

Document of  
The World Bank

Report No: ICR00001028

IMPLEMENTATION COMPLETION AND RESULTS REPORT  
(IBRD-45510)

ON A LOAN

IN THE AMOUNT OF USD 145.0 MILLION EQUIVALENT

TO THE

TEHRAN SEWERAGE COMPANY

FOR A

TEHRAN SEWERAGE PROJECT-Phase 1

June 29, 2009

**Sustainable Development Department  
Middle East Country Department  
Middle East and North Africa Region**

## CURRENCY EQUIVALENTS

(Exchange Rate Effective March 2, 2009)

Currency Unit = Iranian Rial (IRR)

IRR 1.00 = US\$ 0.000103  
US\$ 1.00 = IRR 9,694

## FISCAL YEAR

March 21 to March 20

## ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
DBO	Design Build Operate
GOI	Government of Iran
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion Report
IMF	International Monetary Fund
IRR	Internal Rate of Return
ISR	Implementation Status and Results
LC	Letter of Credit
MDG	Millennium Development Goals
M&E	Monitoring and Evaluation
MIS	Management and Information System
MOE	Ministry of Energy
MTR	Mid-Term Review
NGO	Non-Governmental Organization
NWWEC	National Water and Wastewater Engineering Company
O&M	Operation and Maintenance
PAD	Project Appraisal Document
PDO	Project Development Objective
PMU	Project Management Unit
QEA	Quality at Entry
QSA	Quality of Supervision
TPWWC	Tehran Province Water and Wastewater Company
TSC	Tehran Sewerage Company
WHO	World Health Organization
WSS	Water Supply and Sanitation
WTP	Willingness to Pay
WWTP	Wastewater Treatment Plant

Vice President:	Daniela Gressani
Country Director:	Hedi Larbi
Sector Manager:	Narasimham Vijay Jagannathan
ICR Team Leader:	Lizmara Kirchner

# ISLAMIC REPUBLIC OF IRAN

## Tehran Sewerage Project

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MAP

<b>A. Basic Information</b>			
Country:	Iran, Islamic Republic of	Project Name:	Tehran Sewerage project
Project ID:	P069946	L/C/TF Number(s):	IBRD-45510
ICR Date:	06/30/2009	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	ISLAMIC REPUBLIC OF IRAN
Original Total Commitment:	USD 145.0M	Disbursed Amount:	USD 145.0M
<b>Environmental Category: A</b>			
<b>Implementing Agencies:</b> TSC			
<b>Cofinanciers and Other External Partners:</b>			

<b>B. Key Dates</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	01/28/1999	Effectiveness:		11/28/2000
Appraisal:	01/14/2000	Restructuring(s):		
Approval:	05/18/2000	Mid-term Review:		12/06/2004
		Closing:	06/30/2006	06/30/2008

<b>C. Ratings Summary</b>	
<b>C.1 Performance Rating by ICR</b>	
Outcomes:	Satisfactory
Risk to Development Outcome:	Low or Negligible
Bank Performance:	Satisfactory
Borrower Performance:	Satisfactory

<b>C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)</b>			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Moderately Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
<b>Overall Bank Performance:</b>	Satisfactory	<b>Overall Borrower Performance:</b>	Satisfactory

<b>C.3 Quality at Entry and Implementation Performance Indicators</b>			
Implementation Performance	Indicators	QAG Assessments (if any)	Rating
Potential Problem Project	No	Quality at Entry	None

at any time (Yes/No):		(QEA):	
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	Satisfactory
DO rating before Closing/Inactive status:	Satisfactory		

#### D. Sector and Theme Codes

	Original	Actual
<b>Sector Code (as % of total Bank financing)</b>		
Central government administration	5	5
Sewerage	95	95
<b>Theme Code (as % of total Bank financing)</b>		
Access to urban services and housing	24	25
Pollution management and environmental health	25	25
Public expenditure, financial management and procurement	13	13
State enterprise/bank restructuring and privatization	13	24
Water resource management	25	13

#### E. Bank Staff

Positions	At ICR	At Approval
Vice President:	Daniela Gressani	Kemal Dervis
Country Director:	Hedi Larbi	Inder K. Sud
Sector Manager:	Narasimham Vijay Jagannathan	Jamal Saghir
Project Team Leader:	Lizmara Kirchner	Mohammed Benouahi
ICR Team Leader:	Lizmara Kirchner	
ICR Primary Author:	Diego Juan Rodriguez	

#### F. Results Framework Analysis

##### Project Development Objectives (from Project Appraisal Document)

The major development objective is to improve the environmental conditions for the Greater Tehran population. The objectives would be achieved through:

- Provision of satisfactory wastewater collection and treatment facilities for about 2.1 million people covering an area of about 16,500 hectares;
- Improvements in public health and reduction of surface and ground water pollution;
- Provision of treated wastewater for irrigation of about 15,000 hectares on the Varamin plain;

- Development of the TSC into a fully autonomous entity to be operated on a commercial basis; and
- Facilitation of private sector participation in the sector through contracting out various TSC functions, such as engineering, construction supervision and O&M.

**Revised Project Development Objectives (as approved by original approving authority)**

Not applicable

**(a) PDO Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1 :</b>	Area covered (hectares)			
Value quantitative or Qualitative)	Zero	16,500 hectares		16,500 hectares
Date achieved	12/16/1999	06/30/2006		06/30/2008
Comments (incl. % achievement)	There were minor changes to the project area during implementation, which did not affect its final area - 100% achieved			
<b>Indicator 2 :</b>	Population Served			
Value quantitative or Qualitative)	639,129	2,003,000		2,025,600
Date achieved	12/16/1999	06/30/2006		06/30/2008
Comments (incl. % achievement)	Actual value calculated based on 211,000 existing sewerage connections. Each connection serves on average 2.4 households and have on average 4 people. Level of achievement is 101%.			
<b>Indicator 3 :</b>	Number of Service Connections			
Value quantitative or Qualitative)	21,127	195,000		211,000
Date achieved	12/16/1999	06/30/2006		10/31/2008
Comments (incl. % achievement)	Level of achievement 108%			
<b>Indicator 4 :</b>	Decrease in diarrhea occurrence (% in pilot area south of Tehran)			
Value quantitative or Qualitative)	Not available	10%		9%
Date achieved	12/16/1999	06/30/2006		05/30/2005
Comments (incl. % achievement)	A study undertaken in 2005 has indicated that, for a pilot area, the implementation of sewerage networks decreased the risk of diarrhea incidence by 9%. The study surveyed 2083 individuals in 2001 and 2096 in 2005 (control and experimental groups).			
<b>Indicator 5 :</b>	Quality of groundwater sources for water supply use			

