

**INDONESIA**  
**OVERVIEW OF SEWERAGE EXPERIENCE**

**June 30, 1999**

**Urban Development Sector Unit  
Indonesia Country Management Unit  
East Asia and Pacific Region**

## ACRONYMS

ADB	Asian Development Bank
AusAid	Australian Bilateral Assistance
BAPPENAS	National Development Planning Agency
BOD	Biological Oxygen Demand
BOT	Build Operate Transfer
BUDP	Bandung Urban Development Project
CAS	Country Assistance Strategy
EJUDP2	Second East Java Urban Development Project (Ln. 4017-IND)
JSSP	Jakarta Sewerage and Sanitation Project (Ln. 2336-IND)
Kabupaten	District
Kotamadya	City
KUDP	Kalimantan Urban Development Project (Ln. 3854-IND)
O&M	Operations and Maintenance
OECD	Overseas Economic Cooperation Fund (Japan)
PDAM	Local Government Owned Water Utility
PD PAL	Local Government Waste Water Utility
PVC	Poly Vinyl Chloride
PERUMNAS	State Housing Agency
Repelita	Five -Year Development Plan
SSUDP	Semarang Surakarta Development Project (Ln. 3749-IND)
SUDP	Surabaya Urban Development Project (Ln. 3726-IND)
UASB	Up-flow Anaerobic Sludge Blankets
WATSAL	Water Sector Adjustment Loan (Ln. 4469-IND)
WWTP	Waste Water Treatment Plant

**INDONESIA**  
**OVERVIEW OF SEWERAGE EXPERIENCE**

**TABLE OF CONTENTS**

	<b><u>Page No.</u></b>
<b>A. Introduction .....</b>	<b>1</b>
<b>B. Overview .....</b>	<b>2</b>
<b>C. Service Coverage .....</b>	<b>3</b>
<b>D. Institutional and Management Aspects .....</b>	<b>5</b>
<b>E. Financial Matters .....</b>	<b>6</b>
<b>F. Community Awareness .....</b>	<b>7</b>
<b>G. New Sewerage Investments .....</b>	<b>8</b>
<b>H. Issues.....</b>	<b>9</b>

**Tables**

<b>Table 1: Sewerage Investments by City.....</b>	<b>3</b>
<b>Table 2: Number of Connections, Population and Area Served .....</b>	<b>4</b>
<b>Table 3: Treatment Facilities .....</b>	<b>6</b>
<b>Table 4: Sewerage Charging System .....</b>	<b>7</b>

**Figure**

<b>Figure 1: Repelita VI Investments in Urban Water Supply and Sanitation.....</b>	<b>2</b>
--	----------

**Annex**

<b>Annex 1: Summary of Existing Sewerage Situation</b>	
--	--

# INDONESIA

## OVERVIEW OF SEWERAGE EXPERIENCE

### A. Introduction

1. On site sanitation has been the norm so far in Indonesia. Currently only limited sewerage systems exist in the large and medium urban centers in the country; these include systems in cities such as Jakarta, Bandung, Cirebon, Medan, Surakarta and Yogyakarta. With increasing urbanization and greater use of piped water in urban areas, pollution levels have been increasing both in water courses and in wastewater especially in the larger cities. Government therefore felt that it would be appropriate to revisit the policy framework for sustainable urban sanitation. In October 1998, the national planning agency, BAPPENAS, requested the Bank to prepare an Urban Sewerage Policy Framework Paper, as a complement to the 1997 Bank paper on urban water supply and as an extension to the Asian Development Bank (ADB) work on community-based sanitation.
2. *Objectives.* The objective of the current exercise is to undertake the preliminary work for the development of an Urban Sewerage Policy Framework through: (a) taking stock of the current urban sewerage situation in the country, and identifying the main issues that need to be addressed; and (b) undertaking a preliminary desk review of the experiences with urban sewerage in cities of other developing countries, in particular in Asia. The Urban Sewerage Policy Framework itself would be developed during the next phase.
3. This exercise is consistent with the Bank's Country Assistance Strategy (CAS) for Indonesia, which emphasizes strengthening public sector institutions through policy reform in sanitation and preserving existing physical infrastructure in urban areas. It is also consistent with the policy matrix of the Water Sector Adjustment Loan (WATSAL, Loan No. 4469-IND) which requires local governments to control pollution levels in water courses and in wastewater through proper treatment of domestic and industrial waste water.
4. *Study Team and Budget.* Mr. Risyana Sukarma, Sanitary Engineer, EASUR (based in Jakarta) managed the review of the Indonesia experience, with assistance from a consultant, who was supported by short-term research assistants. Mr. Keiichi Tamaki, Urban Planner, EASUR, conducted the preliminary review of experience outside Indonesia, also with the assistance of a consultant. Mr. Raja Iyer, Principal Management Specialist, EASUR, provided overall guidance to Messrs. Sukarma and Tamaki, and finalized this report with assistance from Ms. JoAnne Nickerson, Operations Analyst, and Mr. Rohan Hoole, Summer Assistant, EASUR. Ms. Inneke Herawati, Team Assistant, EASUR, assisted with the production of this report. This phase of work was supported by a Bank budget of \$40,000.
5. *This report.* The preliminary findings of the Indonesia experience, as well as experience outside Indonesia, were discussed with key stakeholders, including central,

