is certainly not exhaustive.

Water utilities must rectify this situation if any semblance of performance efficiency is to be introduced. The flow of water should be metered at least at the following points in the supply system:
• At entry to and exit from all water treatment plants;
• At entry to and exit from all major reservoirs;
• At entry to – and issue points from - the transmission system;
• At all OZ cross-boundary pipelines at the crossing point, whether importing water to the OZ or exporting water from it; and
• At entry to all DMAs (see Sections 3.2.3 and 3.2.4 for more details on DMAs).

Measurement should be accurate, through the use of electromagnetic flow meters or meters capable of similar accuracy, and continuously recorded in a form that can be readily organized as part of an operational MIS.

In conformity with this proposal, Sections 3.2.3 and 3.2.4 highlight where flow measurement is needed in order to secure the basis for operating under 24-7 supply conditions.

3.2.3 Restructuring the distribution network

As has already been stated in Guidance Note 1, most -- in many cases, all -- pipelines comprising an urban distribution system are totally interlinked with each other (Figure 3.1). This means that water pumped into the system at any point affects the dynamic balance of the entire network to a greater or lesser extent. As water enters the network at a number of points and is consumed with an irregular pattern, the direction and volume of the flow of water at any point in the system are virtually unpredictable. Reservoirs and pumping stations may interrupt the totality of this interlinking but are not intentionally placed on the system to isolate one section from another. Clearly, this high degree of interlinking throughout a network renders management of a water distribution system virtually impossible.

Even where the distribution system was originally designed as a combination of separate networks, possibly each linked to its own service reservoir, additional mains have often been laid to link the networks when water resources to one part of the city have been needed to supplement the supply to other parts. Plans and records of these links are frequently mislaid and no coherent plan of the system remains.

In some cities, transmission pipelines – the sole purpose of which should be to transmit bulk water to OZs for distribution – are themselves used as part of the distribution network. Unwisely, water distribution engineers submit to external pressures to connect areas rapidly to the distribution system and can only satisfy the demand by off-takes direct from the transmission mains passing in the vicinity of the area in question. What started as a one-off action rapidly becomes the norm and any residual control remaining over the system is lost.

In essence, water distribution system conditions found in the majority of cities and towns throughout India, particularly where there is a total lack of flow meters on the system, are unmanageable. When water is fed into a transmission system or network, there is only an imprecise understanding of the areas that will be served by that water. No calculation can be undertaken to determine its distribution, and only the experience of operational
personnel provides any idea of where it goes and how much ends up where. Most operators know approximately, none know with any precision.

Figure 3.1: Typical Urban Water Supply System, South Asia: Entire System Interlinked

Any water utility operating under these conditions, and wishing to regain control of its water service, will need to restructure its bulk transmission pipelines and distribution networks (Figure 3.2). The process is too site-specific to enter into the detailed restructuring process. However, the objectives will be common and, working progressively upstream from the customer end, are the following:

- The local distribution pipelines to be used solely for the purpose of delivering water to customers and not for transmitting water in bulk to other areas;
- The local distribution pipelines to be divided into a number DMAs. A DMA contains a set of local distribution pipelines – a local network – that supplies a limited number of properties. The DMA’s network is isolated from the networks of all other DMAs on its boundary, with the exception of a limited number -- preferably just one -- of supply points to the DMA. The water fed to the DMA through each point of supply is continuously metered. How this isolation is achieved, the purpose and advantages of the division of the networks into DMAs and the component parts of a DMA are described in the next section;
- A number of DMAs are grouped for their day-to-day management into OZs. The boundaries of the OZs may be chosen on the basis of existing or proposed service reservoirs, main or booster pumping stations, pressure zones or other operational considerations. The water delivered to each OZ and exported from the OZ through cross-boundary pipelines between OZs - should be continuously metered; and
All OZs are fed by transmission pipelines whose sole purpose is to transmit water in bulk from treatment plants, bulk storage reservoirs and wellheads to the point of entry to the OZs. Ideally, all off-takes from transmission pipelines, other than those delivering to an OZ, should be removed. However, if supply direct to a network is unavoidable, the flow passing through the off-take must be continuously metered.

The overall objective of the restructuring process – regaining management and operational control of the network – will now be achievable as:

- Pipelines constituting the system will all have their own allocated individual and single purpose and specific duties;
- Water entering and leaving any operational unit will be metered for both flow and pressure, so what water goes where and can reach where will be known;
- Each operational unit, transmission unit and individual OZ will know what volume of water it is either transmitting or receiving, and what pressure;
- The transmission operational unit will know how much water it is losing through leakage on each of its pipelines, and by installation of intermediate metering points will be able to detect points of leakage and repair them;
- Each OZ management unit will know how much water it is receiving and, as described in the next section, will know how much water it is losing through leakage in each of its DMAs. It will therefore be able to detect, locate and repair points of leakage as well as to identify points of unauthorized use and legitimate them; and
By having control over system flows and pressures, leakage and unauthorized use, the water utility will have regained control over its system in all its parts and be in a position to practice supply and demand management, two activities considered by all efficient and effective water utilities throughout the world as essential.

A restructuring process, with these objectives, must be undertaken by water engineers having specific experience in the restructuring of water supply transmission and distribution systems related to the provision of continuous supply. Restructuring will involve the following main activities:

- Collection of the data and production of the plans and records described in Section 3.2.1 and Annexes 1A and 1B;
- Determination of present and future water demand, initially within each ward and existing OZ;
- Identification of all point sources of bulk water and determination of the potential production of each of the sources;
- Construction of a hydraulic model of the complete existing transmission and distribution systems;
- Rationalization of the boundaries of the OZs consistent with good hydraulic practice;
- Within each OZ, determination of rational boundaries for its constituent DMAs (the basis for recommending an appropriate size of DMA is provided in the Section 3.2.4);
- Determination of the present and future water demand of each DMA and the new OZs;
- Identification of those pipelines to be restricted in the future to respectively serve three purposes: bulk transmission from source to the OZs, distribution of water within the OZ to the individual DMAs, and distribution within the DMAs;
- Application of a hydraulic model to determine, according to demands of OZs and their respective DMAs, the need—now or in the future—for additional bulk storage and local reservoirs, bulk supply and online booster pumping stations, transmission pipelines, air valves and isolating valves, flow meters, secondary distribution pipelines and local networks;
- If necessary, retention or installation of transmission links between bulk water sources and transmission pipelines. However, these links should be closed off by valves except for emergencies when it is necessary to temporarily supplement a shortfall in one area by excess in another. Wherever such a link is installed, meters must be installed to measure the flow of water transmitted from one area to another; and
- Commissioning of work needed to restructure the system after having optimized the restructuring needs to satisfy demand, and continuous supply can be progressively achieved as work progresses.

The amount of work needed will vary considerably between urban areas and is impossible to quantify. Some systems will require very little restructuring to achieve the stated objectives, others will require considerable work on rehabilitation, repair and provision of new infrastructure.
3.2.4 Formation of DMAs

In a well-managed, restructured water distribution system, the DMA is the basic management unit. It is also the fundamental building block for conversion from intermittent to 24-7 supply. The constituent elements of a DMA are shown in Figure 3.3.

Each DMA is a hydraulically discrete portion of the network, isolated from neighboring DMAs by a system of boundary valves and preferably fed with water from a single point on its boundary. A meter chamber is built at the inlet to the DMA and flow into the area is continuously metered as is pressure. A pressure control valve is installed. If necessary, more than one point of supply to a DMA is possible but each point of supply must be metered at the DMA boundary and, with each additional point of supply, it becomes more difficult to manage the DMA.

Figure 3.3: Basic Ingredients to Achieve 24-7 Supply in a DMA

A number of factors are used to decide upon the number of DMAs needed to create a manageable network, the definition of their individual areas and boundaries. Having mapped the existing networks and developed a hydraulic model, factors that affect the choice are as follows:

- DMA boundaries should be dictated by the hydraulic needs of the network, existing and extended, rather than administrative district boundaries;
- Attempt should be made, when defining DMA boundaries, to minimize the number of cross-boundary pipelines – first to minimize the number of boundary valves but also to minimize the number of areas that will be cut off from their

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- Attempt should be made, when defining DMA boundaries, to minimize the number of cross-boundary pipelines – first to minimize the number of boundary valves but also to minimize the number of areas that will be cut off from their
supply and require investment in pipelines to free water to them from elsewhere in the system;

- There should be a maximum number of properties within any one DMA, even though individual DMAs may vary considerably in size. The smaller the number of properties served, the more effective can the management of leakage and unauthorized use be. In the UK, under a strict regulatory regime, the private water companies of England and Wales have divided the urban developments in their service areas into small DMAs, varying from just a few 100 properties up to about 1,000, the average size being about 350 to 400 properties. However, it is unlikely that such small DMAs would be appropriate to the more dense developments found in Indian urban areas. Although there is no hard and fast rule for deciding upon the numbers of properties in a DMA best suited to national conditions, initial experience has suggested that DMAs with between 1,500 and 3,000 properties would perhaps be appropriate; and

- The length of pipes and the size of a DMA can be determined by the need to maintain a maximum pressure drop across the area. Water is often fed into a DMA from a single point on its boundary, however, there is a need to maintain a minimum system pressure at the furthest property from the point of feed. The pressure drop between the two extreme points should be kept to about 5 m, as the higher the system pressure needed, the greater will be the leakage from any break in the pipe wall or at joints.

Guidance Note 4, Section 4.6, deals with the usefulness of initially using a relatively small pilot area of one or two DMAs to instill confidence in the 24-7 supply conversion process and to assist in reducing project risk. Other factors considered in making a choice of the pilot DMAs are listed there.

The principal elements that constitute a DMA are:

- Elements to establish the DMA itself:
  - identification of an area of the distribution network that can be rendered a discrete, “watertight” area, a DMA, isolated from all other DMAs by valves on cross-border pipelines without creating border areas that cannot be served with water;
  - a very limited number of points of supply, preferably only one;
  - a chamber constructed on every point of feed to the DMA, where it crosses the DMA’s boundary, to house an online magnetic flow meter and a pressure meter. Both flow and pressure to be measured continuously and recorded in a readily usable form;
  - maximum system pressure within the DMA to be regulated by the installation of an automatic pressure control valve, preferably flow-modulated, on the outlet pipe; and
  - system pressure within the DMA to be routinely measured at a number of points, that is:
    - at the points on the boundary where water flows into the DMA are also measured;
at the points in the DMA on the system known to suffer the lowest pressures; and
at the point on the network calculated to experience the average system pressure within the DMA.

Elements to upgrade the customer connection and close off any “open pipe” situations:

- saddle connections between the distribution main and the property and connection pipes in a poor state of repair and leaking badly should be replaced, particularly those connections constructed from galvanized-iron pipes;
- customer meters should be replaced (this action is explained in Section 3.3.2); and
- it should be ensured that the pipe from the meter into the customer’s property ends either in a tap or a storage tank, the flow into which is controlled by a float valve.

Annex 1C lists the principal actions to be taken when establishing DMAs.

The work entailed in establishing the DMAs, restructuring and rehabilitating the networks and replacement of customer connections should be undertaken with minimum disruption to the water supply to all customers. It is important to take care with this in order to foster a positive feeling in the populace about the project. Once a negative impression is created through too much disruption, it will be difficult to obtain the cooperation of the local population, and this will be needed when the 24-7 supply is commenced, particularly with respect to controlling water demand and acceptance of eventual higher water charges for a better service.

Once established, the DMA provides full operational control to the water utility for the first time as the water input to the DMA and usage within the zone is known and the difference between the two is the volume of NRW.

3.2.5 Leakage reduction and continuity of supply

In theory, assuming that the transmission system has been restructured to deliver water continuously to the OZ, it should now be possible to introduce 24-7 supply to the DMA. However, in most cases, this would result in very high losses through leakage and it would probably be unsustainable.

Where leakage may reach intolerable levels, there is therefore a need to reduce it. Leakage from within the DMA should thus be brought down to an “economically-justifiable level” through a mix of measures which include:

- Management of system pressure (this is covered in greater detail in Section 3.2.7);
- Repair of the hidden back-log of pipe bursts (where active leakage detection, location and repair activity has not been routinely practiced, all networks will have accumulated many small leaks that have not been visible at the ground surface);
- Replacement and rehabilitation of the worst parts of the distribution network (prioritization for replacement may be based upon the experience of the
operational staff or derived from leakage detection exercises using continuous supply for short periods); and

- Replacement of property connections.

An economically-justifiable level of leakage is arrived at when the cost of reducing leakage by one m³ costs more than the value that can be placed on the water that would otherwise be lost.

An appropriate economic mix of these options can be derived through the use of modern leakage management software.

All modern leakage detection equipment still relies upon the ability to detect the “noise” made by a hidden leak of water. Although leak noise can be detected using the human ear and a simple listening device, this is not particularly effective. Modern equipment uses electronic devices not only to “hear” small leaks but also to pinpoint their location accurately. In order to have a leak making “noise” for sufficient time to detect it, there is a need for continuous supply. By undertaking the system restructuring process and establishing the DMAs, the utility will have placed itself in the position to implement 24-7 supply, and therefore routinely detect leaks. This is virtually impossible in an intermittent supply situation. However, while undergoing the transition period, it is essential to minimize continuity of supply only to the needs of leakage detection, to avoid unsustainable levels of water loss.

However, once the leakage has been reduced to an intermediate but sustainable level, if not yet at economic level, the DMA is now ready for continuously-pressurized, 24-7 operation.

Although lower service reservoir capacity is needed in a continuous supply situation than for intermittent supply, there may be a need for additional reservoirs to ensure an equitable supply to all zones and DMAs.

In cases where the system is fed by pumping stations, rather than from service reservoirs, the pumps may need to be modified for 24-7 supply as supply should match the demand pattern. This may necessitate the introduction of variable speed motors or the provision of pumps with a range of pumping capacities.