Value quantitative or Qualitative)	No bselined value	No target value established in the PAD		Analysis of nitrate levels in groundwater showed levels of nitrates much higher in wells located outside of the project targeted area.
Date achieved	12/16/1999	06/30/2006		12/31/2008
Comments (incl. % achievement)				
<b>Indicator 6 :</b>	Quantities of treated effluents ('000 m3/day)			
Value quantitative or Qualitative)	1,265	146,428		125,700
Date achieved	12/16/1999	06/30/2006		03/20/2008
Comments (incl. % achievement)	Before the WWTP started operation the treated of wastewater collected was done at the temporary treatment plant (lagoons) and the wastewater in excess is delivered to the Feroozabad Canal. These effluents are expected to be treated at the WWTP.			
<b>Indicator 7 :</b>	Nematode eggs in treated effluents (#/1000 ml); nematode eggs in treated sludge (#/100 g)			
Value quantitative or Qualitative)	Not applicable	Less than 1 for both indicators		Data not available as the operation of the WWTP only started on June 15, 2009.
Date achieved	12/16/1999	06/30/2006		06/30/2008
Comments (incl. % achievement)	This indicator was featured as a specification/requirement in the bidding process for the DBO contract for the WWTP construction. As such, it is anticipated that this target will be 100% met once the WWTP is fully operational in December 2009.			
<b>Indicator 8 :</b>	Increase in irrigated areas (hectares)			
Value quantitative or Qualitative)	35,000 hectares	45,000 hectares		3,750 hectares
Date achieved	12/16/1999	06/30/2006		06/11/2009
Comments (incl. % achievement)	With the start of operation of the WWTP in June 2009, this target can be considered 25% achieved. When the WWTP becomes fully operational in December 2009, the volume of treated effluents will allow for the irrigation of 15,000 hectares, 100% achievement			
<b>Indicator 9 :</b>	Tariff increases (average volumetric charge)			
Value quantitative or Qualitative)	458 IRR/m3	2,103 IRR/m3		618 IRR/m3
Date achieved	12/16/1999	06/30/2006		12/31/2008

Comments (incl. % achievement)	Original target was established based on the assumption that tariffs would increase by 22% (in nominal terms) per year. Based on lack of progress on this issue the appraisal target was informally revised at the mid-term review to an average 691 IRR/m3.			
<b>Indicator 10 :</b>	TSC to maintain positive cash flow			
Value quantitative or Qualitative)	TSC cash flow is positive	TSC cash flow is positive		TSC cash flow is positive
Date achieved	12/16/1999	06/30/2006		12/31/2008
Comments (incl. % achievement)	TSC maintained a positive cash flow throughout the project's implementation period. Level of achievement is 100%.			
<b>Indicator 11 :</b>	Private sector inputs (% of total)			
Value quantitative or Qualitative)	100% for construction, 80% for technical assistance.		100% for construction, 100% for technical assistance.	100% for construction, 100% for technical assistance
Date achieved	12/16/1999		06/30/2006	06/30/2008
Comments (incl. % achievement)	100% achievement.			
<b>Indicator 12 :</b>	Number of TSC employees per 1,000 connections			
Value quantitative or Qualitative)	9	2		1.3
Date achieved	12/16/1999	06/30/2006		12/31/2008
Comments (incl. % achievement)	The target was fully achieved in a short period of time, given the large number of new connections installed under the project and outsourcing of different areas of operation.			

**(b) Intermediate Outcome Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
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**G. Ratings of Project Performance in ISRs**

No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	06/30/2000	Satisfactory	Satisfactory	0.00
2	08/04/2000	Satisfactory	Satisfactory	0.00
3	12/29/2000	Satisfactory	Satisfactory	4.95
4	05/01/2001	Satisfactory	Satisfactory	13.87

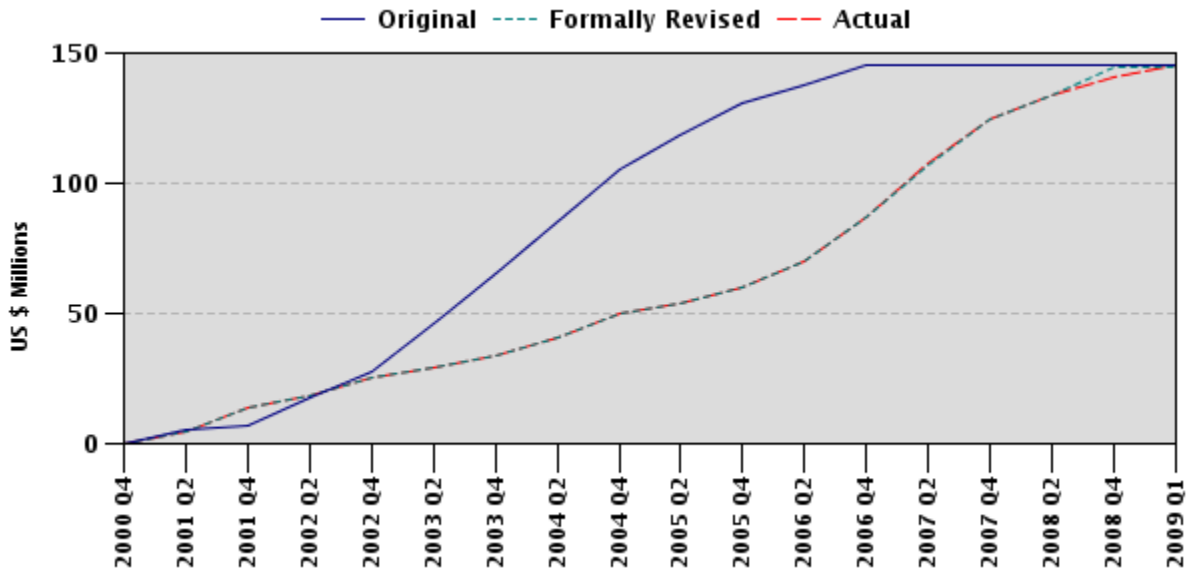


5	08/07/2001	Satisfactory	Satisfactory	13.87
6	02/28/2002	Satisfactory	Satisfactory	21.24
7	08/01/2002	Satisfactory	Satisfactory	26.25
8	03/04/2003	Satisfactory	Satisfactory	30.53
9	07/25/2003	Satisfactory	Satisfactory	34.05
10	01/30/2004	Satisfactory	Satisfactory	46.49
11	06/18/2004	Satisfactory	Satisfactory	49.89
12	12/22/2004	Satisfactory	Satisfactory	54.02
13	05/02/2005	Satisfactory	Satisfactory	55.36
14	11/04/2005	Satisfactory	Satisfactory	66.02
15	06/09/2006	Satisfactory	Satisfactory	86.64
16	12/22/2006	Satisfactory	Satisfactory	107.32
17	06/28/2007	Satisfactory	Satisfactory	124.33
18	11/30/2007	Satisfactory	Satisfactory	133.85
19	06/02/2008	Satisfactory	Satisfactory	141.02

**H. Restructuring (if any)**

Not Applicable

**I. Disbursement Profile**



## 1. Project Context, Development Objectives and Design

### 1.1 Context at Appraisal

1. The Islamic Republic of Iran was an active World Bank borrower until the early 1970s when lending ceased due to a jump in oil revenues and the country graduated from borrower status. Lending resumed in 1991, primarily due a large earthquake and the effects of the long war with Iraq, which resulted in declines in income levels. At the same time, the Government of Iran (GOI) initiated a program of economic reform and major reconstruction. During the period between 1991 and 1993, the World Bank made six loans to Iran, totaling US\$847 million.<sup>1</sup>

2. In 1991, the GOI approved an *Act on the Establishment of Water and Sewerage Companies* that set the institutional and governance framework for the reform in the water sector. This Act re-organized the 11 Regional Water Boards (previously in charge of most urban water supply and wastewater services together with water resources management) into entities with focus on water resources development and management in each of the country's 11 river basins, including bulk water distribution. The Act also provided for the creation of Provincial Water and Wastewater Companies for each of the country's 21 provinces, with the possibility of creating smaller water and sewerage companies for limited geographical areas within a province (which resulted in the creation of 6 city Water and Wastewater Companies in larger provincial capitals);<sup>2</sup> enabling the establishment of these companies as financially autonomous corporate bodies, operated under Iran's Commercial Code. For the Tehran Province, this entailed the establishment of the Tehran Province Water and Wastewater Company (TPWWC). In addition, the referred legislation also provided for the creation of 30 Rural Water Companies, responsible for water service provision in rural areas.