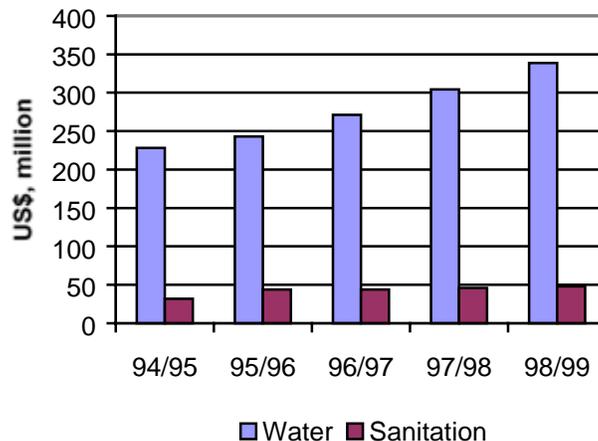
provincial and local government officials, representatives from leading universities, the ADB, as well as bilateral donors, at a Workshop in Jakarta in early May 1999. This report concludes this phase of work and covers the Indonesia part of the exercise. *The findings of the desk review of experience outside Indonesia are currently being refined and will feed into the next phase of work.*

## B. Overview

6. The first modern sewer networks in Indonesia were built by the Dutch in several medium size cities, including Bandung, Cirebon, Surakarta and Yogyakarta, during the first half of the twentieth century. During the last two decades Government, with the support of multilateral and bilateral aid agencies, has expanded these systems and has also developed sewerage systems in other cities, including Jakarta, Medan and Tangerang. As will be seen later, most urban residents in Indonesia, however, continue to rely on on-site sanitation rather than a sewer network, to dispose of human waste.

7. The Government's five-year development plans have allocated substantially larger sums for water supply investments compared to sewerage. For example, in the fifth five year development plan (Repelita V, 88/89 to 93/94), \$1,760 million was allocated for water supply, while the allocation for environmental sanitation was only about \$300 million (about 17% of the allocation for water supply). During Repelita VI (94/95 to 98/99), the allocation for environmental sanitation increased to \$590 million and was 43% of the \$1,380 million allocation for water supply. Of the total Repelita VI allocation for environmental sanitation, \$210 million was allocated for urban sanitation (both on-site and off-site); even this relatively small amount focussed primarily on on-site sanitation. Figure 1 shows the annual investment plans in water supply and urban sanitation during Repelita VI.

**Figure 1**  
**Repelita VI Investments in Urban Water Supply and Sanitation**



8. Table 1 indicates the cost of sewerage investments in each city; these figures exclude investments during the Dutch period. It should be noted that in Surakarta, the

on-going investment program is due to be completed in 2000. It is evident that investments in each city have been quite small, even in large cities like Jakarta and Bandung. In Yogyakarta, the cost of the treatment plant is over 50% of the total cost.

**Table 1**  
**Sewerage Investments by City \***  
(\$ million)

City	Investment Cost
Bandung	32.0
Cirebon	4.5
Jakarta	17.0
Medan	20.0
Surakarta	6.0
Tangerang	1.7
Yogyakarta	30.8

\* Costs in the local currency, the Rupiah, have been converted to dollars, using exchange rates applicable.

### C. Service Coverage

9. This section discusses the extent of service coverage in each of the cities with a sewer system. In general, the existing systems cover only a small part of the city, mainly in the city center and the commercial areas, and in most cases the population served is also quite small. The following paragraphs highlight the situation in each city. Annex 1 provides more detail.