### 3.2.6 Customer connections and leakage

It is an internationally-recognized norm, well-researched, that between 60 and 70 percent of the loss of water through leakage takes place at the customer connection, either from broken joints between the main and the connection pipe or from the connection pipe itself. It is, therefore, extremely important to consider replacing all connections in a poor state of repair.

Linked to this point on the quality of customer connections and leakage is another. At least one instance is known where the water board of a major city requires customers to arrange and pay for their own connections. Although the customer must use only contractors approved by the utility, the scope for abuse of the system is obvious:
connection construction of poor quality, connections to the invert of the main not the soffit, etc.

Given the high proportion of leakage known to occur from this point on the system, even where the connection has been constructed competently, this practice should cease and the utility should be responsible for making all connections.

3.2.7 Controlling system pressure

Controlling pressure is one of the fundamental requirements of efficient and effective management of distribution systems operating under 24-7 supply.

System pressure can be a double-edged sword if left uncontrolled – both beneficial and damaging, sometimes at one and the same time. Pressure is necessary to provide a continuous supply of water to the customers and permits routine effective leakage detection and reduction. However, maintaining a greater pressure than is needed to satisfy service performance requirements, for example, a minimum pressure at any property connection in a DMA, will have adverse effects, that is:

- **Increased leakage**: leakage from most systems is now known to be approximately proportional to pressure, that is, a system usually operated at an average pressure of 10 m would lose twice as much water if pressure is not controlled, and rises to 20 m. The actual relationship for a particular leakage and pressure depends upon the proportions of rigid and flexible pipe materials used and the number of breaks at joints. The greater the proportion of flexible pipes and broken joints, the greater the rate of leakage for a given pressure;
- **Increased frequency of bursts**: recent international research has shown that the frequency with which pipe bursts are experienced in a network rises approximately in proportion to the cube of the pressure change. Thus, doubling the pressure from 10 to 20 m would result in eight times the bursts that would have been experienced at the lower pressure; and
- **Uncontrolled pressure rise due to pipe replacement**: pressure in a distribution system usually rises when pipelines which are leaking are replaced. It follows that if pipes are replaced without controlling pressure, it will create new bursts, negating all or a part of the benefit that would have been derived from the investment.

In addition, it is worth noting that, even with modern leak detection technology, there are always high proportions that are too small to be detected but which, nevertheless, over a long period of time, lead to great loss of water. Controlling pressure is the only way to control the volume of water from such breaks.

Thus, every 24-7 supply project should incorporate pressure management systems – pressure measurement, monitoring and pressure control valves – at key points in the system. It is recommended that a pressure control valve be installed in the metering chamber at the point of feed of water to each DMA. This is an important device to protect the sustainability of continuous supply. It ensures that pressure in the distribution network within the DMA never rises above a pre-set value, which is just enough to
maintain the minimum working pressure at the point of lowest pressure within the DMA. If system pressure is permitted just once – and for a very short period – to rise above this value, a series of new bursts will be generated.

The choice of pressure control valve appropriate to any given set of conditions is a highly skilled activity and should be left to specialists with a broad experience of the different sizes, types and specifications of valves available.

3.2.8 Accurate measurement of customer use

It is important for the efficiency of management and for the financial sustainability of a water utility that customer usage of water is accurately measured. Not only is income measured but it is an essential component in the calculation of NRW, that is, the volume of water represented by the difference in value of the volume of water produced or purchased by a water utility and measured customer usage, the latter being the basis of water from which revenue is derived.

Under intermittent supply conditions, all customer meters, except one available in the market, are incapable of measuring water usage with any dependability whatsoever. The main reasons for this inability to measure usage accurately under intermittent supply are:

- Meter readings reflect the passage of air past the mechanism, in both directions, as well as that of water. However, there is absolutely no certainty that the movement of air measured in one direction as the distribution system empties is compensated by measured movement of air in the opposite direction as the system fills;
- When meters run “dry,” as the distribution system empties down and fills, the bearings of the meter mechanism “burn out” very quickly; and
- There is a tendency for the mechanisms to become blocked by particles of grit that frequently enter the system through breaks in pipes and joints under intermittent supply conditions.

The functioning of the meters could be protected by the inclusion of strainers to prevent grit causing damage but the two other deficiencies would remain and are virtually impossible to overcome.

The single exception to the deficiencies of these meters when working under intermittent supply conditions is a meter which has no moving parts, based as it is on electromagnetic measurement principles. The meter tends to be more than double the price of normal Class 3 meters.

Normal Class 3 displacement meters for measuring customer usage have been designed to function properly, and with acceptable accuracy, under continuous, 24-7 supply conditions. This is because:

- The customer connection pipes – like the rest of the distribution system – are full of water and so there is never an opportunity for readings to be interfered with by the passage of air.
The bearings of the mechanisms are always kept submerged, friction is lower than when they are forced to run in dry conditions and, therefore, the bearings last longer and the meter maintains an acceptable range of accuracy for between seven and 10 years; and Grit is prevented from entering the pipelines through breaks in pipes and joints due to the positive pressure maintained throughout the system and, therefore, there is a much reduced tendency for passages in the meter and their mechanisms to be blocked.

However, meters used under intermittent supply situations will rarely function accurately after conversion to continuous supply due to damage sustained in the course of their functioning under intermittent supply. A new meter is generally found to pay for itself in a matter of three to six months and therefore, it is a cost-effective exercise to change all meters in a DMA once it has been converted to 24-7 supply.

It has been noted that some water utilities expect customers to purchase and install their own meters. The reason given for this is that it has less impact on the cash flow of the utility. This reasoning is extremely short-sighted as, even if customers purchase meters of a given standard, it is another practice that is wide open to abuse. Water utilities should recognize that an accurate measurement of usage is essential to demand management and the financial viability of the organization and that accuracy of measurement of this vital operational parameter should not be left to the customer to obtain.

### 3.2.9 Low per capita water availability and 24-7 supply

In Guidance Note 1, Section 1.8, the question was addressed – Do we have enough bulk water resources to provide a 24-7 service? It was noted that, although there are examples of urban areas having per capita daily water availability of less than 50 l with a 24-7 service, it becomes increasingly difficult to maintain one below that value.

Per capita water availability of less than 50 l per day would usually occur only in extremely dry locations, such as some desert areas. Most urban centers develop where there are adequate water supplies, drinking water availability being one of the main factors limiting urban growth.

However, low per capita availability does not necessarily mean that a 24-7 service is necessarily impossible. If considered, care will be needed in preparing for it and subsequent management and operation of the distribution system. It is not within the scope of this Guidance Note to enter into detailed design or discussion of operational practices. However, under such circumstances, particular attention will need to be given to:

- Restructuring the distribution system into DMAs having smaller numbers of connections than might otherwise be adopted, for example, 250 to 500 properties per DMA, rather than the maximum of 2,500 properties per DMA that might be possible in areas with higher per capita water availability. This will enable leaks to be identified and located more quickly and may even allow detection of taps left running once the normal supply pattern to an area becomes known;
• Reducing system pressure such that supply only to the ground floor of dwellings is guaranteed or, at least, not beyond the typical height of a first floor in the area;
• Informing the general public how to conserve water even though water is available constantly. Such information campaigns, focusing on issues such as never to leave taps running wastefully, to mend leaking taps, never to use a hosepipe for irrigation, purchase of toilet cisterns and household appliances that use less water, etc., should be commenced well in advance of implementation of 24-7 supply and repeated annually at periods of least water availability;
• Ensuring, through tiered tariffs, that only the initial block of water used each month should be charged at a low level and use above this amount should be charged at high rates to discourage use;
• Offering a free service for repairing leaking taps and pipes; and
• Reducing the supply to individual properties where, notwithstanding efforts to limit it, system pressure is high on the networks, by inserting small diameter orifice plates into the pipes connecting the mains to the properties concerned.

Under conditions of extreme water scarcity, city councils and their utilities should draft a set of outline specifications for household appliances to ensure that only certain advanced types of water-conserving devices are used.

At all stages in the preparation for the 24-7 supply conversion project, the general public should be kept informed as to why the water conservation measures are being adopted and their importance to the success of the conversion process. In this respect, where water sources are scarce, two other matters should be given consideration:

• **Rainwater harvesting:** this refers to the capture of rainwater draining from the roofs and impermeable areas by infiltration into permeable soil beneath individual properties, increasing groundwater and improving the possibility that it may be withdrawn and used by households at times of scarcity. Rainwater harvesting at the domestic level does not increase local water resources significantly and can make only a very small contribution to satisfying water demand. However, it instills in the population a sense of the scarcity of water and, to this end, assists in the promotion and practice of water conservation when used domestically, and

• **Water recycling:** the reuse of “grey water,” domestically-generated wastewater from washing, bathing and kitchens, may be recycled for use in toilet flushing and watering gardens and vegetable patches. “Grey water” should be passed through purpose-designed, household treatment units before recycling. Although expensive and fraught with operational problems, domestic water recycling might be promoted in areas of extreme water scarcity. For “greenfield” site developments, it might prove economically justifiable to install communal twin sewer systems, one for “grey water” and the other for sewage, so that the former can be treated at a communal treatment plant and recycled to households through a dual water supply system, one for potable water and the other for recycled water.

Before embarking on communal schemes of recycling, the costs – and risks to the public - need to be very carefully analyzed. Water recycling has proved an expensive option in
the few places that it has been practiced and is more often than not abandoned after a short period. Great care has to be taken to ensure that the dual pipes are clearly marked ‘potable’ and ‘non-potable’ and that the latter system cannot be readily accessed by an unsuspecting public, particularly children, and used for drinking or cooking. Usually, secondary quality, recycled water would need to be color labeled, with non-toxic dye to make it visually unattractive as a source of drinking water.

3.2.10 Effect of 24-7 supply on sewerage

As noted in Guidance Note 1, Section 1.8, wastage and leakage can be significantly reduced under continuous supply conditions and the water saved converted to water used by customers. Therefore, even where no more water has to be produced to satisfy demand, overall per capita usage of water will inevitably rise under 24-7 supply conditions.

In turn, increased water use will result in generation of larger quantities of wastewater. Under most conditions, it is probable that whatever system was used to deal with household wastewater – whether individual onsite facilities, such as septic tanks or cesspits or sewerage networks – will prove capable of handling the increased volumes of water used under 24-7 supply conditions.

However, in some circumstances, the capacity of the wastewater system to deal with increased wastewater volumes may be exceeded leading to unsanitary conditions.

As with other technical problems associated with the conversion process, the capacity of existing systems to cope with increased wastewater generation will be highly site-specific and dealt with as such. The purpose of this section is to raise awareness of a potential problem.

Guidance Note 4, Section 4.5, deals with a strategic conversion project option involving initial pilot area conversion and operation. It is a spin-off benefit of a pilot approach that it will assist in determining whether coping with increased wastewater is likely to prove a problem in the urban area concerned. Possible susceptibility of an area to such problems, for example, high groundwater levels, low soil permeability and densely populated areas, should be one of the criteria used to determine the choice of the pilot area.

Clearly, were this to be a widespread problem for a particular urban area and a sewer system were needed where none exists due to the conversion to 24-7 supply, this could add significantly to the costs of conversion, reduce affordability of the project and thereby lead to a longer implementation period.

3.3 Commercial

For most ULBs, the conversion to 24-7 will require more sophisticated commercial systems and procedures, and much more discipline in the application of those procedures. It is an opportunity for a fresh start.

3.3.1 Building a new relationship with customers
Continuous supply is likely to result in significant changes in the way the customer interacts with the utility. Customers may be unused to being metered; billing and payment arrangements may be changed and expectations with respect to payment discipline will be different. Some high volume users may face higher bills while others will have lower bills.

The utility will need to develop a communication strategy to build public awareness of these changes. Leafleting, media campaigns, public forums, stakeholder forums and, if necessary, home visits, may all have a part to play in getting the messages across.

The 24-7 conversion process is only the start of a much longer relationship with the customer. The reader is referred to the discussion in Guidance Note 2, on how an organization can become more customer-oriented.

3.3.2 Customer metering
The advantages of customer metering have been discussed in preceding sections. Metering provides an equitable basis for charging, enables more effective control of NRW, and provides a basis for balancing supply and demand. In all but a handful of cases, a utility converting to 24-7 supply is likely to choose universal metering.

Having determined that metering is required, decisions have then to be made as to the type of meters, the location of meters, and their maintenance. These issues are discussed below:

Prepayment versus conventional metering: Prepayment meters allow the customer to purchase water in advance using electronic tokens which work in a very similar way to telephone cards. Prepayment meters are more expensive than conventional meters but have several advantages:
- from the utility’s perspective, they eliminate customer debt, reduce fraud risk, lower the costs of meter reading and billing, and generate advance cash flows;
- they can be effective ways of delivering lifeline quantities of water to customers. For example, in Johannesburg, South Africa, prepayment meters are used to provide residents of Soweto with 6 m3 free water per month; and
- some customers may prefer prepayment meters because they make household budgeting easier and prevent them from getting into debt.

Choosing a meter: The choice of the customer meter is a critical decision for a utility. Selection should never be on cost grounds alone. Other factors to consider include:
- **meter technology**: the most common type is mechanical (either inferential (turbine) or positive displacement (piston)). The alternative is electromechanical, but these are usually much more expensive;
- **meter quality**: the wide variation in meter prices is often associated with different levels of quality control and standards of workmanship;
- **water quality**: high levels of suspended solids and dissolved solids can impair the serviceability of mechanical meters;
- **meter environment**: the meters must be robust enough for the environment in which they will be used. The purchaser needs to consider the effect of temperature extremes (for example, very high ambient temperatures or the possibility of freezing), high salinity environments, and also exposure to physical wear and tear;
- **meter reading process**: will the meters be read manually, or will they be read using AMR systems? AMR systems ensure accurate data transfer and can reduce fraud but can be expensive;
- **meter theft**: electromechanical meters have components which may be attractive to thieves. For example, some mechanical meters contain brass which could be melted down and sold;
- **tamper-proofing and vandalism**: how easy is it for customers to tamper with, vandalize, or bypass the meter? Can the meters be fitted with tamper-evident seals or similar devices?
- **servicing**: how easy is it to service or replace the meters?
- **procurement strategy**: over-reliance on a single supplier of meters could leave a utility exposed, for instance, if there are future problems with meter reliability. Depending on its size, a utility may consider using multiple suppliers, or several different types of meter.