3. The Provincial and City Water and Wastewater Companies as well as the Rural Water Companies were supported, at the national level, by the National Water and Wastewater Engineering Company (NWVEC) – operating under the Ministry of Energy (MOE), and reporting directly to the Vice Minister for Water and Wastewater Affairs – in matters of policy, investment planning, and human resources development and in the establishment of standardized systems and procedures.

4. The World Bank initiated the formulation of this project with the government in the period of 1992 – 1993, in which the GOI requested World Bank support to its program of reforms to achieve decentralization in the water and wastewater sector, more financial autonomy through the provision of services on a more commercial and consumer oriented basis, and a series of policy reforms. The Government was particularly concerned with the deteriorating environmental conditions in Tehran caused primarily by the lack of a proper wastewater collection and disposal services. At the time of project preparation, only 9% of the population in Tehran had sewerage connection. Although the GOI had identified as a priority the provision of

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<sup>1</sup> The loans financed the Earthquake Recovery Project (Loan 3301-IRN), Sistan River Flood Works Rehabilitation (Loan 3478-IRN), Tehran Drainage Project (Loan 3479-IRN), Irrigation Improvement (Loan 3570-IRN), Power Sector Efficiency (Loan 3583-IRN), and Health and Family Planning (Loan 2584-IRN)

<sup>2</sup> These were for the following cities: Tehran, Shiraz, Ahwaz, Esfahan, Mashhad and Hamedan.

wastewater collection and disposal services for some time, for many years the GOI was unable to effectively mobilize sector institutions, particularly the TPWWC, to address this issue on a large scale; and during project formulation, the establishment of a separate company to provide wastewater collection and disposal services for Greater Tehran was discussed.

5. In 1993 when the project was ready to be appraised, new Bank lending was not possible for a variety of reasons, and bilateral relations were limited to implementation of ongoing projects, analytical work and technical assistance. Bank lending resumed in the year 2000 with the approval of this operation and the Second Primary Health Project (Loan 4550-IRN).<sup>3</sup>

6. In order to promote accountability and autonomy of its line management, the TPWWC commenced in 1996 a program for spinning off line units into subsidiary companies to operate as independent profit centers, with the TPWWC retaining the majority shareholdings. As such, three municipal water supply companies were created in three towns of the Tehran Province; six zonal distribution companies within Greater Tehran and the Tehran Sewerage Company (TSC) were also established. TSC was delegated the responsibility for wastewater collection and disposal services; the company was to carry out the TPWWC's ambitious program of wastewater collection and treatment service expansion, and to operate the facilities once they were built.

7. During project preparation, the sector situation of wastewater collection and disposal in Tehran can be summarized as follows:

- a. About 21,000 sewer connections were in operation, serving a population of about 640,000 and corresponding to an overall connection rate of about 9%.
- b. Nine small wastewater treatment plants (WWTP) were in operation and, despite overloading, they were performing reasonably well treating about 1.3 million m<sup>3</sup> of wastewater per year.
- c. The remaining population in the city was served by absorption wells which, through infiltration or overflowing pollute ground and surface water sources.
- d. Inadequate level of cost recovery.

## **1.2 Sector Issues Identified at Appraisal**

8. At the time of appraisal, three main issues were identified as facing the wastewater sector in Greater Tehran: (a) poor performance of on-site wastewater disposal facilities, causing an increased risk for ground and surface water pollution; (b) sector institutions that still had to gain adequate autonomy and be operated on a commercial basis; and (c) complicated tariff structures and arrangements for transfer of revenues from the TPWWC to the TSC.

9. In addition to contributing to ground water pollution, the poor performance of on-site wastewater disposal facilities was mainly due to the following:

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<sup>3</sup> Given the absence of lending since 1993, there was no current CAS at the time of Board approval of this project. An Interim CAS was discussed by the Board on April 16, 2001 (Document Number 22050-IRN).

- a. In the southern zones of Tehran, the proportion of fine materials in the soil is higher making absorption pits unstable. This issue affected large areas of the city with a population in excess of 2.3 million.
- b. In the northern portion of the city, major problems are experienced because of the impervious nature of the ground due to geological outcroppings, as well as the high water table encountered in this zone (in some areas within two meters of the surface). As such, wells in these areas fill rapidly and require emptying every three to six months to avoid overflow into surface streams.

10. With regards to autonomy and commercial operation of sector institutions, the TSC started its operation on a small-scale; the majority of its existing assets had not been officially transferred and recorded in company's financial statements. In addition, at the time of project preparation the TSC's audited financial statements showed operating losses despite its good collection rate and significant increases approved by the GOI to the connection fees (in the order of 100 to 300 percent between 1997 and 1999) and tariffs (on average by 22% annually between 1997 and 1999, which was still below the inflation rate of 24% in 1999), demonstrating the inadequate level of its tariffs at the time.

11. As the TSC was to grow into a much larger operation, with an objective to significantly increase its number of users, the company had the option of evolving either into a ponderous public enterprise doing most things in-house, or a more effective leaner structure focused on planning, finance as well as project management and contracting out execution and operation tasks to private firms. In its Letter of Sector Policy, the GOI expressed its commitment to increasing tariffs and connection fees in order to ensure adequate recovery of the TSC's operating and investment costs, assuring therefore the TSC's long-term sustainability. As such, the Loan Agreement was signed with the TSC with a guarantee given by the GOI. In addition, a side letter was signed between GOI, as the loan Guarantor, and the Bank in which annual tariff adjustments of 22% on average would be applied.

12. Complicated tariff structures and arrangements for transfer of revenues from the TPWWC to the TSC. Sector tariff structures and connection charges applied were based on overly complex calculations that should be simplified and made clear to water users and decision makers. For the particular case of Tehran, which was the only case where a separate company (i.e., the TSC) was in charge of sewage collection and disposal services, charges for sewage collection and disposal were billed to consumers by the TPWWC in the water bill and this revenue was transferred to the TSC.

13. After the Act of 1991, the GOI decided to introduce a fee equivalent to 10% of the water bill to households that are not connected to sewerage services in order to provide additional financing to sewerage investments. Again, for the particular case of Tehran, it meant that this charge would be collected by the TPWWC in the water bill and transferred to the TSC.

14. The financial analysis undertaken during project preparation established that the TPWWC transferred to the TSC an amount in the order equivalent to 15% of the TPWWC's total operating revenues and connection fees, and that the continuity of these transfer was necessary to ensure the TSC's future financial viability. As such, in the GOI's Letter of Sector Policy, the government outlined its commitment to ensuring that 15% of the TPWWC's total operating

revenues and connection fees would be transferred to the TSC on a regular basis, in addition to the TSC's sewage collection and disposal revenues.