10. *Bandung.* Bandung's original sewerage system was built by the Dutch in 1916. The newer system was built under the ADB financed, first, second, and third Bandung Urban Development Projects (BUDP I, II and III) from the eighties and comprises two separate systems, only one of which has treatment. The west-center system, which includes the old Dutch system, serves about 2,000 ha and the east system serves 800 ha. Together they cover 17% of the city area.

11. Bandung's sewerage system has about 90,000 connections, serving about 450,000 people (20% of the city population). *About 22,000 of these are direct house connections; the remainder are indirect connections through either interceptors or inspection chambers.* A number of small scale industries and hospitals also discharge directly into the sewers, although this is illegal.

12. *Cirebon.* Cirebon has three generations of sewers: (a) a combined storm water and sewerage system constructed in 1920 to serve the commercial areas; (b) a system built in 1978 to serve housing estates built by the state housing agency, PERUMNAS; and (c) a system constructed in 1996 with Swiss assistance. The total service area of 384 ha represents 9.7% of the city area, and the total of about 19,000 connections serves a population of 90,000 (32% of the city population).

13. *Jakarta.* Jakarta's conventional sewerage system in the downtown area was built during the last two decades under the World Bank's Jakarta Sewerage and Sanitation Project (JSSP Ln. 2336-IND). The city also has a low cost sewer system in the PERUMNAS housing estates. A total of 2,300 connections serves a population of 220,000 (2.8% of the city population), in a service area of 1,800 ha.

14. *Medan.* Medan's central city system was built under the ADB's Medan Urban Development Projects, I and II. The service area of 530 ha represents 1.9% of the city area. The 7,400 connections serve 49,000 people, i.e., about 2.25% of the city population.

15. *Surakarta.* The Surakarta sewerage network consists of a system to the south of the city, built by the Dutch in 1940, and a PERUMNAS housing estate system, built in 1984. Both systems are being expanded under the Bank's Semarang Surakarta Urban Development Project (SSUDP, Ln. 3749-IND), due to close in September 2000. When completed, the system will cover 1,165 ha (26% of the city area) and will serve about 70,000 persons (13% of the city population) through an estimated 8,000 connections.

16. *Tangerang.* Tangerang has two sewer systems: a PERUMNAS system built in the late seventies and a separate system covering two sub-districts, completed in the early nineties. A total of 9,800 connections serve about 46,000 persons (about 4% of the city population).

17. *Yogyakarta.* Yogyakarta has a Dutch system built in the mid-thirties, a system in the Gajah Mada University Complex built in the early nineties, and a recently completed treatment plant. The total service area is 1,250 ha (6% of greater Yogyakarta), while the 10,000 connections serve a population of 85,000 (10% of the greater Yogyakarta population).

18. Table 2 summarizes the number of connections and population coverage in each city.

**Table 2**  
**Number of Connections, Population and Area Served**

City	# of Connections ('000)	Population Served ('000)	Population Served (%)	Area Served (%)
Bandung	90.0	450	20 <sup>2</sup>	17
Cirebon	18.8	90	32	9.7
Jakarta	2.3	220	2.8	-- <sup>4</sup>
Medan	7.4	49	2.3	1.9
Surakarta <sup>1</sup>	8.0	70	13	26
Tangerang	9.8	46	4	-- <sup>4</sup>
Yogyakarta <sup>3</sup>	10.1	85	10	6

<sup>1</sup> When completed.

<sup>2</sup> Including through indirect connections

<sup>3</sup> Greater Yogyakarta population/area

<sup>4</sup> Negligible.

#### D. Institutional and Management Aspects

19. *Institutional Arrangements.* The water utilities of the respective cities are now responsible for operating and maintaining the sewerage systems in Bandung, Cirebon, Medan, and Surakarta. Typically, there is a separate division for sewerage, reporting to the President Director or the Technical Director, with sections for planning, operations, etc. Jakarta has a separate sewerage utility, Perusahaan Daerah Air Limbah (PD PAL). The institutional arrangements in Tangerang and Yogyakarta are described below.

20. Following the creation of a separate city government in *Tangerang* (carved out of the earlier district government of Tangerang), the PERUMNAS system is now managed by the sanitary engineering division of the city, while the other system is still managed by the district water utility (even though the system is within the city boundary).