**Where to locate the meter**: the main options available for residential houses are:

- **external underground**: this is likely to be the most expensive solution. Meters are located in boundary boxes, which are usually located in the street at the perimeter of the property. Access for meter reading is good, and the boundary boxes provide some protection against theft and vandalism;
- **external above ground**: meters are located above ground at the boundary of the property. There is good access for meter reading but the meters are not protected from theft and vandalism; and
- **internal**: meters are located inside the property upstream of the first tap. Access for meter reading is dependent on customers being at home and willing to provide access. Another consequence of installing meters inside the home is that the utility will inevitably carry the costs of any leakage in the customers supply pipe upstream of the meter. There may be difficult legal and practical complications associated with the maintenance and replacement of the customer’s supply pipe.

There are particular issues with metering apartment blocks, and it may be necessary to seek legal advice before determining a policy. The main options are:

**One meter installed per apartment block**: The owner of the freehold of the apartment block is responsible for paying the bill, and recovers the costs of the service from the tenants/leaseholders. While this may be the simplest arrangement from the utility’s perspective, it can be harsh on the tenants when the owner does not pay, and the entire apartment block is disconnected.

**One meter per apartment**: Each tenant or leaseholder has a meter. Usually the meter is located outside the apartment. Sometimes meters for all apartments are located centrally. This may be the fairest approach from the customer’s perspective. Difficulties can arise if
the internal plumbing of the apartment block is in poor condition. The owner of the block may be legally responsible for maintaining the internal plumbing, but it will be the utility that carries the financial cost of any leakage upstream of the customer meters.

**Maintaining meter stock:** Meters should be routinely inspected, recalibrated, rehabilitated or replaced. The utility needs to establish systems for planned maintenance and replacement of meters, for identifying and reporting broken meters, and for flagging unusual meter readings which might indicate that there are problems with the meter. The utility can recover the costs of checking and replacement either through its day-to-day tariff, or through a meter rental charge.

### 3.3.3 Billing

**Selecting a billing system:** Most municipalities and utilities transferring to 24-7 will already have an established billing system. The existing system should be reviewed to confirm that it has the necessary functionality to support a metered 24-7 operation. The introduction of 24-7 may provide a good opportunity to update the system. There is a very wide variety of systems available on the market. High-end systems which are integrated with other software (for instance, with finance, operations, human resources, customer services) can be very expensive and are only likely to be cost-effective for larger utilities;

**Establishing a reliable customer database:** Inaccurate billing data is often a major cause of lost revenue. Inaccuracies arise from illegal connections, inaccurate customer information, and omissions from the system. During the process of conversion to 24-7 supply, a full physical survey of the service area should be undertaken. The customer register can be further validated by cross-checking with the customer databases of electricity or gas utilities; and

**Meter reading:** The frequency of meter reading may be monthly, quarterly, six-monthly or annually. It is likely that high volume industrial meters will be read more frequently than domestic meters. It is not necessarily the case that the meter reading frequency must be the same as the billing frequency, as interim bills can be based on estimated volumes.

Systems and checks will need to be established to address the potential for collusion between meter readers and customers. For example, meter readers can be rotated and periodic meter reading audits can be undertaken.

Internationally, some utilities have introduced doorstep billing where the meter is read and the bill is issued in a single visit. The advantage of this approach is that the process of issuing and delivering the bill is made quicker and more reliable, and many billing errors can be identified and resolved on site.

### 3.3.4 Instilling a culture of payment

This is the ultimate challenge for a utility. Many of the aspects of good commercial practice have been discussed in Guidance 2. In summary, the utility should develop:
• Accurate and timely billing using computerized billing systems, and reliable bill distribution;
• Sound commercial practices including controls to identify and root out fraud;
• Customer-friendly payment arrangements (frequency, payment methods), and mechanisms through which billing errors can be identified and resolved;
• Provisions in the tariff structure for fines, penalties and incentives to encourage good customer behavior;
• A supportive legal environment which provides powers to enforce payment (for example, through disconnection, fines, etc.);
• Procedures for managing customers facing genuine hardship;
• A willingness to disconnect (followed by rapid reconnection when payment is received); and
• A willingness to follow up on customers who may try to reconnect themselves illegally.

3.3.5 Fraud and corruption
Without adequate checks and controls, fraud and corruption can take place at virtually every stage in the billing and payment process. Fraud can be perpetuated by consumers (for instance, by tampering with or bypassing meters), by meter readers (for example, by colluding with customers to record false meter readings), by commercial staff (for instance, by embezzlement of customer payments), and by operations and management staff (for instance, by taking bribes to ensure that enforcement proceedings are not pursued). The utility will need to develop systems and procedures that limit the opportunities for fraud, and that expose fraud where and when it occurs. Some of the measures that can be taken to address fraud are discussed in Guidance Note section 22.5.2.
Guidance Note 4: Planning and Implementing Conversion to 24-7 Supply
Guidance Note 4: Planning and Implementing Conversion to 24-7 Supply

4.1 Government Support and Commitment for 24-7 Supply

It is virtually impossible for a water service organization to both provide an intermittent supply and to operate efficiently – the two are incompatible. Another major factor which compounds the problems facing water service providers throughout the country is that few have a set of charges formulated on the basis of full cost recovery or recognize that volumetric charges cannot be applied with any confidence under intermittent supply conditions. Water charges are, almost universally, extremely low throughout the country in international terms, even when relative costs of living are taken into account. It will be virtually impossible to convert from intermittent to continuous supply in a sustainable fashion without some capital investment, major improvements in the efficiency of operations and increases in water charges.

Conversion of a water supply service from intermittent to continuous supply will, therefore, generally require a radical restructuring of the water service provider, its infrastructure, operations and charging policies.

Such radical change can only proceed with the approval of the local governing council, or whichever level of government is responsible for water service provision. The conversion process will only succeed with the strong commitment of government throughout the conversion process and subsequently as there are often local interests – particularly commercial – keen on maintaining the status quo of intermittent supply. It is therefore essential to carefully:

- Prepare the arguments for and against conversion to 24-7 supply, backed by data and costs;
- Prepare the materials needed to present the pros and cons; and
- Conduct an information campaign aimed at, and tailored to, all classes of stakeholders.

All stakeholders will need to be assured that:

- Continuous supply is practical and affordable and that it can be made sustainable;
- Increases in water charges will be accompanied by significant improvements to the water service that will be appreciated by their constituents; and
- There are readily demonstrable benefits arising out of a continuous supply.

The terms of office for government vary between four and five years. Understandably, governments prefer to adopt policies and projects that result in tangible improvements within their term of office. Unfortunately, it is difficult to plan, design, implement and complete a 24-7 supply conversion project within the time-span of a single term of office. It would, therefore, be prudent for those involved in planning a 24-7 supply conversion process to consider how significant advances can be made within short timeframes.
This latter point is an important one. Even though, for a particular situation, it may not be considered essential on technical grounds, it will often be beneficial to first introduce 24-7 supply into a relatively small pilot area. A pilot area, encompassing perhaps 2,500 to 5,000 connections, can usually be established, and operation of 24-7 supply introduced, in a relatively short period, between six and 12 months. This approach has the following merits:

- Residents of the pilot will immediately experience a major improvement in their water supply and quality of life, and any “threat” to return to intermittent supply would, without any doubt, meet with strong and vociferous resistance; and
- Although water charges should be increased in areas benefiting from an improved water supply service, a carefully executed information campaign should be able to demonstrate that overall costs to households will be no higher or lower than they were previously.

This pilot area approach to “kick-start” a conversion process will assist in enlisting support for the conversion to continuous supply as:

- The risk to government of approving a pilot approach will be much smaller than deciding to proceed immediately for a project covering the entire city or town; and
- Success with the pilot area will give government the confidence to approve the full-scale project, since its feasibility has been proved in the small-scale.

Towns and cities that introduce continuous supply will be able to use higher quality water services as a selling point to sources of inward investment, particularly to international investors. These latter generally seek good living conditions for their managers and are wary of poor publicity that could be generated, were they seen to be investing in an area that did not look after the best interests of its population. The introduction of 24-7 supply will assist local and regional governments in their efforts to attract inward investment.

Local enterprises built on the business arising out of intermittent supply – principally private water vendors of all types, suppliers of small booster pumps and domestic water treatment devices – will almost certainly perceive 24-7 supply as a threat to their business and will generally be opposed its introduction, directly or indirectly. However, 24-7 supply offers alternative, related business opportunities and, if these are communicated to them, they may cease their resistance to the change. Once again, a pilot approach to conversion provides businesses with the chance to identify the new opportunities and to adjust their businesses to them.

4.2 National and Regional Government Support to 24-7 Supply Conversion Initiatives

The skills and operational experience needed to plan, design and implement conversion of an intermittent water supply system to continuous supply - and then to operate and maintain a 24-7 supply system efficiently and effectively – have been listed in Guidance Note 3, Section 3.1.1. A review of these will leave few in any doubt that, at this point in time, there is a lack of these skills and operational experience throughout the country.
However, it is true that in almost every water service entity in the country, there are engineers and administrators with the education and qualifications upon which required skills and experience can be built.

It is in the interest of national and regional governments that water services be converted from intermittent to continuous supply. The principal benefits accruing to national and regional economies, and the well-being of their populations, are significant:

- **Improved health**: far fewer incidences of waterborne disease and lower infant mortality rates will significantly reduce the cost of healthcare and the drain on resources of hospitals, clinics and local doctors;
- **Improved water service quality**: being the key to public acceptability of higher water charges opens the door to water service providers becoming financially self-sufficient, reducing the need for operational subsidies from government;
- **Operation under continuous supply** provides the conditions for radically improved efficiency and effectiveness of water service providers, in turn contributing to a reduced need for subsidies;
- Continuous supply permits service providers to routinely reduce leakage which, in many cases, will convert scarce, lost water resources into useful supply, thus reducing the need for investment in costly water resource acquisition projects (dams, long transmission pipelines, etc.) or at least, delaying the need for such investment;
- **Improved revenue** permits service providers to invest in extensions of their networks to serve the poor which, apart from raising their living standards, will make a significant contribution to achieving the MDGs for water supply;
- **Improved living conditions for women and children from poorer households** – released from the ties of coping with intermittent or non-existent water supplies – will permit them the choice to undertake gainful employment and education should they so decide; and
- **Improved conditions for inward investment**, particularly from developed countries whose investors compare relative living conditions and social infrastructure for their staff.

Given the significance of these benefits, it is in the interest of national and regional governments to empower local water service providers to undertake the process of conversion to continuous supply.

Most urban water service providers will wish to undertake as much of the conversion process in-house as they are able. However, to do this, due to lack of the necessary skills and experience, they will need support.

To make the best use of scarce trained and experienced personnel, it would be beneficial to establish a Continuous Water Supply Support Unit (CWSSU) at the level of regional government. The objectives of the CWSSUs would be to:

- Actively promote conversion from intermittent to continuous supply;
Advise local governments, and their water service providers, in all aspects and stages of the process of conversion from intermittent to continuous supply;

Manage “seed-corn” funding that will allow local governments to kick-start the conversion process, to monitor their progress and relate further funding to achievement of preset, milestone targets;

Assess the capabilities of water service providers wishing to introduce 24-7 supply and advise them on whether they should train or recruit staff or outsource some or all of the conversion process activities;

Provide training to the managers and staff of regional and local government water service providers that decide to initiate a 24-7 supply project and/or obtain “seed-corn” funding; and

Advise on modern management systems and technology that have the potential to achieve the operational efficiencies that should flow from the introduction of 24-7 supply.

Initially, it is possible that the professional staff and skilled technicians from the CWSSUs will themselves need specialized training. Such training can be sought nationally but, if unavailable, can be sourced internationally.

Central government should consider establishing an additional support unit to:

- Fund and support the establishment of regional CWSSUs;
- Advice on how they should be structured and managed;
- Update and expand upon these Guidance Notes in the light of experience gained; and
- Produce documentation relating to 24-7 conversion projects – technical notes, typical contract documents, etc. – that can be adapted and used by each regional CWSSU.

4.3 Project Champion

As described in the previous section, the benefits of conversion to continuous supply are often not fully perceived and understood by local government. As with any reform process that may create local winners and losers and short-term transaction costs, the process of conversion to continuous supply will benefit from the support and commitment of a strong, respected “champion.”

The “champion” may be a single individual who firmly believes in the need to convert to continuous supply. Although it might be advantageous for the individual to understand the technicalities of the conversion process, this is not essential if he/she is well-advised by persons and organizations that do. However, the champion should understand the process involved in conversion and its various stages. The champion will have perceived the benefits for the entire community in the long-term and will wish to drive the process through. Preferably, there would be one such “champion” in each stakeholder organization involved in the conversion program. However, this ideal is unlikely to be achieved and is not essential to success but the identification and official recognition of one project champion is often an important factor in making progress.
4.4 Implementation Options

One of the most important matters to be addressed at an early stage in planning the 24-7 supply conversion program is how the project will be implemented.

It is important to recognize that the mode of implementation to be adopted must be addressed early in the planning stage as the adopted approach will have important ramifications for the entire conversion process. Some options may only be possible if preceded by enabling legislation. If this proves to be the case, it will be necessary to determine legal constraints and take actions to counter these. Clearly, the earlier this is recognized, and appropriate actions taken, the less likely will delays to implementation be.

There are three major stages in the implementation process:

- Planning and design;
- 24-7 conversion; and
- Long-term operational stage.