## 1.2 Original Project Development Objectives (PDO) and Key Indicators (as approved)

15. The original PDO was to improve the environmental conditions in Greater Tehran through:

- a. Provision of satisfactory wastewater collection and treatment facilities for about 2.1 million people covering an area of about 16,500 hectares.
- b. Improvements in public health and reduction of surface and ground water pollution.
- c. Provision of treated wastewater for irrigation of about 15,000 hectares on the Varamin Plain.
- d. Development of the TSC into a fully autonomous entity to be operated on a commercial basis.
- e. Facilitation of private sector participation in the sector through contracting out various TSC functions, such as engineering, construction supervision and O&M.

16. Key performance indicators identified and selected for the PDO were as follows:

Project Development Objectives	Key Performance Indicators
Provide satisfactory wastewater collection and treatment	<ul style="list-style-type: none"> <li>• Area covered (hectares)</li> <li>• Population served ('000)</li> <li>• Number of service connections ('000)</li> <li>• Decrease in diarrhea occurrence (%) (pilot area south of Tehran)</li> </ul>
Safeguard ground water sources for water supply use	<ul style="list-style-type: none"> <li>• Quality of ground water source at individual wells</li> </ul>
To provide treated wastewater or irrigation	<ul style="list-style-type: none"> <li>• Quantities of treated effluents ('000 m<sup>3</sup>/day)</li> <li>• Nematode eggs in treated effluents (#/1000 ml)</li> <li>• Nematode eggs in treated sludge (#/100g)</li> <li>• Increase in irrigated areas (hectares)</li> </ul>
To develop the TSC into an autonomous entity to be operated on commercial basis	<ul style="list-style-type: none"> <li>• Training to be carried out (annual budgeted amount spent in %)</li> <li>• Tariffs increases (%) in               <ul style="list-style-type: none"> <li>- volumetric charges and</li> <li>- connections fees</li> </ul> </li> <li>• TSC to maintain positive cash flow</li> </ul>
To facilitate private sector participation	<ul style="list-style-type: none"> <li>• Private sector inputs (as % of total):               <ul style="list-style-type: none"> <li>- construction</li> <li>- technical assistance/consultant service</li> <li>- project management</li> </ul> </li> </ul>

## 1.3 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

17. The PDO was not revised during project implementation.

## 1.4 Main Beneficiaries

18. The beneficiaries of the project were identified as 2.1 million people covering an area of about 16,500 hectares in Tehran that would benefit from the provision of satisfactory wastewater collection and treatment facilities, as well as reduced health risks due to the improved sanitary and environmental conditions in the city. In particular, the project design targeted low income groups living in the southern part of the city, which represented about 65% of the total population expected to be covered by the project.

19. The farmers of the Varamin Plain would also benefit by having increased agricultural outputs through the use of treated effluents for irrigation and of treated sludge for soil conditioning. The project's wastewater investments were expected to provide additional treated water for irrigation for approximately 15,000 hectares on the Varamin Plain.

## 1.5 Original Components (as approved)

20. The project originally consisted of six components:

21. Component 1 – Interceptors and Laterals. This component comprised the installation of 2,390 km of laterals and interceptors to collect wastewater in the northern, southern and partly in the central areas of Tehran for discharge into the western and eastern trunk mains. Areas expected to be covered were 5,600 hectares (in the north), 10,000 hectares (in the south) and 900 hectares (in the center) with a total population of about 2.1 million.

22. Component 2 – Western Trunk Main. This component entailed the construction of 10 km of the western trunk main, which was expected to be laid as a pipeline. The total length of the western trunk was planned to be about 24 km, out of which about 14 km southern part had already been laid.

23. Component 3 – Eastern Trunk Main. Under this component, the eastern trunk main would be constructed as a tunnel. The total length of the tunnel was planned to be approximately 20 km (4 km in the northern part and 16 km in the southern part), of which a 4 km culvert already had been constructed.

24. Component 4 – Wastewater Treatment Works. This component comprised the construction of the first phase of a WWTP in the south of Tehran with a capacity of 450,000 m<sup>3</sup>/day or 5.2 m<sup>3</sup>/second. The wastewater would be treated to a quality that, after dilution with surface water, would enable unrestricted irrigation. Secondary treatment was proposed with chlorination for disinfecting treated effluents, with provisions made for the extension to tertiary treatment, if required.

25. The treated effluents would be utilized under the existing Varamin irrigation scheme. Out of 70,000 hectares identified as suitable for irrigation on the Varamin plain, an area of 50,000 hectares had already been developed when the project was appraised, but only 35,000 hectares were under agricultural production. The treated effluent would enable the full utilization of the 50,000 hectares. During the non-irrigation season surface water and treated effluents (about 40% of annual production) would be used for ground water recharge.

26. The close proximity of the proposed treatment works to agricultural areas provided a useful output of sludge to be produced. The sludge could be applied only to cotton and cereal crops at a rate of 8 tons per hectare per year (lowest feasible rate). The strategy contemplated at the time of appraisal was to maximize the area to which the sludge could be applied to approximately 12,000 hectares.

27. Component 5 – Operation and Maintenance Equipment. This component would finance operation and maintenance equipment for works to be operated by the TSC and possibly for equipment to be owned by the TSC and leased to operating and maintenance contractors as needed. The equipment would include: water jets, closed circuit television equipment, rods and pumps. This component also included financing for office equipment and vehicles.

28. Component 6 – Consultant Services / Technical Assistance. This component was formulated to provide technical assistance and comprised various consultant assignments and support aimed at: (i) enhancing the TSC's project management capabilities, (ii) strengthening the TSC and providing capacity building to enable its development into an autonomous entity operating on a commercial basis, (iii) complement the TSC's engineering capacity in areas where shortcomings had been identified, such as the treatment works turnkey tender specifications, (iv) construction supervision in order to ensure that contracts were executed according to their specifications, (v) the preparation and implementation of an environmental monitoring system to monitor the quality of the effluent discharges from the WWTP, (vi) updating the sewerage development program for Greater Tehran based on recent development and projections of future demand for wastewater services, (vii) prepare the design and criteria for phase two, based on the project's implementation experience.

## **1.6 Revised Components**

29. No revisions were made to the project components; however, actual component costs differed from the appraised amounts. As shown in the table below, the cost of interceptors and laterals, which were constructed during the early years of implementation, were 60% lower than the appraisal estimate, mainly due to increased competition as a result of new entrants into the manufacturing and construction markets. The higher than estimated costs of the remaining components are mainly a result of delays, high inflation in the face of a relatively constant exchange rate,<sup>4</sup> and the devaluation of the US Dollar against the Euro. A detailed explanation of the differences between appraised and final cost estimates can be found in Annex 1. As a result, two reallocation of funds were requested by the Borrower and approved by the Bank on September 2006 and June 2008.