21. In *Yogyakarta*, the institutional arrangements are complicated because the system covers three local government jurisdictions. The local public works departments manage the system in two jurisdictions, whereas the city cleaning department is responsible for sewerage in Yogyakarta. The waste water treatment plant is being managed by the provincial public works department. **In April 1999 agreement was reached to create a separate agency (similar to PD PAL in Jakarta) to take over responsibility for sewerage in greater Yogyakarta.**

22. In nearly all the cities, responsibility for desludging septic tanks and operating sludge treatment plants is still unclear, with the agency responsible for sewerage, and the city cleaning department both having at least informal responsibility for these activities. It is expected that over time this responsibility will go together with responsibility for off-site sanitation.

23. *Operations and Maintenance.* Most of the sewerage systems have gravity flow sewer networks which utilize pumps in certain places to lift wastewater to flow to the treatment plant. In the older generation systems in Bandung, Cirebon, Surakarta, and Yogyakarta, river water is used to flush the sewer, in order to dilute the wastewater and clean the accumulated sediment. Smaller sewer pipes (<400 m.m.) are mostly PVC, with reinforced concrete used for some of the larger pipes; in some places fiberglass pipes are used. In Yogyakarta, the older generation sewer uses egg-shaped pipes.

24. Maintenance is neglected in most of the facilities – both in the older generation sewers, and in the systems constructed in the PERUMNAS housing complexes, e.g., Tangerang. In Yogyakarta, the pipes were blocked and full of garbage, sludge, and grease. Some of the manhole covers were lost, or covered by new road surface. In Tangerang, the PERUMNAS system has been poorly maintained since completion. The exceptions are Bandung and Medan, where manholes, pipes, and pumps are regularly cleaned and repaired during routine maintenance.

25. The most common treatment process comprises stabilization ponds with aeration. In Medan, up-flow anaerobic sludge blankets (UASB) are used prior to aeration. Table 3 indicates the types of treatment facilities in each city. Most plant

effluent conforms to the local water quality standards; however, this is often due either to high infiltration of groundwater into the sewer, or the existence of combined sewer and rainwater drains.

**Table 3**  
**Treatment Facilities**

	<b>Bandung</b>	<b>Cirebon</b>	<b>Jakarta</b>	<b>Medan</b>	<b>Surakarta</b>	<b>Tangerang</b>	<b>Yogyakarta</b>
Type of treatment	Oxidation/ Stabilization ponds	Oxidation/ Stabilization ponds	Aerated ponds	UASB, facultative ponds	Aerated pond	Aerated/ anaerobic ponds	Aerated ponds
Average Treatment capacity (m <sup>3</sup> /day)	81,000	16,000	21,600	20,000	3,750 (design)	5,500	15,500 (design)
Inflow BOD (mg/l)	360	100,225	146	N/A	385	N/A	N/A

26. In most systems, the treatment plant is underutilized due to insufficient inflow as a result of a smaller than planned number of connections, broken pumps, or both. In Bandung, for instance, the plant operates at 30% of capacity. Some treatment plants are unable to properly treat the inflows. In Bandung, effluent from small industries and hospitals affects plant performance, while in Yogyakarta, waste from the batik factory causes treatment problems. Some of the treatment plants have become public health hazards. For example, in Surakarta, Medan, and Yogyakarta, local people fish in the treatment ponds, while in Cirebon children sometimes swim in the pond. Laboratory facilities in some treatment plants are inadequate to carry out the necessary tests.

27. Lack of appropriate staff skills is one of the causes for poor operations and maintenance. Training programs developed in the past have now been discontinued, and technical guidelines and operating manuals are not in use.

### **E. Financial Matters**

28. *Connection Charge.* Connection charges vary by city, and are currently in the range of \$15-70 equivalent. In order to increase the number of connections, cities offer installment payment facilities to consumers, such as in Cirebon, Medan, and Surakarta. In Cirebon, a community cooperative, Mitra Swadaya, provides loans to its members for payment of the sewer connection charge. In Cirebon and Medan, the connection charge is below cost.