The principal questions to be addressed with respect to each of these stages are:

- Does the water service provider have the necessary expertise, experience and resources in-house?
- If not, what are the perceived deficiencies and how may these be remedied?

The main options lie between:

- In-house implementation;
- Outsourced implementation; and
- Mixed in-house and outsourced implementation.

The details for each option are addressed later in this Guidance Note. However, some elaboration of the practicability of the three options and the respective main issues that they raise will be beneficial at this point.

4.4.1 In-house implementation

Many local governments and their water service providers will want to undertake as much of the 24-7 conversion process in-house. This is a valid option that should be carefully considered. However, before embarking upon this course, an objective assessment should be made of the in-house skills, experience and capabilities, as well as the availability of managers and staff to undertake the work entailed.

Section 3.1.1 of Guidance Note 3 sets out, in some detail, the technical and managerial skills needed to plan, design, implement, manage and operate a 24-7 supply service. It will be observed that considerable skill and experience are needed.

There is virtually no operational experience of continuous supply in the country today. Although many engineers and administrators in water service organizations will be aware of what is needed and, in some cases, will understand the theory of how these skills may
be applied to achieve the required objective, there are few, if any, with actual experience to back this.

Water service providers that embark upon the process of conversion to 24-7 supply by only using their own management and staff resources would be engaging a high level of risk. Arguably, in most situations, the level of risk would be such as to invite failure.

Even were there to be the necessary experience in the organization to plan, design and implement a conversion process, the management and staff of a water service organization providing an intermittent service are generally wholly occupied in water scheduling activity, crisis management and damage control. Diversion of existing managers and staff to the conversion process would almost certainly result in a further fall in the quality of service.

For water service providers presently lacking the capability and experience to undertake the 24-7 supply conversion process in-house – and not wishing to incur undue risk - there are four possible approaches:

- Provide training for their existing managers and staff using training institutions with the necessary knowledge and experience;
- Recruit managers and staff with the appropriate knowledge and experience;
- Temporarily employ, for the period of the conversion process, an organization with the necessary capability and experience; or
- A mix of these three approaches.

In all cases, it will be essential for this staff to be protected from being drawn into serving the needs of the existing intermittent supply service; the staff will almost certainly need to work within a unit dedicated solely to 24-7 supply conversion.

4.4.2 Outsourced implementation
Depending on the circumstances and on the basis of decisions arrived at in consultation with various stakeholders, a water service provider may decide to engage the services of appropriately experienced consultants, contractors and water service operators for implementing a 24-7 conversion program. The nature and amount of the outsourced work will depend upon:

- The degree to which the water service provider lacks the requisite skills and experience; and
- The acceptability to employees and other stakeholders of employing the private sector in water service provision.

An organization may consider that it needs assistance in planning and designing the 24-7 conversion program but that it has the capability to undertake the process and subsequent operation itself and from its own resources. Alternatively, it may consider that although it has most of the skills and resources needed to undertake conversion and operation, it would benefit from specialized assistance at all stages of the process.
On the other hand, the water service provider may wish to outsource the entire conversion process and, in some cases, may wish to have a specialized company operate the system for a sufficient period to prove its sustainability as a 24-7 supply service and to train its own in-house staff in 24-7 supply operation.

Some water service providers may wish to take the opportunity to upgrade other aspects of its service to ensure that they obtain the greatest benefit possible from continuous supply operation.

Third-party assistance and support to local governments and their water service entities can take many forms, dependent upon perceived needs, ranging through:

- Advisory – ad hoc or continuous throughout the process;
- Detailed planning, design and contract formulation;
- Implementation supervision;
- Construction – infrastructure upgrading, restructuring and extension;
- Specialist ad hoc operational support;
- Outsourcing of water service operations; and
- Packaging all aspects of conversion to 24-7 supply, including an option for long-term operation of the water supply service.

The greater the extent of third-party involvement, the more supervisory the role of local government and of the water service entity becomes – and even some aspects of supervision may be outsourced.

Use of third parties to undertake all or a portion of the conversion process and subsequent operations carries a cost with it. However, this cost must be balanced against:

- The risks entailed in undertaking the work in-house and the cost of failure; and
- The economies that can be expected by greater efficiency and effectiveness of employing experienced third-party companies to undertake the work – economies obtained by building performance targets into the contracts under which they are required to perform.

The greatest involvement of the private sector occurs when it is contracted to take full responsibility for the entire service for a period of time, with the public sector service provider taking on a supervisory role and, possibly, even a regulatory role.

The options by which the private sector is usually contracted to participate in water service provision, together with their respective applicability, advantages, disadvantages and risks, are described in Tables 4.1 to 4.4.

4.4.3 **Mixed in-house and outsourced implementation**

Other than options by means of which the entire water service provision role is outsourced to the private sector, it will be clear from the foregoing that the most common means of implementation will be one where the public sector service provider works with one or more experienced private sector companies to plan, design and undertake the conversion process and operate the continuous supply.
Even where a complete water supply service is outsourced, it is usual for the contracted private sector company to provide only the most senior managers and personnel needed to supply those specialist skills and experience not found in the public sector water service provider’s own organization. Under this form of outsourcing, managers and staff of the public sector service provider continue to undertake their former roles but under private sector management.

Experience has shown that the best results are obtained where the public sector service provider and the private company work together to achieve the objectives. This is best achieved in a non-confrontational contractual relationship.

4.5 Key Strategic Issues
In every project, there are specific strategic issues that are key to success. These key matters have to be identified and successfully addressed early in the planning process. Dependent upon their nature, they have the capacity to impede progress, and even halt it, if they are not addressed; or they can ensure that the project proceeds smoothly if acceptable solutions to them are adopted.

Key strategic issues vary according to local political, social and economic circumstances and the institutional status of the water service provider and its operational performance.

One of the first actions to be taken, with the involvement of the project champion, if there is one, when planning the 24-7 project is to analyze the project process objectively and to identify strategic issues that are likely to prove key to progress in the local context.

The following list is by no means exhaustive. However, it serves to give an indication of the type of issue that could prove key to progress and success.

**Project fundamentals:**
- Is all, or just a part, of the service area to be converted?
- Within what period should the conversion process be completed?
- Should conversion be tried first in one or more pilot areas to “flush out” problems with the process and better define costs?
- What technical and demographic criteria should be used to prioritize the conversion program?
- Does the water service provider have the technical data on its infrastructure and operations, as well as the customer data, needed to plan, design and implement the 24-7 conversion project? If not, how does it intend to rectify this and what timescale would be needed?
- What should be the policy regarding services to the poor?
- Should the project be confined to conversion to 24-7 supply or should the opportunity be taken to raise water service quality and performance, in general?

**Water service provider managers and staff:**
Are the managers and staff of the water service provider supportive of the 24-7 supply conversion project?
If not – or if there are “pockets of resistance” to the project – what needs to be done to convince managers and staff to come “on-side”?
What are the positive, and the negative, implications for employment and employment conditions of an upgraded water service? How will the benefits manifest themselves and the effects of the negative aspects be mitigated?

In-house or private sector implementation:
- Does the water service provider have the managers and staff with the capabilities, technology and experience to carry the project through unaided?
- If not,
  - what are the capability, technology and experience deficiencies?
  - should these deficiencies be rectified through recruitment and procurement to bolster the water service provider?
  - If not, what forms of private sector involvement would be appropriate and be considered?
- What political, institutional and customer issues might be generated by the involvement of the private sector in water service operations?

Legal:
- Are there any regional or local laws/regulations that would need to be drafted with respect to implementing the conversion project? If so, would the processes to draft and pass these place any constraints on progress?
- Are their legal impediments to providing connections to individual household units in unauthorized colonies and settlements?

Performance assessment and regulatory:
- Is there a sufficient understanding of the current operational status of water service provision to allow progress with improvements to be measured and assessed? If not, what data need to be gathered and what timescale is needed to establish the baseline?
- Is there sufficient independent regulatory provision to ensure that project objectives are being respected?
- If the private sector is to be used in operations, will the water service provider act as the contract supervisory body or should this be carried out by an independent third party?

Finance:
- What is the most prudent approach to enable recovery of the costs of a continuous supply water service, while addressing affordability issues for the poor? Is there broad agreement around these issues?
- Is external funding needed for the conversion project? If so, how much is needed, over what period and from what sources will it be sought?

Communications:
What are the key target groups of stakeholders: people’s representatives, NGOs, managers and staff of the water service provider, customers and SPSPs?

How should the project objectives and details be communicated to each of these groups?

Which organization – internal or external - is capable of managing and carrying through these communication exercises?

A list of these key matters should be drawn up in a formal document, and a process and timetable for addressing and resolving issues initiated with those concerned in promoting and influencing the project. Where an issue requires specialist knowledge, appropriately qualified professionals should advise on the choice between options.

4.6 24-7 Supply Conversion Strategy: “Big Bang” or Pilot Scale?

One of the most important project fundamentals listed in the foregoing section relates to the pace at which the 24-7 conversion program should move. Two main strategic approaches can be identified in this respect:

- "Big Bang" – in this approach, a decision is taken, right from the outset of the project planning process, to convert water supply from intermittency to continuity throughout the entire urban area even though the project may be undertaken in stages; and

- Initial Pilot Area Conversion – in this approach, a relatively small portion of the urban area, a maximum of 10,000 properties or 5 to 10 percent of the total, is selected for conversion to continuous supply before a decision is taken as to whether to proceed to undertake conversion of the entire area.

The selection and establishment of continuous supply in a pilot area followed by a period of operation would usually take between 18 and 36 months from identification of the pilot area. The pilot area approach therefore builds in a delay of between two and three-and-a-half years into a conversion program. However, pilot operation has a number of significant benefits:

- It provides a means of convincing skeptics – whether people’s representatives, administrators or the general public – that 24-7 supply is practical, achievable and affordable, while incurring only limited expenditure;

- Technical problems due to local conditions – state of the distribution system and household connections, ease or otherwise of establishing DMAs, effect on amount of wastewater generated and on sewerage/drainage – can be identified and assist with planning the complete project;

- Similarly, costs associated with the conversion process can be better assessed after the establishment of the pilot area; these can further assist in obtaining approval to proceed with the full project; and

- It provides time to gather project data, particularly relating to the existing distribution system.

In effect, a pilot-scale trial of conversion to 24-7 supply reduces project risk and can be highly effective in gaining support and approval for the process.
Guidance Note 3, sets out the principal hydraulic factors to be taken into account when choosing DMA numbers and boundaries. When undertaking a pilot area approach, one or two DMAs should be selected, first in accordance with those criteria and then by attempting to accommodate the following additional factors:

- If more than one DMA is created for the pilot work, it would be useful to choose areas that are representative of the entire urban areas network – both the materials used and its general state of repair;
- The area should contain a mix of household economic classes, preferably from the poorest to the wealthiest in the urban area concerned;
- Varying cultures, traditions and ways of life lead to a range of water use patterns and it would be useful for the households within the pilot DMA to represent the religious and ethnic mix of the urban area; and
- The range of housing types included in the DMA – single storey, two or three storey and multi-storey housing as well as commercial buildings -- should also be representative of the area.

Clearly, it will not always be possible to respect all of the above factors when choosing the DMAs for pilot area work. However, the more that can be accommodated, the more useful will the pilot work be.

4.7 Dedicated 24-7 Supply Conversion Unit

It will be clear, even from a cursory reading of these Guidance Notes, that the process of conversion from intermittent to continuous supply requires considerable effort and dedication. It is not a process that can be undertaken lightly.

Intermittent supply requires considerable manpower to schedule supplies and deal with “fire-fighting” the inevitable daily problems that continually arise due to emergency repairs and replacement of an ailing infrastructure. Most water service operations in India cover only a small proportion of their operational costs out of their revenue. Active managers and staff of the water service provider are therefore fully employed – and often over-stretched -- on routine duties and the funds do not exist to recruit additional staff.

However, given the conditions under which water service managers and staff must work, they do not have time to give to the difficult and onerous tasks involved in planning, managing and implementing a 24-7 supply conversion project.

Just as a “project champion” is highly beneficial for maintaining project momentum (see Section 4), so is it vital to establish a “24-7 Supply Conversion Unit,” to carry out the work of conversion. The Conversion Unit should work only on the 24-7 supply project. Clearly, improved performance should result in increased revenue and the results of the work of the dedicated unit should eventually become self-financing. However, an initial investment will be required.

Assuming that a decision is taken to establish the dedicated unit, the next step will be to decide upon the extent of its duties. Although there are many variations on each, there are probably three principal options for the nature of its role:
1. Implementation completely from in-house resources
The Conversion Unit will require full managerial and technical staff to complement the amount and nature of work commensurate with conversion of an intermittent water supply system to a continuous one. Due to the nature of the work that it is tackling, this unit should have a completely different approach to the operation of the water service from that of the current organization. The Unit will become the repository of modern approaches to water service management and operations, and ways should be considered to maximize the value to be drawn from this. As areas are converted to continuous supply, the operational personnel associated with those areas could – and probably should – be brought under the Unit’s management. It could be appropriate to consider whether the Unit should form the focus of a complete restructuring of the water service provider.

2. Implementation partly by in-house and partly by private sector resources
In this option, the Conversion Unit will only have staff to execute what the service provider has decided to do in-house. However, in this situation, there will also be a need to engage staff to manage the contracts used to procure the services of the private sector. This may entail adding staff with legal and financial management qualifications in order to draw up contracts – or these services may also be procured. If it is thought beneficial to the long-term interests of the organization, provision might be made in the contracts with the private sector for staff of the Unit to obtain on-the-job training.

3. Implementation only by private sector resources
In this situation, the Unit engages staff only to plan the overall conversion process and to produce and manage the contracts procured with the private sector. Clearly – as with all aspects of the conversion process – the size of the area to be converted to continuous supply may very well place limits on what will be affordable. Smaller towns, with populations less than 150,000 to 250,000, may be unable to support the dedicated unit that the work demands. Under these circumstances, there may be benefit to considering some form of aggregation with neighboring towns to form a viable unit.