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<sup>4</sup> Between 2002 and 2006 the inflation fluctuated between 12 and 16%, in 2007 it was around 18% and in 2008 24%. The contracts for the construction of the trunk mains was mostly in IRR, while the DBO contract for the construction of the WWTP was in Euros and IRR. The IRR exchange rate fluctuated between IRR 8,200 and

Components	Appraisal Estimate (US\$ millions)	Actual/Latest Estimate (US\$ millions)	Percentage of Appraisal
1. Interceptors and Laterals	209.30	127.10	61%
2. Trunk Main and Tunnels	46.60	83.09	178%
3. Wastewater Treatment Works	64.00	120.85	189%
4. Operation and Maintenance Equipment	2.70	1.71	63%
5. Technical Assistance, Consultant Services, PMU and Training	17.40	25.02	144%
6. Front-end Fee	1.45	1.45	100%
<i>Total</i>	<i>341.45</i>	<i>359.22</i>	<i>105%</i>

## 1.7 Other significant changes

30. There are no other significant changes to report in this section.

## 2. Key Factors Affecting Implementation and Outcomes

### 2.1 Project Preparation, Design and Quality at Entry

31. The Tehran Sewerage Project was highly relevant as it clearly responded to priorities of the GOI at the time of appraisal, i.e., the severe environmental conditions in Greater Tehran, the serious deterioration of public services and the need to create institutional capacity. As mentioned earlier in this report, the project was originally ready to be appraised in 1993; however, at that time new lending was no longer feasible, so the project preparation was essentially put on hold. As the opportunity arose in late 1999 to engage in new lending to the GOI, this project was identified as suitable to mark this new engagement and project preparation had to be finalized on short-notice. Aside from delaying project execution for about 7 years, the interruption in project preparation placed additional pressure on the team to deliver the project in a very short time, limiting its ability to undertake a more thorough appraisal of the project.

32. This, in addition to the fact that the project was designed before the World Bank implemented a more rigorous approach towards the monitoring and evaluation of its programs, helps explain some of the shortcomings with regards to baseline and target information on some of the project's performance indicators. For example, there was no baseline included neither in the appraisal document nor in the environmental impact assessment with regards to the quality of the groundwater and how it is monitored.

33. With the benefit of hindsight, some of the requirements on the institutional and reform side, although consistent with Bank approach to the sector at the time, were overly ambitious, in particular the achievement of autonomy and full cost recovery by the TSC, during project implementation through relatively large sustained tariff increases. Another shortcoming was the lack of a clear mechanism/framework that would allow for the proper verification of financial transfers between the TPWWC and the TSC.



34. Nevertheless, the overall design of the project could be considered ahead of its time, as it pursued an integrated approach to water management, in which the construction of a sewerage network would contribute to improving the quality of groundwater in one end, and at the other the treated wastewater would be reused in agriculture with significant improvements in ambient environment quality.

35. **Incorporation of Lessons Learned.** The preparation of the Tehran Sewerage project built on lessons learned from then on-going projects.<sup>5</sup> These were: (a) to establish a strong project management capacity with the use of the private sector, as feasible; (b) to divide tunnel works into separate lots in order to enable local competition, this particular lesson was shown to have significant cost advantages under the Tehran Drainage Project; (c) to apply the Tehran Stock Exchange rate in all transactions; (d) to ensure adequate cost recovery and availability of counterpart funding. No substantive analysis of these lessons is presented in the PAD, and no lessons learned from projects in the sector in other countries were presented.

36. **Risks and Mitigations.** The risks presented in the PAD were reasonably well defined and relevant, but they were not comprehensive. Given the nature of the operation, and the fact that this was the first to bring the private sector to Design-Build-Operate (DBO) a wastewater treatment facility, a major risk stemming from the limited capacity, experience and knowledge of the TSC of these processes, including procurement, should have been identified.

37. Although during appraisal and negotiations assurances were received from the government as to their commitment to the continuation of the TPWWC's financial transfers to the TSC,<sup>6</sup> this element should have been identified as a potential risk, as it proved important in ensuring a greater degree of autonomy by the TSC.

38. **Participatory Processes.** Civil society/community participation processes were adequate. The project was discussed with representatives from municipalities, industry, and local NGOs. Public meetings were held in April and September 1999 (with the representatives of the Bank missions present). Participants expressed their support to the project and the following viewpoints: (a) the project is urgently needed, (b) the TSC should ensure that quality work will be carried out, (c) the capacity of the TSC/PMU will need to be enhanced; and (d) proper arrangements should be made for effective inter-agency coordination.

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<sup>5</sup> Tehran Drainage Project and Sistan River Flood Works Rehabilitation Project.

<sup>6</sup> As recorded in the minutes of negotiation dated March 17, 2000.

## 2.2 Implementation

39. TSC established a Project Management Unit (PMU) to manage and support the TSC in the implementation of the project. Given the unfamiliarity of the TSC with Bank procedures, the supervising team devoted considerable effort in the early stages of project implementation to escort the client through Bank requirements, guidelines and processes, particularly on the procurement side, while having to take into account the complex local environment, such as the process of obtaining permits from the municipality of Tehran, which tends to be bureaucratic in nature.

40. Project implementation started at a good pace, particularly since the TSC had already started some of the works on sewers, which were submitted for retroactive financing. In addition, the contract for the consulting firm that would prepare the bidding documents and specifications for the WWTP, the single largest contract in the project, was awarded in early 2001. This consulting firm also supported the TSC in the evaluation of bids and was responsible for construction supervision. Although the project suffered from delays due to a number of different reasons, some of which are outlined below, project ratings in Bank ISRs were kept within the satisfactory range. This was primarily due to the fact that the challenges faced during implementation were normally not concurrent and were accompanied by satisfactory progress in other areas of implementation.<sup>7</sup> Some of the key issues that affected the project's implementation progress were:

41. *Introduction of Innovative Procurement and Contracting Methods is a Lengthy Process*  
The GOI's was reluctant to undertake the procurement of the WWTP following an international competitive bidding (ICB) process, and proposing instead to award this contract to a local contractor. As this proposal was against World Bank procurement guidelines, it could not be accepted. It took almost a year for the government to agree to carry out an ICB process for the WWTP using a design-build-operate (DBO) contract. In 2002, further procurement delays of the DBO contract were incurred, given the high level of complexity, the large size of the contract, and the unfamiliarity of the country with the procurement processes of the Bank. These delays, of more than 10 months, took place during the pre-qualification and evaluation processes, which required much iteration between the TSC and the Bank, as well as extensive discussions within the Bank .

42. *Challenges in Declaring the WWTP Contract Effective.* After the WWTP contract was signed in July 2003, and given the GOI's limited experience in working with Bank's Special Commitment for Letters of Credit (required under this contract), it took some time before the Central Bank of Iran cleared a process to open the required letters of credit. Hence, the contract only became effective 11 months later on June 7, 2004.

43. *Construction Delays.* Delays were also experienced in the construction of the WWTP and the eastern trunk main. The construction of the WWTP suffered delays related to (i)

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<sup>7</sup> For example, although the contracting of the WWTP suffered delays, during that period the TSC was progressing satisfactorily on the implementation of laterals and interceptors and on areas of institutional strengthening, including capacity building, financial management, commercial efficiencies, and increased number of subscriptions.

shortage of materials (mainly cement), and (ii) overall slowdown in construction by the contractor for about 12 months, while claims related to the delays incurred at the initial stages of the contract were being discussed and agreed upon. Delays in the construction of the eastern trunk main were due to: (i) added level of complexity due to the high water table in these areas, (ii) difficulty in obtaining permits from the Tehran municipality in a timely manner, and (iii) shortage of materials (mainly cement). Disbursement delays, caused by the United States sanctions and pressure on the international banking system, particularly related to financial transactions, also affected negatively the project's implementation as World Bank disbursements were on hold for about four months in early 2007; as a result the Loan Agreement was amended in which the designated accounts were converted to Euro in May 2007. Delays in the availability of counterpart financing affected timely payments to the contractors and contributed to overall construction setbacks.