29. *Sewerage Charge.* A range of practices are in vogue with regard to the monthly charge for sewerage. In Bandung, Cirebon, Medan and Surakarta, where the water utilities manage the sewerage system, the sewerage charge is included in the water bill, either as a percentage surcharge to the water bill or through a tariff based on water use. In Jakarta the sewerage charge is based on floor area, while in Yogyakarta it is based on the number of residents. Unfortunately in some cases the customer is not billed at all, e.g., those connected to the PERUMNAS system in Tangerang, and to the old Dutch systems in Surakarta and Cirebon. Table 4 indicates the charging system in various cities.

**Table 4**  
**Sewerage Charging System**

City	Basis
Bandung	30% surcharge on water bill
Cirebon	15% surcharge on water bill, including for those without sewer connection. Additional 25% environmental fee, payable to the city.
Jakarta	Based on floor area and type of building use, e.g., residential, commercial.
Medan	Based on water use and floor area and type of building use, e.g., residential, commercial.
Surakarta	Propose to bill based on water use.
Tangerang	Not billed
Yogyakarta	Based on number of residents and type of building use. Those outside city are not billed.

30. *Cost Recovery.* Almost all of the sewer systems rely on government subsidies to meet operations and maintenance costs. For example, in Yogyakarta, the provincial government fully subsidizes the cost of operating the treatment plant. Large annual subsidies are also required in Medan, Tangerang, and Surakarta. (The Surakarta system is expected to recover full O&M costs in the next two years.) Even PD PAL in Jakarta is dependent on government subsidies to cover O&M costs. Three factors contribute to the need for subsidies: (a) failure to make the planned number of connections (e.g., only 7,400 connections have been provided in Medan, against plans for 30,000, and in Yogyakarta only 10,000 connections provided against plans for 17,000); (b) low or no tariffs; and (c) sewerage facilities are operated without a proper commercial incentive framework.

31. All of the investments have been financed through central government or bilateral grants to the provincial or local governments instead of market-rate loans.

### **F. Community Awareness**

32. A limited number of interviews were conducted in each city as part of this study to ascertain community awareness about sewerage and views on the sewerage system in their city. Because of the small sample size, these findings should be considered indicative rather than conclusive.

33. In general, members of the community had very limited knowledge of the sewerage systems in their cities. In Medan, consumers interviewed did not know where to report a clogged sewer. In one area of Surakarta, people built their houses with septic tanks, as they did not know that the street was sewered. However, in another area of Surakarta, people were willing to connect to the sewer system, as they were told that the connection was free and that there would be no monthly charge; in the same area, some consumers disconnected from the sewerage system because the pipe was blocked. In Tangerang, people complained that the sewer pipes and manholes were all clogged. They

overcame the problem by either clearing the pipes themselves or by breaking the pipes to keep the sewage flowing into nearby drains. On the positive side, residents in Cirebon and parts of Tangerang were satisfied with the sewerage system and indicated that the sewers were well maintained.

34. *The Malang System.* In contrast to the general lack of customer awareness is the success story of a small community-based sewer system in Malang (East Java). Mr. Agus Gunarto, a local resident of Malang, designed and built a sewerage system for 60 households in his neighborhood (sewage led to a concrete treatment tank, with the treated effluent flowing into the Brantas river). The community contributed to the construction costs and pays monthly charges to cover operating costs. The system has been functioning for ten years and has since been replicated in five other neighborhoods in Malang. This local initiative in raising community awareness on sanitation issues, and developing successful pilots in Malang has won Mr. Gunarto considerable national and international recognition. He was an invited speaker at the Bank's 1999 Water Forum, when he presented the findings of an AusAid-funded study on the Malang systems.

### G. New Sewerage Investments

35. New sewerage investments are in varying stages of design and implementation in a number of cities, with Japanese, World Bank or other bilateral support.

36. *Japanese Supported Investments.* The Japanese government is supporting sewerage investments in Denpasar (Bali), Ujung Pandang (South Sulawesi) and Jakarta.

37. In the Denpasar metropolitan area, a two-phased approach is planned, with the first phase covering the city center, and the tourist areas of Kuta and Sanur. When completed in 2004, Phase I will cover about 1,750 ha, and serve 150,000 people. The total investment of \$35 million was to be partly financed by an OECF loan and partly by the central government, with about \$4 million being on-lent to the provincial government of Bali. It is not clear if the investments will be able to recover operations and maintenance costs. The project is currently on hold.