4.8 Preparing the Technical Project
In order to prepare the continuous supply conversion project, qualified specialists/companies may need to be employed. Their role will be to specify the infrastructure requirements needed to satisfy the conversion objectives established by the local managers of the program – the municipal council or the water service provider. It may be that, having assessed the project requirements and costs, the original objectives and program are considered over-ambitious and may need to be modified.

The extent to which the specialist company will need to undertake the detailed design and specification of infrastructure requirements will depend on whether the conversion work is to be undertaken by the water service provider and local contractors, or whether it is to be contracted out to a specialist contractor. Options for the latter are dealt with later in this Guidance Note.
4.9 Preparing the Technical Data and Baseline Performance

Annexes 1A and 1B set out the basic technical and customer data needed to plan a 24-7 supply conversion project.

These data also serve to establish a baseline performance of the water service prior to conversion. This will prove important when it comes to measuring the benefits stemming from the conversion to 24-7 supply – and the inevitable and understandable comparison with cost of completing the conversion process. The baseline performance established may vary between urban centers, dependent upon the specific local objectives identified for achieving continuous supply. However, these would usually include:

1. Service coverage by:
   - percentage of population served by a household connection;
   - property connections to network;
   - standpipes/kiosks on network; and
   - other sources
2. Service continuity: receiving 24-7 supply (some areas near treatment plants may benefit in this way); and minimum, maximum and average number of hours of supply
3. Customer meter coverage: in operation; and out of operation
4. NRW: total real (leakage) and apparent (unauthorized use, customer meter inaccuracy, etc.) losses (measured as total volume of water and as percentage of production; and estimated real losses

[Annex 2A presents a table prepared by the International Water Association (IWA) which illustrates the preferred constituent elements of a Water Balance and which contains a rational breakdown of Revenue and Non-revenue Water. In preparing baseline performance data, this table should be completed – as far as is practical – by attributing water volumes to each constituent element.]

Some of the other baseline performance data that would need to be gathered includes:

- Water quality, at customer taps (particularly bacterial purity);
- Energy consumption;
- Staffing (total numbers/1,000 connections);
- Customer complaint response time;
- Technical data records – assets and operational;
- Cost per unit of water produced and sold;
- Revenue collection efficiency; and
- Cost recovery.

Given the importance of the baseline performance to a water service provider embarking upon a major capital works improvement program, it would be prudent to have the results either endorsed by an independent third party or, better still, to have the data, and any associated quality analyses, collated, prepared and presented by an independent body.

4.10 Internal and External Communications
A high-profile project such as conversion of a water distribution system from intermittent to continuous supply can only be achieved with the support and cooperation of all groups of stakeholders affected by the process. If progress is not to be subjected to hindrance by any stakeholder group, the promoter of the project will need to maintain excellent communications with them all. However, in constructing a communication strategy, the promoter will need to recognize that there are three main groups, each of which will have different concerns and interests and these may well need different communications approaches if they are to be successfully addressed. The three groups are:

- Managers and staff of the water service provider (internal communication);
- People’s representatives, media and NGOs (external communication); and
- Customers (external communication).

Of these three groups, it is essential to keep the first two aware of proposals as they develop but, in general, prior to their implementation; whereas with the third grouping, it is better to keep customers informed once a preferred approach and timetable have been selected to avoid confusion and excessive expectations with respect to both the program and its benefits. Points which are raised by customers, if considered beneficial to the project, may be incorporated into the final agreed approach and timetable.

The main objectives of a communication strategy and program are to inform the stakeholder group of:

- Intention to pursue a 24-7 supply conversion program;
- Drawbacks to continuation of intermittent supply;
- Benefits and costs of achieving 24-supply;
- Intended approach with respect to the conversion process and the subsequent operation of the service;
- Draw out concerns in order to determine how these might be mitigated; and
- Obtain, as far as practical, approval of the process.

Communication, both internal and external, of the intention to move away from intermittent supply to a 24-7 supply system is a difficult call for the water service provider to make. This is because in order to justify the process and its cost, there is a need to explain the positive benefits that will stem from the process while comparing them with the negative aspects of the present intermittent supply, highlighting just how poor the service has been in the past – and admitting that it will continue be so in the future unless the conversion process is begun. However, it is necessary to “bite the bullet” and make this comparison, despite the fact that it may reflect badly on the water service provider’s past performance. In most circumstances, the unreasonably low price that a service provider has been able to charge for water delivered to customers will have been outside its control, and this may be justifiably used to deflect some of the inevitable criticism.

Given the above, it is imperative that the communication process be started only once the senior management of the water service provider is itself completely committed to the 24-7 supply conversion process.
Most water service providers and their governing bodies will be able to define what they would like to achieve from a communications program. However, most will not know the best way to achieve their objectives. In most cases, where it can be afforded, it would be advisable to employ the services of a company or an individual specialized in communications to design the program and to assist with its implementation. In almost all cases, the actual process of communication with each stakeholder group should be conducted by the senior managers of the water service provider, and not the specialist third party.

4.10.1 Water service provider managers and staff
Quite naturally, managers and staff not directly involved in the planning of a 24-7 supply conversion project will have concerns with respect to their future employment and roles in a changed institutional situation. Progress with the conversion process will be highly dependent upon the cooperation of managers and staff throughout the water service provider. They should be informed at as early a stage as possible of the proposed conversion process so that they may air their concerns and make suggestions as to how the objectives might be achieved.

If, following a consultative process, it is decided to seek assistance from a private sector entity, with some or all of the operations of the water service, experience shows that this can cause notable concern and anxiety to managers and staff. However, they may well be unaware of the considerable benefits that can accrue to the staff in a water service institution that has been rendered more efficient and effective by the upgrading of a public sector service provider. These benefits can be in the form of:

- Improved salaries and employment conditions;
- Participation in performance-related advancement and bonuses; and
- Training for both professionals and technicians.

The change will enable the institution to become customer-oriented – rather than supply-oriented – and this will improve the working atmosphere within the institution.

By initiating a communication process with managers and staff, concerns can be identified at the earliest opportunity and attempts made to accommodate changes needed to allay these concerns.

It follows that this communication must be maintained throughout the conversion process, and necessary assurances provided to address concerns.

4.10.2 People’s representatives, media and NGOs
The whole-hearted support of people’s representatives for the 24-7 supply conversion process will also be essential. However, their support will be essential from an earlier stage than even that of the managers and staff of the water service provider – as it will be needed to initiate the process in the first place.

When consulting with people’s representatives on the project, it is necessary to:
• Ensure that they are aware of the benefits that will accrue to both government and the population from continuous supply;
• Explain why intermittent supply is a danger to health, suppresses efficiency of the water service and harms both macro and household economies;
• Emphasize how the project can be divided into short duration stages each with their own recognizable achievements. [A 24-7 conversion project is ideal for this form of staged treatment as it consists of a progressive creation of isolated DMAs (see Section 3.2.4)]; and
• Demonstrate how it is possible to mark achievement milestones by the percentage of the total population benefiting from 24-7 supply in a given timeframe.

The media and NGOs are both important stakeholders. They should be engaged at the appropriate stage. Both groupings – similar to the customer base – need to be kept informed of concrete proposals. However, it should always be borne in mind that the objectives of a communication process are to understand the concerns of each grouping and to try to accommodate these within the project through measures that mitigate their concerns.

It is essential that press releases be carefully worded and that an opportunity be provided for the press to obtain further clarification of any points they do not understand. It may be worth trying to inform editors of the project so that they may guide their staff in the approach to be taken in print.

NGOs can play a very important and positive role, particularly local district associations representing area groups of customers. Should NGOs have reservations concerning the project, or even oppose it, efforts should be made to understand the reasons for their resistance or opposition. Their reasonable concerns should be appropriately addressed.

4.10.3 Customer information

There are three main points on which customers should be informed with respect to a 24-7 supply conversion program:
• The conversion process itself and progress with its implementation;
• Any effects that improvements in the service may have on water charges; and
• How to minimize water usage when water is continuously available on demand.

Customers of the water service will receive news on the 24-7 supply conversion process through the local media. However, information on the project may not be presented accurately or objectively by the media and it will be prudent for the water service provider to present the facts of the project to its customers clearly and simply in advance of press coverage.

It is, therefore, in the best interest of the water service provider to ensure that customers receive a regular update on the process and its progress through a printed release issued with the customer’s water bill.
Customers should also be given reasonable notice – at least three months – of any intention to raise water charges. They should also be given an opportunity to question any increases in charges, whether in writing or at a public meeting.

4.10.4 Customer water conservation awareness

However, there is another aspect of customer information which is of paramount importance. Customers are used to having water available only a few hours in the day, sometimes more, but often with a lower frequency and duration. Taps may well be routinely left open to be certain of obtaining water whenever it becomes available at any time of the night or day. Were these to be the continuing practice when the supply of water is continuously available, the customer would be faced with a very high bill. Similarly, there is little incentive to mend a leaking tap under intermittent supply conditions but a defective tap or cisterns can add considerably to a monthly bill if left to drip or run in a continuous supply situation.

To avoid undue wastage and high bills, customers should be provided with a leaflet showing them how much water would be used under normal circumstances for different water usage operations – cleaning dishes, washing machines, baths, etc. In addition, they should also be made aware of how much water would be wasted if taps are left running when they do not need to be, for example, when cleaning teeth or washing dishes, and if a leaking tap is left to run unchecked.

It would also be good practice to provide parallel bills for the first three months of a customer receiving a continuous, metered supply, that is, one bill produced under the old regime and another showing what a properly metered, continuous supply would have cost over the same period. The lower of the two bills should be the basis of payment levied for the parallel bill period. This will provide a period under which customers may monitor their usage and adjust their water usage habits to minimize their water bill, should they so wish.

4.11 Check-list of Actions for Planning and Implementing Conversion to 24-7 Supply

In order to assist those planning a 24-7 conversion process, Annex 2B contains a check-list of actions to be considered under each stage of the process:

- Stage 1 Initial Decision to Proceed
- Stage 2 Outline Planning
- Stage 3 Detailed Planning and Design
- Stage 4 Implementation
- Stage 5 Operational

Separate lists of actions have been included under the headings

- Stream A 24-7 Conversion Project – Technical, Funding and Progress
- Stream B Capacity
- Stream C Communications and Consultation
- Stream D Water Service Provider Performance and Upgrading
Clearly, although every action in the list should be considered for every project, the nature of the actual action taken should be proportionate to the size of the urban area under consideration.

Table 4.1 Advantages and Disadvantages of Private Sector Procurement Options for 24-7 Water Distribution Services

<table>
<thead>
<tr>
<th>Procurement Option</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialist Support to In-</td>
<td>- Maintains control in-house</td>
<td>- Public sector need to “know what you do not know” – needs continual</td>
</tr>
<tr>
<td>house Options</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Apparent simplicity in procurement and implementation</td>
<td>- Lengthy public sector process for procurement of works contracts extends</td>
</tr>
<tr>
<td></td>
<td>- Difficult to regulate own organization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and therefore to maintain performance and program targets</td>
<td>- Improvement process lengthened significantly by “learning curves” for in-</td>
</tr>
<tr>
<td></td>
<td>- Appears to minimize cost – savings may prove illusory as, due to lack</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of experience and skills, success difficult to achieve</td>
<td>- High level of planning and coordination expertise required of public sector</td>
</tr>
<tr>
<td></td>
<td>- Improvements can be achieve in stages, town by town</td>
<td></td>
</tr>
<tr>
<td>Service Contracts</td>
<td>- Maintains control in-house</td>
<td>- Public sector need to “know what you do not know” – needs continual</td>
</tr>
<tr>
<td></td>
<td>- Apparent simplicity in procurement and implementation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improvements can be achieved in stages, town by town</td>
<td>- Lengthy public sector process for procurement of works contracts imposes</td>
</tr>
<tr>
<td>Management Contract -</td>
<td>- Management of complete “retail” water service passed to Management</td>
<td></td>
</tr>
<tr>
<td>without capital works</td>
<td>Contractor (MC) and no need to identify public sector skills shortfalls</td>
<td>- High level of planning and coordination expertise required of public sector</td>
</tr>
<tr>
<td>construction</td>
<td>- Easier for public sector to regulate a third-party and therefore to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>meet performance and program targets</td>
<td>- Lengthy public sector process for procurement of works contracts extends</td>
</tr>
<tr>
<td></td>
<td>- Public sector managers and staff can share in MC bonus payments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- MC should have skills to assist public sector in its overall water</td>
<td>- Insufficient data on present infrastructure assets and operational</td>
</tr>
<tr>
<td></td>
<td>service restructuring process</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- To be viable, most towns must be included</td>
</tr>
</tbody>
</table>

- Longer procurement process than specialist support or service contracts – a total of 12 to 15 months
- Managers and staff of public sector must work under private company direction (while remaining public sector employees)
- Lengthy public sector process for procurement of works contracts extends implementation period
- Insufficient data on present infrastructure assets and operational performance renders it difficult to set fair targets for MC
### Management Contract - with capital works construction
- Overcomes problem of delays resulting from public sector procurement regulations.
- Management of complete “retail” water service passed to MC and no need to identify public sector skills shortfalls.
- Easier for public sector to regulate a 3rd party and therefore to meet performance and programme targets.
- Public sector managers and staff benefit from training and can share MC bonus payments.
- Management Contractor should have skills to assist public sector in its overall water service restructuring process.

### Service Company
- All the advantages of MC with capital works construction.

### Partnership or Alliance Contracts
- All advantages of MC with capital works construction.
- Seeks to be non-confrontational.
- Active participation of public sector means risks shared with MC, should result in lower costs.
- Public sector share in commercial benefits.

### Leasing
- All advantages of MC with capital works construction.
- Leasing company takes over customer contact.
- Longer contract period provides stability for seconded public sector managers and staff.