44. *TSC Institutional Aspects*. In spite of implementation challenges, the TSC was able to complete the construction of the networks as planned and have a large portion of them operational at the time of project completion. In addition, although the company registered operating losses, income from connection charges and transfers from the TPWWC ensured that the TSC maintained a positive cash flow throughout the project's implementation. Finally, a significant transfer of know-how took place during project execution in technical, management and financial areas, as the company's staff had to frequently work with consulting firms and also benefited from training sessions in-situ and abroad in these areas.

45. In 2002, the TPWWC started to demonstrate reluctance in transferring the agreed financial resources (15% of its total operating revenues and connection fees) to the TSC and an ensuing dispute developed over specific definition of the revenue base used for the calculation of the 15%, and the fact that there were no mechanisms to verify the exact amount of the transfers. This issue was partially resolved every year when the NWWEC exerted pressure on the TPWWC and transfers to the TSC were normalized. However, the issue related to the needed for introduction of a defined framework with clear definitions for the calculation of the amount to be transferred from the TPWWC to the TSC, as well as verification mechanisms to ensure a greater transparency in this process still remain unresolved.

46. The TSC contracted an independent audit on this issue and as a result, it is disputing with the TPWWC an outstanding transfer balance of about US\$20 million.<sup>8</sup> During its supervision visits the Bank consistently recommended that the NWWEC contract an independent party to pass a view as to the specific definition of the revenue base used for the calculation of the 15%, review past documentation, assess the need for a settlement, and recommend a framework to be implemented that will ensure the transparency of the process going forward; however no such review has been undertaken.

47. The agreement of increasing tariffs by an average of 22% (in nominal terms) on an annual basis was based on the ambitious goal of achieving full cost recovery by the end of the project implementation period. As presently known, given the public good nature of wastewater service provision, full cost recovery for wastewater services is not a feasible goal and normally service providers are required to recover through the tariff, operation and maintenance costs.

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<sup>8</sup> TPWWC disputes the audit findings.

During implementation, the team showed flexibility in its approach to this issue insisting on the predictability in the availability of financial resources as well as on the approval of tariff increases that would allow at a minimum for the recovery of operation and maintenance costs.

48. Tariffs were increased by an average 10% per year in 2002 and 2003, and by 7% in 2004, and in 2005 there were no increases. Subsequent average increases were of a marginal nature, with an average decrease of 3% being registered as of December 2008 as a result of the changes in the tariff structure introduced by the GOI. Therefore, the TSC registered net operating losses<sup>9</sup> as its tariff revenues were not sufficient to keep up with inflation (increases were in nominal terms)<sup>10</sup> and cover its operating costs, making the company progressively more dependent on transfers from the TPWWC. The inadequate water and wastewater tariff levels most likely triggered the TPWWC dispute over the 15% as the two companies became increasingly constrained financially.

49. However, in spite of the lower tariff increases, the TSC has been able to maintain a positive cash flow and finance its share of the investment cost from connection charges and a share of the transfers it received from the TPWWC. In addition, the company's operating ratio<sup>11</sup> improved from 2.61 in 2000 to 1.61 in the year ended on March 20, 2008, while its working ratio<sup>12</sup> improved from 2.28 to 1.07 in the same period.

50. The above-mentioned points provide a sample snapshot of the complex sector operating environment in the Islamic Republic of Iran. The delays mentioned above, coupled with high inflation and the fact that the WWTP contract was signed in 2003 with a large portion in Euros, have contributed to higher costs, resulting in a shortfall in funding of about US\$28.7 million, and were the reason the project's closing date had to be extended by two years to June 30, 2008.<sup>13</sup> The GOI has expressed its commitment to ensuring that adequate funds are allocated to complete the project as well as to finance two years of the operation of the WWTP by the DBO contractor. Since the project closed on June 30, 2008, the TSC has been provided with adequate resources to finalize the remaining works planned under phase one (i.e., the WWTP and the eastern trunk main).

### **2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization**

51. The TSC tracked progress of some of the key performance indicators outlined in the PAD in its progress reports, particularly the ones related to the number of new connections, length of network installed and financial information on the TSC. During the project's mid-term review, the indicators to be tracked on a regular basis were streamlined in order to track more effectively the project's progress towards the achievement of its development objectives.

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<sup>9</sup> TSC's income statement from 2001 to 2008 can be found at the end of Annex 3.

<sup>10</sup> Between 2002 and 2008 the official rate of inflation in Iran fluctuated between 12% and 24%.

<sup>11</sup> Operating ratio represents the level of expenses, including depreciation, as related to revenues; i.e., expenses, including depreciation ÷ revenues.

<sup>12</sup> Working ratio represents the level of expenses, excluding depreciation, as related to revenues, i.e., expenses, excluding depreciation ÷ revenues.

<sup>13</sup> The best solution would have been to provide additional financing for this operation; however, the World Bank could not approve additional financing in light of the current context.

52. One of the short comings with respect to monitoring and evaluation is the limited baseline information available on the quality of ground and surface water and its subsequent monitoring. This project was designed before the World Bank implemented a more rigorous approach towards the monitoring and evaluation of its programs. Although the project financed the design of an environmental monitoring system to monitor effluent, as well as surface and ground water quality, the limited reliable data available is not presented in a format that can be compared with the data provided at the end of the project.<sup>14</sup> Furthermore, the environmental monitoring system has not been fully implemented.

## **2.4 Safeguard and Fiduciary Compliance**

53. Financial management was identified as a key weakness during project preparation, and an action plan with corrective measures for improvement was prepared and agreed upon with the TSC. As a result of the implementation of this action plan, the project introduced new financial management practices to the TSC and provided capacity building activities that resulted in upgrading key aspects of the TSC's financial management system that addressed all identified shortcomings. This project represented the first time the TSC had to operate with foreign currency financing and exchange rate differences. In order to facilitate the reporting aspects of the project, the financial statements of the project were prepared independently from the TSC financial statements in spite of the fact that the project data was extracted from the TSC's records and accounts. The audit of project accounts were always received prior to the due date as defined in the loan agreement and the auditors' opinions were unqualified throughout the project life. Transaction reviews performed periodically by the Bank team did not identify any ineligible expenditure, reflecting the reliability of the controls that were in place during project implementation.

54. Overall, procurement activities complied substantially with the provisions established in the Loan Agreement. The staff of the TSC's contract office and the PMU received basic training on World Bank procurement policies before project implementation. Procurement plans were updated on a quarterly basis and filings were in good order. All of the larger packages procured under the project (i.e., the WWTP, main trunks, consultancies and goods – representing about 65% of the project costs), used World Bank standard bidding documents and were subject to prior review. The construction of the WWTP was the first one in Iran to use a DBO approach, and the TSC is currently sharing with other water and wastewater companies in Iran its experience in using DBO contracts.