38. The Ujung Pandang project envisages three sub-systems, with a total service area of about 650 ha, and population coverage of about 220,000 persons. It is expected to cost about \$7 million, excluding land costs. Although the Master Plan has been completed with Japanese financing, there are no firm plans for implementation. The Japanese are also likely to support expansion of the Jakarta system.

39. *World Bank-Financed Investments.* The Bank's Kalimantan Urban Development Project (KUDP, Loan No. 3854-IND) is supporting pilot projects in Banjarmasin, South Kalimantan (15 ha service area, population served 5,000 equivalent, investment cost of \$0.5 million as a grant to the city) and Balikpapan, East Kalimantan (40 ha service area, 796 house connections, and investment cost of \$0.5 million as a grant to the city). It is expected that the respective water utilities will operate the systems, with the full costs of operations and maintenance being recovered. Pilots are also planned in Samarinda under KUDP, in Surabaya, under the Surabaya Urban Development Project

(SUDP, Loan No. 3726-IND), and in Malang, under the Second East Java Urban Development Project (EJUDP2, Ln. 4017-IND).

40. *Other Systems.* A central government built system in Parapat, North Sumatera on Lake Toba (a tourist destination) is not yet operational. Sewer systems are also under implementation in Bengkulu and Padang in Sumatera, with German assistance.

## H. Issues

41. This brief review confirms anecdotal information on urban sewerage in Indonesia: extremely limited coverage, generally poor service quality, reliance on government subsidies for both investments and O&M, and insufficient community awareness. In view of the importance of proper sanitation from both public health and environmental perspectives, developing and implementing an Urban Sewerage Policy Framework for efficient and sustainable service is deservedly a high priority for GOI. The subsequent paragraphs provide an overview of the issues that need to be addressed in the Policy Framework.

42. *Existing Sewerage Systems.* Over \$100 million have been invested in the past two decades on urban sewerage, with the major investments being in the cities of Bandung, Yogyakarta, Medan and Jakarta. Careful consideration should be given to finding ways to maximize the benefits from these investments, while ensuring that the beneficiaries contribute to the full recovery of O&M costs within a short period.

43. *Sewerage Investments in the Pipeline.* The financial and economic aspects of sewerage investments in the pipeline, especially the larger ones in greater Denpasar and Ujung Pandang, need to be carefully reviewed before commencing project implementation. Even after allowing for externalities, the tariff structure should, at a minimum, be adequate to achieve O&M cost recovery. A contribution to recovering at least a portion of the capital costs, e.g., interior plumbing, house connections, secondary sewer network, from the beneficiaries should be given serious consideration. It is evident, however, that these investments would not increase overall service coverage in urban areas significantly.

44. *Expansion in Service Coverage.* In view of the substantial investments required, it is unlikely that a significant expansion in service coverage (either in cities that already have limited sewer networks or in urban areas currently without sewerage) can be achieved in the near term. Urban centers for which off-site sanitation is essential (either because of groundwater conditions or because of population density) would need to be identified and prioritized in order to optimize benefits from limited available resources.

45. *Financing Sewerage Investments.* Determination of the appropriate basis for financing sewerage investments will be the key element of the sewerage framework. The options range from financing under commercial terms to grant financing, with a wide range of intermediate combinations of loans at subsidized terms mixed with grants in between. Factors influencing the choice of financing arrangements would need to include, inter alia, an analysis of the externalities, ability and willingness to pay, and

experience of urban areas in other developing countries, especially in Asia. As discussed earlier, ability to recover O&M costs would be an important benchmark for sustainability.

46. *Role of the Community.* The Malang case study highlights the role the community can play in making sanitation investments sustainable. Experience in other developing countries confirms that sustainability is more likely if the community is consulted about the technological and financial choices and participates in the decision making process. The Policy Framework should, therefore, consider an appropriate role for the community, especially when making major investment decisions.

47. *A Well Functioning On-Site Sanitation System.* In many cities of Indonesia, on-site sanitation is likely to be the only solution in the medium term. It is, therefore, imperative that means be developed to ensure that septic tanks are properly constructed as per approved standards, desludged regularly, and the sludge is discharged only in a functioning sludge treatment plant.

48. *Role for the Private Sector.* As in the case of water supply, the private sector could play a major role in providing an efficient urban sewerage service, possibly without recourse to public funds. The full range of private sector participation, from BOTs for treatment plants to management contracts and concessions for entire systems, should be carefully examined and appropriately provided for in the Policy Framework.