### Disadvantages
- Longer procurement process than specialist support or service contracts – a total of 12 to 15 months.
- Managers and staff of public sector must work under private company direction (while remaining public sector employees).
- Insufficient data on present infrastructure assets and operational performance renders it difficult to set fair targets for MC.
- To be viable, most towns must be included.

- All disadvantages of MC with capital works construction, although procurement may be shorter.
- Regulation of service company must be vested in a third-party institution, independent of public sector.
- Public sector share in commercial risks.

- All disadvantages of MC with capital works construction.
- Public sector committed to an operator for a long period.
- Sufficient asset data may render it difficult to fix a leasing fee and compile bid document.
<table>
<thead>
<tr>
<th>Procurement Option</th>
<th>Asset Ownership</th>
<th>Prime Responsibility For 24-7 Water Distribution Service</th>
<th>Duration (years)</th>
<th>Customer Relationship &amp; Contact</th>
<th>Form of Remuneration of Private Sector Company or Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialist Support to In-House</td>
<td>Public sector</td>
<td>Yes</td>
<td>No</td>
<td>Only while support needed</td>
<td>Public sector Fee or Lump Sum</td>
</tr>
<tr>
<td>Service Contracts</td>
<td>Public sector</td>
<td>Yes</td>
<td>No</td>
<td>1–3</td>
<td>Public sector Fee or Lump Sum</td>
</tr>
<tr>
<td>Management Contract - without capital works construction</td>
<td>Public sector</td>
<td>In law</td>
<td>By contract</td>
<td>5–7</td>
<td>Public sector Fee + Performance Bonus</td>
</tr>
<tr>
<td>Management Contract - with capital works construction</td>
<td>Public sector</td>
<td>In law</td>
<td>By contract</td>
<td>5–7</td>
<td>Public sector Fee + Performance Bonus + Cost of Works</td>
</tr>
<tr>
<td>Service Company</td>
<td>Public sector</td>
<td>In law</td>
<td>By contract</td>
<td>5–7</td>
<td>Public sector As either MC contract</td>
</tr>
<tr>
<td>Partnership or Alliance Contract through Service Company</td>
<td>Public sector</td>
<td>Shared</td>
<td></td>
<td>5–7 extendable by mutual agreement</td>
<td>Service Company Fee + Performance Bonus + Cost of Works</td>
</tr>
<tr>
<td>Leasing</td>
<td>Public sector</td>
<td>In law</td>
<td>By contract</td>
<td>&gt; 10</td>
<td>Leasing Company From service revenue</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------</td>
<td>--------------------------------------</td>
<td>-------------------------------------</td>
<td>---------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Specialist Support to In-house</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Separately bid</td>
<td>Public sector</td>
</tr>
<tr>
<td>Service Contracts</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Separately bid</td>
<td>Public sector</td>
</tr>
<tr>
<td>Management Contract - without capital works construction</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Management Contractor</td>
<td>Public sector</td>
</tr>
<tr>
<td>Management Contract - with capital works construction</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Management Contractor</td>
<td>Public sector</td>
</tr>
<tr>
<td>Service Company</td>
<td>Public sector</td>
<td>Public sector</td>
<td>Service Company plan approved by Public sector</td>
<td>Public sector</td>
<td>Service Company</td>
</tr>
<tr>
<td>Partnership or Alliance Contract (Service Company)</td>
<td>Public sector &amp; Operator</td>
<td>Independent Institution</td>
<td>Partners mutually agree the capital works program</td>
<td>Public sector</td>
<td>Service Company</td>
</tr>
<tr>
<td>Leasing</td>
<td>Leasing Company</td>
<td>Public sector</td>
<td>Leasing Company plan approved by public sector</td>
<td>Public sector</td>
<td>Leasing Company</td>
</tr>
</tbody>
</table>
Table 4.4
24-7 water distribution Service Improvements – Procurement Options

<table>
<thead>
<tr>
<th>Procurement Option</th>
<th>Commercial</th>
<th>Financial</th>
<th>Regulatory</th>
<th>Foreign Exchange</th>
<th>Political</th>
<th>Development</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public Sector</td>
<td>Private</td>
<td>Public Sector</td>
<td>Private</td>
<td>Public Sector</td>
<td>Private</td>
<td>Public Sector</td>
</tr>
<tr>
<td>Specialist Support to In-house Options</td>
<td>Low</td>
<td>Med</td>
<td>None</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Service Contract</td>
<td>Low</td>
<td>High</td>
<td>None</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Management Contract - without capital works construction</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Service Company</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Partnership or Alliance Contract (Service Company)</td>
<td>Shared - Medium</td>
<td>Shared - High</td>
<td>Shared - High</td>
<td>Low</td>
<td>Med to High</td>
<td>Shared - Medium</td>
<td>Shared - Medium</td>
</tr>
<tr>
<td>Leasing</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>


Guidance Note 5:
24-7 Supply: Benefiting from Improved Distribution System Management
Guidance Note 5: 24-7 Supply: Benefiting from Improved Distribution System Management

5.1 Preamble
As has been pointed out in the Introduction to this set of Guidance Notes, 24-7 supply schemes in India are as yet in the early stages of implementation or preparation.

It would therefore be premature to draw lessons for this Guidance Note on the operational stage of 24-7 supply in a national context. This Guidance Note, therefore, sets out some of the anticipated operational benefits that should be derived from a continuously pressurized distribution system. Section 1.3 of Guidance Note 1 has already highlighted the major health and social benefits arising out of a 24-7 supply of water. It is expected that this present Guidance Note will be expanded upon once significant experience has been obtained from the operational stages of the 24-7 supply schemes in the course of preparation and implementation.

In the meantime, this Guidance Note briefly sets out some points on the following topics:

- 24-7 Supply: Operational Objectives and Benefits;
- Monitoring Performance;
- Operational Data Management;
- Operational Outsourcing: Contract Regulation; and
- Regulation: Institutional Options.

5.2 24-7 Supply: Operational Objectives and Benefits
Clearly, the primary objective of a 24-7 supply conversion project is to provide an area with a continuous supply of water at a reasonable pressure. However, there are many additional operational benefits that flow from a 24-7 supply, which are not available under an intermittent supply regime. These consequent effects should equally be considered as objectives, for example, conditions are created which allow the water service provider to:

- Exercise management control over the amounts of bulk water distributed to each OZ;
- Monitor, to an acceptable degree of accuracy, NRW performance for the entire system or at the level of the DMA;
- Using software based upon the Burst and Background Estimates (BABE) concepts, determine the real losses (leakage) for the system overall and for each DMA – and hence, for the first time, the water service provider will know the NRW breakdown between real and apparent losses;
- Carry out routine leak detection, location and repair activity on all constituent parts of the supply system – transmission pipelines and distribution networks;
- Manage system pressure to minimize leakage, while satisfying service pressure commitments;
- Detect unauthorized connections; and
- Accurately meter customer water usage.
In turn, the above allow the water service provider to manage its distribution system infrastructure assets and its revenue more effectively, for example:

- Lower the operational costs of water production by minimizing the amount of NRW per unit volume of water sold;
- Target distribution pipe replacement according to priorities indicated by the amount of water lost through leakage in each DMA;
- Apply a degree of control over water usage through pressure control;
- Introduce block tariffs to assist the poor in affording connection to the water network and, if considered necessary, to penalize excessive usage; and
- Issue water bills based on actual usage.

5.3 Operational Data Collection and Management

Installation of flow and pressure meters at key points throughout the transmission and distribution networks is an integral part of conversion of a service to continuous supply. As has already been mentioned, customer meters function to their designed accuracy for the first time under continuous supply. This measurement of supply and demand and key operational parameters provides the water service provider with the tools to collect meaningful operational data.

These operational data are the essential foundation on which the management of all modern efficient and effective water services is based. It is the life blood of best management practice.

When designing the system for 24-7 supply, a decision should be taken as to how to collect, transmit, collate and then use the operational data that will be generated by the system. Given modern forms of communication, the additional cost of continuously recording data and its onward transmission to a center for monitoring and control is relatively small. The principal decision will be what data should be transmitted to OZ managers and what should be passed on to headquarters where managers need an overall picture of the operational status of the system.

The following offers guidance on this decision with respect to management of the transmission and distribution systems:

Operational zone management

A manager of an OZ operating under 24-7 supply conditions will wish to have data which give him operational and management control over the following:

- The daily net volume of water received into the zone under his management, that is, the difference in water metered as received from the transmission system and neighboring zones and that “exported” to the neighboring zones;
- The volume of water entering each DMA within the zone and the pressure at which it enters;
- System pressure at key points within each DMA;
- The metered volume of customer water usage; and
- The real losses within each DMA (this can be automatically calculated using software based on the BABE concepts).
Apart from the data used to determine whether the manager is receiving sufficient water and customer data for billing, much of the operational data received is used to manage and reduce leakage. The data permits the manager to target where leakage detection gangs should be working at any time and which lengths of distribution main are in need of replacement, and hence to reduce losses to an economical minimum. The data also permit the manager to understand where unauthorized connections have been made and hence to legitimize them.

**Headquarters management**

Managers at headquarters, responsible for supervision of the transmission system and OZs need operational data that allow them to:

- Ensure that each OZ is receiving the bulk water that it needs or, at times of shortage, to ensure that water is being distributed equitably between the OZs;
- Check that losses on transmission mains are being minimized; and
- Check that no OZ is allowing either real losses (leakage) or apparent losses (unauthorized connections, meter inaccuracy, etc.) to fall behind the performance targets set for them.

### 5.4 Establishing Performance Targets and Monitoring Performance

Section 4.7 of Guidance Note 4, Planning and Preparing for Conversion to 24-7 Supply, described the parameters to which values should be attributed to establish a baseline performance of the water service provider prior to commencing system conversion work.

Having prepared the 24-7 supply conversion project, and established a baseline performance, it is now possible to set annual targets for improved performance. These targets should be reasonable, and commensurate with the funds allocated for improvements. Each water service provider will wish to set its own performance targets dependent upon the initial status of its system and objectives. Examples of technical performance targets might be:

**OZ managers**

- NRW reduction, preferably measured in m³/year, with possible minimum reductions for each real and apparent loss;
- Maximum time between detection or reporting of leaks and their repair; and
- Maximum number and duration per year of breaks in service.

**Headquarters managers**

- NRW reduction for transmission systems;
- NRW reduction for OZs under their control;
- Continuity of supply to OZ; and
- Respect of service levels for each DMA under their control.

Annex 3 describes the most recent view of establishing performance standards for real loss reduction and for comparing them between water service providers or, in this case, between OZs.
A distribution system operated under continuous supply conditions, with appropriate metering of flow and pressure, allows performance to be continuously monitored. In turn, each manager is aware of his own performance with respect to targets set for him. The managers’ individual performance can be used as a basis for an incentive system of payments to both them and the staff under their management. It also allows performance to be one of the main criteria for advancement through the organization.

5.5 Operational Outsourcing: Contract Regulation

In the same way that the operational performance of the managers and staff of a public sector institution can be monitored, so can the performance of private contractors involved in delivering part or all of a water service. Where private contractors provide the water service, a separate unit would be established within the employer’s organization to manage the contract governing service provision. Data routinely collected as described in the foregoing sections would be used to regulate the contract.

However, the employer should be aware that, under conditions of outsourcing, the baseline performance should be established and agreed together with the private operator. In some situations, particularly in the absence of metering and knowledge of the system and its condition, it may prove impossible to establish a baseline performance before signature of a contract. Under these conditions, it has been suggested that in the first year of a contract, the work of the private operator would be to install metering equipment, to map the system and to establish a performance baseline in collaboration with the employer.

Whereas some criteria for management of the progress of a contract might be set at the time of signature, for example, the rate at which DMAs would be established and customers connected to a continuous supply, other performance criteria such as reductions in NRW and energy consumption would be set by mutual agreement once the baseline performance has been established.

A system will need to be put in place where measurements made to check on performance of the private contractor are taken and agreed by both parties. This system will need to include routine checks on the accuracy of the instrumentation used to measure performance.

5.6 Regulation: Institutional Options

Regulation of a water service is a “thorny” issue. The latest approaches seek to minimize the amount of regulation needed. How much regulation and by whom it is undertaken are very much local decisions. There are two principal types of regulation: Economic; and Quality of service.

Economic regulation
Under economic regulation, fair prices are set for the water service with respect to connection and consumption. What should be taken into consideration when setting a fair tariff has been dealt with in Guidance Note 4, this section describes the options for how price regulation is carried out. In general, it is for the water service provider to “make the case” for a price increase. However, it is generally unsatisfactory for the water service provider to impose increased prices on its customers without some form of review and approval by a regulatory body. This is because water services are, with very few exceptions, monopolies and therefore prices are not regulated by market conditions.

In its simplest form, the water service provider should submit its request for an increase to the local municipal council that governs its actions. However, in many situations, such bodies have neither the resources nor the competence to analyze and review any substantiating documentation submitted by the service provider. Under these circumstances, the council may employ an independent third party to carry out the review on its behalf and act upon its recommendations.

The key aspect in regulation is the identification of key regulatory objectives and goals that need to be upheld. Alternative independent regulatory mechanisms, including contractual compacts, are available for enforcement and compliance with regulatory requirements. In general, regulation, both in terms of the key regulatory objectives and implementation frameworks, should be minimalist and avoid the imposition of compliance requirements unrelated to a clear, substantive public purpose.

**Quality of service**

A water service provider should be required to meet certain minimum standards of service. These relate to:

- The quality of water supplied which should meet specific physical, chemical and bacteriological standards. This quality should be measured at the outlet from all treatment plants or entry to the transmission system as well as at key points through the transmission and distribution systems and, critically, at customer taps; and
- Service levels which are minimum standards of service that are to be expected by customers, for example, minimum pressure at customer meters, continuity of supply, response time to complaints and reports of leaks, minimum quantity of water supplied, etc.