55. The procurement of interceptors and laterals (representing about 35% of the project) was done using national competitive bidding procedures, using modified national standards to allow for compliance with World Bank requirements. These modifications included the use of a bill of quantities, as opposed to a bill of prices, using a single envelope bid that is opened and read immediately after bid submission. Evaluation of these bids was done according to World Bank procedures. Ex-post procurement reviews revealed some inconsistencies in the evaluation process, and it is recommended that future projects include additional training of the TSC staff.

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<sup>14</sup> The environmental monitoring system documentation provides very limited and basic data on soil conditions in the Varamin Plain, air pollution in Tehran, and water quality in three surface water streams, and suggests some quality standards to be adhered to.

56. The PMU had environmental experts with the responsibility of coordinating and monitoring the implementation of the Environmental Management Plan (EMP). These experts ensured that environmental issues related to construction activities were adequately included in the construction contracts, as well as in the contracts for the supervising consultants. In addition, the team carried out random checks of contractor's compliance with health, environment and safety measures. The environment team also guided a consultancy on the preparation of a framework to implement an environmental monitoring system. This work was completed in 2004 and provided parameters to be measured for the monitoring of environmental ambient quality and the impact of the wastewater investment program. Unfortunately, it provided only limited baseline information on ground and surface water quality; as such no reliable information is available to assess one of the project's important impacts: the improvement of ground and surface water quality. The TSC will implement the proposed system for monitoring effluent quality once the WWTP is fully operational. In the meantime, the TSC has signed a contract with Sharif University for the monitoring of effluent quality.

57. The TSC also carried out a follow up social assessment in 2004 in a number of neighborhoods where the project was implemented, selectively focusing on comparing areas where customers had and had not been connected to the sewerage network. The study findings indicated that area residents are willing to pay for sewerage services, and that the project did not have a major impact on house prices as anticipated during preparation. In general, lower income households benefited more from the project than affluent ones, with connections in lower income neighborhoods in the south outnumbering those in the more affluent project areas (about 65% of the connections were done in the south of Tehran). The connections for these lower income areas received cross-subsidies from differentiated connection charges applied to more affluent areas in the north of Tehran.

## **2.5 Post-completion Operation/Next Phase**

58. Post-completion arrangements could be verified only in relation to the wastewater facility through the DBO contract with the private sector, as the TSC has opted to retain the contractor in charge of building the WWTP to operate and maintain it for a period of two years. Using project funds, the TSC hired consulting firms to update its sewerage master plan and prepare a feasibility study for a second phase of Tehran Sewerage. However, the sustainability of the next phase may be in jeopardy, as the TSC may find it difficult to borrow the estimated US\$250 million financing required for the implementation of these works.

59. The TSC's prospects for being able to recover its operating and maintenance costs is good, given the recent efforts by the GOI on tariff reform, allowing for cost-recovery tariffs to be charged to public/government entities and planned future increases to the tariff, which will enhance the TSC's long-term sustainability prospects. The GOI is committed to supporting the TSC, particularly in financing investments in the sector. Worldwide experience points to the fact that full cost recovery in the provision of sanitation services is not a feasible goal, and that investments in the sector are highly subsidized given the public good nature of this service. Going forward, the GOI will need to provide subsidies to sanitation investments in Greater Tehran, as it is already doing in other parts of the country. The long term sustainability of TSC will be secured if GOI would guarantee a predictable flow of funds that will allow the company to plan and implement long-term investments.

### 3. Assessment of Outcomes

#### 3.1 Relevance of Objectives, Design and Implementation

60. There was no current Country Assistance Strategy (CAS) at the time of Board approval of this project. This project was an integral component of a development program prepared by the GOI for the extension of wastewater collection and disposal facilities for Greater Tehran, proposed to be implemented in 5 phases covering the period up to 2030.

61. An Interim CAS was discussed by the Board on April 16, 2001,<sup>15</sup> and it identified untreated sewerage as well as municipal and hazardous waste as major environmental issues in Tehran and secondary cities. It highlighted investment in sewerage as one of its key priorities for lending, along with low income housing, urban upgrading, as well as community-based infrastructure and employment creation schemes for the poor. These priorities were in line with the GOI's Third Five-Year Development Plan, covering the 2000 to 2005 period.

62. Although the project was prepared in advance of the declaration of the Millennium Development Goals (MDGs), the project is very well aligned with the targets set forth in the MDGs particularly the target aimed reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation.

#### 3.2 Achievement of Project Development Objectives

63. The project fully accomplished the physical goals of construction of the sewerage system and the WWTP. The institutional objectives were not fully met, primarily because the proposed reforms were very ambitious and would require, in any complex setting, more time to be mainstreamed into the governance structures and processes of the country. However, significant advances were accomplished in improving the financial standing of the sector and in improving the institutional capacities. The project overarching objective was to improve the environmental conditions of Greater Tehran, through five specific objectives. Achievement of these five specific objectives is discussed in the following paragraphs.

64. Provision of satisfactory wastewater collection and treatment for about 2.1 million people covering an area of about 16,500 hectares. This objective was met, as the project increased considerably the sewerage network of Greater Tehran. The TSC had a total of 211,000 connections as of December 2008, which translates into about 2 million people served.<sup>16</sup> Wastewater collection has increased considerably to about 125.7 million m<sup>3</sup>/year (i.e., 340,000 m<sup>3</sup>/day); and the first module of the WWTP with a treatment capacity of 1.3 m<sup>3</sup>/second (i.e., 112,000 m<sup>3</sup>/day) started operating on June 15, 2009. The complete treatment plant with a capacity of 450,000 m<sup>3</sup>/day (i.e., 5.2 m<sup>3</sup>/second) is expected to become fully operational by December 2009.

65. Improvements in public health as well as reduction of surface and ground water pollution. This objective can be considered as largely met, given that: (i) a study conducted in

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<sup>15</sup> Document number 22050-IRN

<sup>16</sup> Each connection serves on average 2.4 households. The average household size in Greater Tehran is 4 people.

2005 determined that diarrhea incidence, decreased in children aged 6 to 60 months due to the increased sanitation coverage and sewage collection, (ii) based on recent data, groundwater quality has improved (as measured by nitrate levels) in the areas of project intervention, and (iii) although there are no specific measurements available, it has been observed that the quality of water in open channels that run through the city has improved, with less odor being noticed.

66. A 2005 study on the impact of urban sewerage system on childhood diarrhea in Tehran,<sup>17</sup> which analyzed information on diarrhea incidence collected in 2001 and in 2005 (before and after the installation of the sewerage network) indicated that: (a) even without sewerage, there was a dramatic reduction in diarrhea between the two times of measurement both in the control and experimental groups, and (b) the reduction in the sewered areas was greater. Table 1 below gives a summary of the results.

**Table 1: Comparison of diarrhea incidence in Zones 17-18 - Tehran**

Groups	Experimental	Control
2001(before)	18.6 %	16.6 %
2005 (after)	10.1 %	10.5 %
Decrease	46 %	37%
Attributed risk	9%	

67. Table 2 below demonstrates<sup>18</sup> the level of nitrates in a sample of wells located outside and inside the areas of project intervention. In some of the areas outside the project intervention the level of nitrates are 4 times larger than those encountered inside. These are preliminary, but very encouraging findings, as approximately 50% of the water supplied in Tehran is from ground water sources. Excessive levels of nitrates in drinking water can cause serious illness and can death, particularly in infants.<sup>19</sup> Hence, these groundwater quality improvements have a positive effect on the population's public health.