Under normal, routine conditions, the water service provider should keep records demonstrating its performance with respect to water quality and service levels. However, these records should be reviewed and audited by an independent body, whether a public regulatory institution or a private company contracted for the task.

The quality of water to be supplied is usually set by national or state legislation. However, it is for each municipal council to set the service levels that it wishes to demand of its water service provider. Given that municipal councils might not have the professional staff or experience to set reasonable levels of service, they may wish to take independent advice on the matter.
Given that the water service provider has been granted the right to charge an adequate price for water delivered, the granting of any increase in water prices should be linked to the performance of the water service provider in meeting water quality standards and service levels. In this respect, whichever body is used to carry out price regulation should either also be responsible for the quality of service or aware of the provider’s performance in this respect.
Annexes

Annex 1A: Water Transmission and Distribution Systems

Basic Technical Data Required for Planning and Introducing 24-7 Supply

The following basic technical data should be prepared:

A. Water Supply – Transmission and Distribution Systems

1. A set of plans of the water supply operational area on either digitized base maps or a GIS platform (Note: If other utilities – gas, electricity, telephone or highways – are already using a particular GIS platform, use the same or ensure compatibility) to a scale of 1:10,000:
   - The geographic boundary of the water supply area;
   - Likewise, where the supply area has been sub-divided into OZs for the purpose of operating and maintaining the water service infrastructure, their geographic boundaries should be shown; and
   - The location and technical details of existing water supply civil works infrastructure, age and status:
     - Water supply and distribution mains – primary and secondary mains and distribution networks (location, line, diameters, materials, state of repair);
     - Flow meters on the supply system;
     - Standposts and other points of community water supply;
     - Air and gate valves (including zone boundary valves, if any), hydrants and washouts; and
     - Location of principal water supply infrastructure, for example, water treatment plants, inline and booster pumping stations, principal and local storage reservoirs, principal and zonal operational offices and depots.

The base plans used should be the most recent possible, showing all highways, streets and lanes, housing and either show contours or spot levels throughout the supply area.

- Plans of each pumping station, reservoir and operational office area should be prepared to 1:250 or 1:100 scale.
- Pumping station details, including principal mechanical and electrical plant infrastructure specifications, actual duty details, age and status.
- Reservoir details, including capacity and operating levels.
- With respect to the OZ boundaries, identify and record on plans every cross-boundary water pipeline – both importing water into, and exporting from, the zones. Highlight the diameter and material of the cross-boundary pipelines and identify the areas they supply on both sides of the boundary.
- Install accurate flow meters – for example, electromagnetic meters – at each point that a transmission or distribution pipeline crosses an operational border. Maintain flow continuous records to determine the bulk supply routinely imported to and exported from each OZ.
• Identify all sources of bulk supply of water to each OZ. Determine the degree of security to be attributed to each source, that is, the record of maintaining the expected supply, particularly with respect to power outages.
• Define the present supply scheduling regime to the OZs.
• Record burst/leak frequency data – primary and secondary mains, distribution network and connections.
• Prepare records of power supply outages as they have affected each OZ over a period of at least three years.

B. Sewerage – Zonal, Trunk and Interceptor Sewers
1. A set of plans of the sewerage operational area on either digitized base maps or a GIS platform (Note: If other utilities – gas, electricity, telephone or highways -- are already using a particular GIS platform, use the same or ensure compatibility) to a scale of 1:10,000:
   • The geographic boundary of the sewerage service area, highlighting where, if at all, this differs from the water supply area; 
   • Likewise, where the supply area has been sub-divided into OZs for the purposes of operating and maintaining zonal sewerage networks, their geographic boundaries should be shown, highlighting where, if at all, these differ from the water service OZs; and
   • The location and technical details of existing sewerage civil works infrastructure, age and status:  
     o primary and secondary zonal sewer networks, trunk and interceptor sewers (location, line, diameters, materials, state of repair);
     o manholes;
     o storm sewage overflows and storm sewage receptors; and
     o location of principal sewerage infrastructure, for example, pumping stations, sewage pumping mains, wastewater treatment plants, effluent outfalls and sludge disposal areas.

As for water supply, the base plans used should be the most recent possible, showing all highways, streets and lanes, housing and either show contours or spot levels throughout the supply area.
• Plans of each pumping station, pumping main and storm sewage overflow, prepared to 1:250 or 1:100 scale.
• Pumping station details, including principal mechanical and electrical plant infrastructure specifications, actual duty details, age and status.
• Identify and highlight on the plans all sewers entering and leaving each OZ.
Annex 1B: Water Transmission and Distribution Systems: Basic Customer Data Required for Planning and Introducing 24-7 Supply

The following basic customer data should be prepared.

A computerized database of all properties within the total water and sewerage service area – both connected and unconnected - should be prepared. Where the service area has been sub-divided into OZs, the records should be collected in accordance with those zonal boundaries and summed to provide statistics for the whole service area.

The following information should be collected – and recorded electronically - either from the existing customer/revenue records of the urban administration or water utility or by a property-by-property survey:

1. All properties in each zone to be shown on the 1:2,500 scale plans, together with number of floors and dwelling units.
2. Property address.
3. Name of property owner.
4. Name of each customer billed within the property – each of the dwelling units separately billed to be attributed a unique reference number.
5. Number of persons ordinarily resident at the property.
6. Whether the property is connected or not to the water distribution network. If not connected, or if the household supplements supply from other sources, note the other usual source(s) of water used by the household and approximate amounts of water taken from these sources per day (including number and volume of tankers used per month).
7. Whether or not the property uses its own tube-well(s), or if a tube-well is shared with other properties, which properties. Note depth and pump capacity of well(s) and approximate amount of water used from this source.
8. Type and volume of onsite water storage – ground, intermediate landing and/or roof.
9. Does the property make use of its own booster pumps? From their own storage tank or direct from connection or distribution network?
10. Size and material of connection to the public water supply network – and approximate date of installation.
11. Type, age and functionality of customer meter.
12. Note the “discontinuity” arrangement within the property separating the property from the distribution system, for example, control by means of a tap or a float valve on a storage tank or the lack of any discontinuity?
13. Length of connection between the distribution main and the meter, and between the meter and the first tap or float valve.
14. Whether the property is connected to the public sewerage system. If not connected, note what other arrangements are made for disposal of wastewater from the property.
15. Note where surface water is falling from the property drains to soakaways, rain-water harvesting facility, sewer, storm drain or watercourse.
When collecting the above data, it will be useful to separately summarize for each OZ, where these exist:

- Numbers of domestic connections, divided between metered and unmetered; and
- Numbers of bulk supply customers in each zone, their location on the 1:2,500 scale plans and their individual average monthly consumptions.

Particular attention should be paid to the collection of data on areas not officially connected to the water service systems of the urban administration or water utility, for example, low-income populations housed in authorized and unauthorized slums and similar developments. People living in such areas may have, individually or collectively, made their own arrangements for “tapping into” the water service infrastructure and their connections should be legitimized and extended to all inhabitants of such areas.
Annex 1C Conversion from Intermittent to Continuous Supply

Actions Entailed in Establishing a DMA

1. Confirm the intended boundary of the DMA.
2. Hydraulically isolate the DMA from the rest of the transmission and distribution system, with the sole exception of the single main feeding the DMA. This hydraulic isolation is to be achieved by installing a gate valve on every cross-boundary main and by replacing defective or leaking boundary gate valves where these already exist.
3. At the DMA boundary, on the single main feeding the DMA, install a magnetic flow meter, a pressure control valve and pressure meter and an emergency bypass of the meters – all in a lockable chamber. Meter readings of both flow and pressure should be continuously logged in a form that can be down-loaded into a computer database in a form capable of charting and analysis.
4. Plans of the distribution system within the DMA to be produced, or updated where they exist, to a scale of 1:2500. These plans should not only show the infrastructure listed in Section A of Annex 3A but should also show the new inlet chamber, the boundary valves and the distribution system location in the plan (providing diameter, material and approximate depth data). Every standpost, other points of community supply and properties connected to the public water distribution network should be marked.
5. Every standpost directly connected to the public network, or fed from a storage tank filled from the public network, is to be provided with a meter in its own lockable chamber. All faucets on standposts to be replaced with self-closing taps.
6. A Class 3 meter to be installed in a lockable box on the connection pipe to every property connected to the distribution system at the external side of the wall of the main building where the connection enters the building – each property to have only one connection, multiple connections to be removed. (This provision may be modified for unauthorized developments to avoid the possibility that ownership of land might be conferred by installation of a meter per property. In these cases, a number of properties might be served by a single meter but each of the properties served from the meter would then be provided with a separate connection from that meter.)
7. Within every connected property, the internal connection pipe between the customer meter and the first faucet or storage tank float valve to be replaced, using a medium density polyethylene (MDPE) pipe, and fitted with one of the following three options at the end of this pipe:
   - A brass faucet (tap) at the kitchen sink or another convenient point between the kitchen and the meter at a point indicated by the property-owner;
   - A small MDPE storage tank at the ground-floor ceiling level, equipped with a float valve on the feed pipe to the tank from the meter; or
   - A float valve on an existing ground storage tank after the meter.
8. A computerized database of all properties within the DMA – connected and unconnected - to be prepared, or updated if already prepared, having the data listed in Annex 1B preferably collected or verified by a house-to-house survey of the DMA.
9. Owners of properties found to have unauthorized connections in the exercise conducted above, to be offered the option of regularizing their connection, or be disconnected by the urban administration or water utility. For those properties for which their connection is regularized, the work described in f. and g. above to be carried out.

### IWA Water Standard Balance

<table>
<thead>
<tr>
<th>System Input Volume</th>
<th>Authorised Consumption</th>
<th>Billed Authorised Consumption</th>
<th>Billed Metered Consumption</th>
<th>Revenue Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Authorised</td>
<td>Total Authorised</td>
<td>Total Billed Authorised</td>
<td>Total Billed Metered</td>
<td>Total Revenue Water</td>
</tr>
<tr>
<td>Total Unauthorised</td>
<td>Total Unauthorised</td>
<td>Total Unbilled Authorised</td>
<td>Total Unbilled Metered</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Losses</th>
<th>Apparent Losses</th>
<th>Unauthorised Consumption</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
<td>Total Apparent</td>
<td>Total Unauthorised</td>
</tr>
<tr>
<td>Total</td>
<td>Total Apparent</td>
<td>Total Unauthorised</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Real Losses</th>
<th>Leakage on Transmission and Distribution Mains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Leakage on Transmission and Distribution Mains</td>
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</table>

<table>
<thead>
<tr>
<th>Real Losses</th>
<th>Leakage on Service Connections up to point of Customer Meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Leakage on Service Connections up to point of Customer Meter</td>
</tr>
</tbody>
</table>

### Other Losses

- **Customer Meter Inaccuracies**
- **Leakage on Transmission and Distribution Mains**
- **Leakage and Overflows at Storage Tanks**
- **Leakage on Service Connections up to point of Customer Meter**
## Annex 2B: 24-7 Supply Conversion Process Check-List

### 5 Stages
- **Stage 1**: Initial Decision to Proceed
- **Stage 2**: Outline Planning
- **Stage 3**: Detailed Planning and Design
- **Stage 4**: Implementation
- **Stage 5**: Operational

<table>
<thead>
<tr>
<th>Stream A: 24-7 Conversion Project: Technical, Funding &amp; Progress</th>
<th>Stream B: Capacity</th>
<th>Stream C: Communications &amp; Consultation</th>
<th>Stream D: Water Service Provider Performance Upgrading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. INITIAL DECISION TO PROCEED</strong></td>
<td></td>
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</tr>
<tr>
<td>Prepare case for converting to 24-7 supply</td>
<td>Assess capabilities and experience of water service provider in-house staff to undertake all or part of conversion process activities separately for each of planning and design, implementation and operation stages</td>
<td>Develop outline communications and consultation strategy for implementation, once approval to proceed to Outline Planning stage has been obtained</td>
<td>Consider linking 24-7 conversion project to a general upgrading of water service provider performance</td>
</tr>
<tr>
<td>Determine whether grants or soft loans available to assist conversion process</td>
<td>If there are shortcomings in present staff capabilities, prepare case for training programs for existing staff, recruitment of experienced staff and/or third-party assistance</td>
<td>Include outline strategy in presentations to obtain approval</td>
<td>Consider institutional restructuring options to respond to 24-7 supply conversion process and general upgrading of performance</td>
</tr>
<tr>
<td>Prepare a broad outline timetable to complete the stages in the conversion process.</td>
<td>Determine what third-party assistance will be required for each stage of the conversion process and the manner in which this support would be contracted</td>
<td>Include staffing and</td>
<td>Include upgrading and institutional restructuring proposals in presentations to obtain approval</td>
</tr>
<tr>
<td>Prepare presentations for obtaining approval to proceed to Outline Planning Stage.</td>
<td></td>
<td></td>
<td>Once approval given to proceed to Outline Planning stage, initiate and complete any restructuring required to undertake that stage</td>
</tr>
<tr>
<td>Obtain approval(s) to proceed to Outline Planning and general upgrading of water service provider performance, for example, approvals from water service</td>
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</tr>
</tbody>
</table>
**2. OUTLINE PLANNING STAGE**

| Produce outline planning activity list, outputs and program | Designate staff dedicated to manage and undertake Outline Planning of 24-7 supply conversion project |
| Collect and collate data needed to prepare Outline Plan | If necessary, train existing staff, recruit additional experienced staff and/or contract professional support to assist with Outline Planning stage |
| Produce Outline Planning Report including: | Prepare detailed capacity plan for Detailed Planning & Design stage, including: |
| - current operational status, quality and performance of water service and project objectives with respect to service improvement | - roles of staff drawn from existing complement and any training needs |
| - staffing to proceed at each stage of the conversion process and intentions with respect to recruitment and/or contracting professional support | - recruitment of specialized staff |
| - outline project cost and effects on tariffs (accuracy of +/- 20%) | - professional support to be contracted out |
| - costed and uncosted benefits | Include capacity planning proposals in Outline Planning Report to obtain approval |
| - timeline for each stage in the process, including | Once approval given to proceed to Detailed Planning & Design |
| - whether or not to undertake a pilot area exercise (need | Establish a Continuous Water Supply Project Monitoring and Advisory Committee – CWSC (including representatives of customer groups and appropriate NGOs) |

In accordance with Communications Strategy, commence 24-7 supply project information dissemination program for informing stakeholder groups, for example, water service provider managers and staff, government in general, appropriate NGOs, the media and actual and potential customers.

In accordance with Consultation Strategy, CWSC to invite comment on project from stakeholder information dissemination groups and initiate consultation process.

Plan and program the progressive restructuring of water service provider appropriate to each stage of the project preparation, implementation and operation, the planning to address policies regarding:

- institutional management and staffing and inter-departmental communication and coordination
- manager and staff conditions of employment
- asset records
- accountancy and financial management
- service levels
- fraud and corruption reduction measures (if necessary)
- management information systems and procedures
- tariff policy
- customer
to convince government and/or general public about project benefits and viability; sufficiency of project technical and cost data to proceed to detailed design and implementation)
- phasing of progressive introduction of 24-7 supply throughout urban area
- NRW reduction program
- proposed approach to extending piped supply to jhuggi-jhopri (JJ) clusters and poorer authorized urban areas and for reducing financial burden for connection of their households
- finance plan, including tariff and subsidy reforms
- requirements to pass new, or modify existing, laws/regulation to implement and operate 24-7 supply
- SBP, taking into account improvements to water service operational efficiency, including NRW reduction, and effectiveness arising from introduction of stage, Initiate and complete any adjustments to existing staffing, training, recruitment and contracting of third-party support approved in the report and needed to commence next stage.

Include results of Communications and Consultation processes in Outline Planning Report
Following approval of Outline Planning Report, undertake next round of communication and consultation
Review Communications and Consultation Strategy for Detailed Planning and Design Stage and, if necessary, revise to take account of views arising from consultation

metering, billing and collection unauthorized connections connection of the poor customer communications and relations

Include proposals for the progressive introduction of each of the above in the Outline Planning Report

Once approval given to proceed to Detailed Planning & Design stage, Initiate and complete any institutional restructuring and upgrading required to undertake that stage
### 3. DETAILED PLANNING & DESIGN STAGE

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>If necessary or beneficial, modify outline plan to take account of stakeholder consultation feedback</td>
<td>Designate staff dedicated to manage and undertake detailed planning and design of conversion project. If necessary, continue to train existing staff; recruit additional experienced staff and/or contract professional support to assist with Detailed Planning &amp; Design stage. Assess current manager and staff capabilities and operational capacity and capabilities as input to assessing options for implementing project, for example, contracting works with or without system operation or staff training in 24-7 operational technology.</td>
</tr>
<tr>
<td>Prepare GIS plans of transmission and distribution systems</td>
<td>Keep the Project Monitoring and Advisory Group, the CWSC, informed of project approach and progress throughout Detailed Planning and Design stage. Update stakeholders concerning development and implementation of the project and receive any further feedback – review and, if necessary, modify the information dissemination and consultation plan for subsequent stages.</td>
</tr>
<tr>
<td>Collect and collate detailed data: technical, economic and customer</td>
<td>Consider options for equipment and systems to be purchased and installed related to restructuring and upgrading of the water service provider. Produce tender documents for the chosen equipment and systems. Based upon the technical requirements developed during the Detailed Planning and Design stage review, and revise if necessary, the progressive restructuring of water service provider appropriate to each of the stages.</td>
</tr>
<tr>
<td>Take final decision concerning need for a pilot area exercise, based on whether there is a need to convince government and/or general public about project benefits and viability; and sufficiency of project technical and cost data to proceed to detailed design and implementation</td>
<td>Keep the Project Monitoring and Advisory Group, the CWSC, informed of project approach and progress throughout Detailed Planning and Design stage. Update stakeholders concerning development and implementation of the project and receive any further feedback – review and, if necessary, modify the information dissemination and consultation plan for subsequent stages.</td>
</tr>
</tbody>
</table>

Prepare presentations for obtaining approval to proceed to Detailed Planning and Design Stage based upon the Outline Planning Report.

Obtain approval(s) to proceed to Detailed Planning and Design Stage.

Keep the Project Monitoring and Advisory Group, the CWSC, informed of project approach and progress throughout Detailed Planning and Design stage. Update stakeholders concerning development and implementation of the project and receive any further feedback – review and, if necessary, modify the information dissemination and consultation plan for subsequent stages.

Designate staff dedicated to manage and undertake detailed planning and design of conversion project. If necessary, continue to train existing staff; recruit additional experienced staff and/or contract professional support to assist with Detailed Planning & Design stage.

Assess current manager and staff capabilities and operational capacity and capabilities as input to assessing options for implementing project, for example, contracting works with or without system operation or staff training in 24-7 operational technology.
Prepare detailed project for connecting all households, irrespective of economic class, throughout the whole of the urban area for upgrading and restructuring the transmission and distribution networks, creating DMA, replacing connections and customer meters and rehabilitating the networks as necessary and developing hydraulic models of existing and proposed systems.

If undertaking pilot area conversion prior to implementation of full project, separate the design of the pilot area from the full project.

Prepare the Detailed Planning and Design Report, including:
- Project description
- Data and transmission and network plans
- Drawings and specifications
- Hydraulic models
- Proposed method of implementation
- Detailed costs
- Detailed finance plan
- Implementation program, including pilot area work (?) and phasing

and techniques

Prepare detailed capacity plan for Implementation Stage, appropriate to the chosen project implementation option, including:
- roles of staff drawn from existing complement and any training needs
- recruitment of specialized staff
- professional support to be contracted out

Include capacity planning proposals in Detailed Planning & Design Report to obtain approvals.

Once approval given to proceed to Implementation stage, adjust existing staffing, training, recruitment and contracting of third-party support approved in the report and needed to commence next stage.

Prepare a detailed baseline water service performance report, with involvement of the Project Monitoring and Advisory Group, the CWSC.

Include any revisions to the restructuring requirements and the baseline water service performance report in the Detailed Planning and Design Stage report.

Once approval given to proceed to Implementation stage, initiate and complete any institutional restructuring and upgrading required to undertake that stage.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
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<tbody>
<tr>
<td>Project description</td>
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<td>Data and transmission and network plans</td>
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<td>Hydraulic models</td>
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<td>Proposed method of implementation</td>
<td>Prepare detailed capacity plan for Implementation Stage, appropriate to the chosen project implementation option, including roles of staff drawn from existing complement and any training needs recruitment of specialized staff professional support to be contracted out Include capacity planning proposals in Detailed Planning &amp; Design Report to obtain approvals Once approval given to proceed to Implementation stage, adjust existing staffing, training, recruitment and contracting of third-party support approved in the report and needed to commence next stage.</td>
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<td>Detailed finance plan</td>
<td>Prepare detailed capacity plan for Implementation Stage, appropriate to the chosen project implementation option, including roles of staff drawn from existing complement and any training needs recruitment of specialized staff professional support to be contracted out Include capacity planning proposals in Detailed Planning &amp; Design Report to obtain approvals Once approval given to proceed to Implementation stage, adjust existing staffing, training, recruitment and contracting of third-party support approved in the report and needed to commence next stage.</td>
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<tr>
<td>Implementation program, including pilot area work (?) and phasing</td>
<td>Prepare detailed capacity plan for Implementation Stage, appropriate to the chosen project implementation option, including roles of staff drawn from existing complement and any training needs recruitment of specialized staff professional support to be contracted out Include capacity planning proposals in Detailed Planning &amp; Design Report to obtain approvals Once approval given to proceed to Implementation stage, adjust existing staffing, training, recruitment and contracting of third-party support approved in the report and needed to commence next stage.</td>
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<tr>
<td>4. IMPLEMENTATION STAGE</td>
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<td>------------------------</td>
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</tr>
<tr>
<td>If necessary or beneficial, modify outline plan to take account of stakeholder consultation feedback</td>
<td>Designate staff dedicated to manage and undertake implementation of conversion project</td>
</tr>
<tr>
<td>Ensure project funding arrangements in place</td>
<td>If necessary, continue to train existing staff, recruit additional experienced staff and/or contract professional support to assist with Implementation stage</td>
</tr>
<tr>
<td>Prepare tender documentation appropriate to the chosen method of implementation</td>
<td>Assess current manager and staff capabilities and operational capacity and capabilities with respect to operating a water service under 24-7 supply conditions, for example, dealing with the procedures, systems, operational technology and techniques</td>
</tr>
<tr>
<td>Advertise the project and intentions to invite proposals; prepare any prequalification (PQ) requirements and carry out PQ process; invite tenders for contracts</td>
<td>Prepare detailed capacity plan for Operational Stage, appropriate to the chosen project implementation and operational options, including</td>
</tr>
<tr>
<td>Evaluate bids, obtain approval to selected tenderers; conduct negotiations and contract award processes</td>
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<tr>
<td>Works supervision</td>
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<tr>
<td>Prepare progress reports on each contract</td>
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<tr>
<td>Prepare Implementation Stage Report</td>
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</tbody>
</table>
5. OPERATIONAL STAGE

Ensure that managers and staff have capabilities to undertake their duties with respect to 24-7 supply operation, in accordance with the chosen form of implementation and operation, through training, retraining, recruitment and/or contracting of third-party support.

Consider conversion of stakeholder consultations into Customer Service Groups.

Collect operational data – technical, operational, financial and customer – to monitor water service provider performance with respect to levels of service chosen for 24-7 supply operation.
Annex 3: Measuring and Benchmarking Real System Losses (Leakage)

Throughout the period of this preparatory work, the DMA should be fed with water in accordance with its normal intermittent supply entitlement.

Measuring and Benchmarking Real System Losses (Leakage)

The success of a project to convert from intermittency to 24-7 supply is highly dependent upon performance in controlling losses of water from the system.

In the past, leakage management performance has been measured as “percentage of losses.” This criterion is now discredited as it cannot be used to compare performance between providers. The false impression given by leakage performance expressed as percentages can best be understood when considering that, using this criterion, performance could apparently be improved were water production to be increased or customers be encouraged to use more water – without reducing leakage at all!

The proposal of a Task Force of leakage management specialists from around the world, established by the IWA, has recommended a number of more rational criteria for measuring and comparing performance in its publication Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures.

For almost all urban situations in India, the most appropriate performance measure for real or physical losses (leakage) will be: “Liters per service connection per day per meter of system pressure”.

However, this assumes that the system is pressurized 24 hours a day. Whatever losses are presently experienced in India would need to be factored up to represent a notional 24-hour loss for comparison purposes.

In the UK, where the regulator has ensured that water companies reduce their leakage to near economic levels, performance of the 24 companies ranges between: 80 and 220 l per service connection per day which, given the national average system pressure of 45 m, equates to 1.78 and 4.8 l per service connection per day per meter of system pressure.

A newer comparison of performance, also endorsed by the IWA, is a ratio which relates Unavoidable Annual Real Losses (UARL) to Current Annual Real Losses (CARL).

The UARL is the economic level of real losses below which it would cost more to reduce loss than the value placed on that loss. Software is now available to estimate UARL. The ratio is termed the International Leakage Index (ILI) (Figure A3.1).
A survey of about 25 companies conducted by the IWA produced ILIs up to 12. An ILI of two or less is considered excellent (Figure A3.2).

ILIs were estimated in the course of the studies carried out in Delhi, Indore and Guwahati for the workshop held in Hyderabad in September 2003, “24-hour Water Supply: Is This Goal Achievable?” organized by WSP-SA working with GoI, ASCI and the Change Management Forum. In Delhi, one of the best areas studied was the Rohini area of Delhi, whose ILI was estimated at 44. However, the ILI for Guwahati was estimated to be 208. It must however be...
noted that these estimates were based on unreliable data in the absence of any metering practices. At the same time it is evident that much work has to be done on improving the distribution system infrastructure of urban India to bring it to the point where it can be compared to the best internationally. However, this does not need to be achieved all at one time for any city. Only an intermediate situation needs to be targeted in the first instance. In the above example, going by the early estimations of the ILI, although, the Rohini area’s distribution system was clearly not in good condition at the time of the study, it is probable that the area could be converted to 24-7 supply with little intervention on the network other than repairing the back-log of bursts.

The shortcomings of comparing leakage performance between water service providers using leakage volume as a percentage of production have been illustrated at the beginning of this Annex. Plotting percentage performance against ILI underscores the irrelevance of percentages as a comparator between service providers as indicated in Figure A3.3. Some providers having percentage losses near 50 percent have ILIs varying from 10 to 100.

Figure A3.3: Comparing ILI to Percentages
Guidance Notes for Continuous Water Supply (24-7 Supply)

December 2009

WSP MISSION:
WSP’s mission is to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services.

WSP FUNDING PARTNERS:
The Water and Sanitation Program (WSP) is a multi-donor partnership created in 1978 and administered by the World Bank to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services. WSP provides technical assistance, facilitates knowledge exchange, and promotes evidence-based advancements in sector dialogue. WSP has offices in 25 countries across Africa, East Asia and the Pacific, Latin America and the Caribbean, South Asia, and in Washington, DC. WSP’s donors include Australia, Austria, Denmark, Germany, Finland, France, the Bill and Melinda Gates Foundation, Ireland, Luxembourg, Netherland, Norway, Sweden, Switzerland, United Kingdom, United States, and the World Bank. For more information, please visit www.wsp.org.

WSP-SA provides WSP-SA programmatic support.

The Water and Sanitation Program assisted the Ministry of Urban Development (Government of India) to formulate these guidelines for typical issues that need to be addressed to explore approaches to improve water supply and sewerage services, including suitable partnerships with the private sector.

FOR MORE INFORMATION CONTACT: wspsa@worldbank.org