**Table 2: Nitrates Levels in Groundwater Wells (in mg/l)**

Year	Well in Area Outside Project Intervention		Well in Area Inside Project Intervention	
	Area 33	Area 35	Area 89	Area 65
2000	80	-	-	-
2001	-	-	-	-
2002	75	-	-	-
2003	81	-	16	53
2004	-	-	-	-
2005	95	92	24	55
2006	94	99	23	57

<sup>17</sup> *The Impact of an Urban Sewerage System on Childhood Diarrhea in Tehran, Iran: a Concurrent Control Field Trial.* Kohahi et al. Transactions Royal Society of Tropical Medicine and Hygiene (2009) 103, pp 500-505.

<sup>18</sup> Further discussion on monitoring and modeling can be found in Section 6 below.

<sup>19</sup> These illnesses are caused primarily due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of a child's blood causing what is known as 'baby-blue' syndrome.



Year	Well in Area Outside Project Intervention		Well in Area Inside Project Intervention	
	Area 33	Area 35	Area 89	Area 65
2007	89	115	42	51
2008	-	82	-	62
2009	98	71	29	61

Note: Sample is of 4 wells, one in each area. These areas are shown in the map at the end of this report.

68. Provision of treated wastewater for irrigation of about 15,000 hectares on the Varamin Plain. This objective was met. The start of operation of the first of the four modules of the WWTP (with a capacity of 1.3 m<sup>3</sup>/second, about 41 million m<sup>3</sup>/year) on June 15, 2009 will provide enough water to irrigate about 3,750 hectares, and when the WWTP becomes fully operational (expected in December 2009) and the annual volumes of wastewater collected, currently in the order of 125.7 million m<sup>3</sup> per year, will be treated and made available for agricultural use. Until then, the collected sewage will continue to be treated in the temporary lagoons and then transferred to the Firoozabad canal. The irrigation infrastructure is already in place and the farmers will be able to benefit from the treated wastewater as soon as it becomes available. The farmers in the Varamin plain are following up on this issue regularly with local authorities in order to ensure this much needed water is available as soon as possible. The Ministry of Agriculture has exerted tremendous pressure on the project for its completion as presently one of the primary reasons for the limited expansion of irrigation is the lack of water.

69. Development of the TSC into a fully autonomous entity to be operated on a commercial basis. This objective was not met. Although the project has had a positive impact in terms of improving the efficiency of the TSC's operation, the lack of adequate tariff increases meant that the TSC continues to depend on transfers from the TPWWC to cover its operating cost.<sup>20</sup> Nevertheless, during the project implementation period the TSC's has been able to maintain a positive cash flow and finance its share of the investment cost from connection charges and a share of the transfers it received from the TPWWC. In addition, the company's operating ratio<sup>21</sup> improved from 2.61 in 2000 to 1.61 in the year ended on March 20, 2008, while its working ratio<sup>22</sup> improved from 2.28 to 1.07 in the same period.

70. The still-pending definition of a clear framework for the calculation of the amount to be transferred from the TPWWC to the TSC, and verification mechanisms to ensure transparency of this process also negatively affects the company's autonomy, as it limits the predictability of available financial resources. During the project's mid-term review in late 2004, the NWWEC informed the Bank that it was re-thinking the institutional framework currently in place for the

<sup>20</sup> Tariffs were increased by an average 10% per year in 2002 and 2003, and by 7% in 2004, and in 2005 there were no increases. These increases however, were nominal. Subsequent average increases were of a marginal nature, with an average decrease of 3% being registered as of December 2008 as a result of the changes in the tariff structure introduced by the GOI. These increases in the tariff were not enough to keep up with inflation during the period, between 2002 and 2008 the official rate of inflation in Iran fluctuated between 12% and 24%.

<sup>21</sup> Operating ratio represents the level of expenses, including depreciation, as related to revenues; i.e., expenses, including depreciation ÷ revenues.

<sup>22</sup> Working ratio represents the level of expenses, excluding depreciation, as related to revenues, i.e., expenses, excluding depreciation ÷ revenues.

provision of water and wastewater services in Greater Tehran; representing a shift in the GOI's initial commitment of having the TSC as a separate and fully autonomous entity. To date no final decision has been taken by the GOI in this regard.

71. While the new tariff structure approved by the GOI in early 2007 was simplified in its calculation, it represented in practice the GOI's policy to decrease the cost of connection fee to end-users and it also resulted in the lowering of wastewater charges. This policy, if not corrected, will have a negative impact on the TSC's future investment program, particularly the second phase currently under preparation, as it represents a significant reduction in income earmarked for investments. On a positive note, in 2008 the GOI approved the charging of cost recovery tariffs to local and national government entities sector-wide, which will contribute to augment the TSC's revenues from the collection and treatment of wastewater, this improvement should be reflected in the company's financial statements for the year ended on March 20, 2009 which will be issued in September.

72. Facilitation of private sector participation through contracting out various TSC functions, such as engineering, construction supervision as well as operation and maintenance. This objective has been fully met. The involvement of the private sector has been extensive in different areas of operation in the TSC, particularly in the areas of engineering, supervision and maintenance activities as well as the construction of the WWTP (which was done through a DBO contract). The private sector involvement enabled a significant transfer of know-how during project execution in technical, management and financial areas, as the company's staff had to frequently work with consulting firms and also benefited from training sessions in-situ and abroad in these areas. Given the role of private sector participation through outsourcing, the number of staff per 1,000 connections in the TSC reduced from 9 in 2000 to 1.3 in 2008.

### **3.3 Efficiency**

73. An ex-post economic analysis of the project was carried out, under which the economic analysis featured in the PAD was reviewed, and its methodology adjusted to one deemed more adequate. In the ex-post analysis the quantified benefits are: (i) the avoided costs from the construction, as well as operation and maintenance of cesspits in Tehran for households and buildings, and (ii) the value of the net incremental output from irrigation of the additional land that will be irrigated through the use of treated effluents. This value is a conservative estimate since it is based on low value crops (wheat and barley) but evidence from the meetings held with personnel from the Ministry of Agriculture is that in the area there is an array of high value crops being produced. Given that no information was provided on yields, costs and potential revenues for these high value crops, we use the most conservative of estimates.

74. The results from the ex-post cost-benefit analysis indicate that the project has a net present value of US\$103.21 million, using a 12% discount rate. This result is considered a lower bound estimate, since additional benefits, such as improvements in public health, the incremental improvement in groundwater quality, as well as the decrease in the use of groundwater, which consequently lowers energy use and pumping costs were difficult to estimate and were not considered in the analysis. Furthermore, the analysis did not include the valuation of non use values. More details of this analysis, including sensitivity analysis, are presented in Annex 3.

75. In addition, the project contributed to increased efficiency in the performance of the TSC. The TSC was able to reduce the number of staff per 1,000 connections from 9 at appraisal to 1.3 as of March 20, 2008. The TSC's performance is positive in terms of improvement of key financial targets, which increase the likelihood of its long-term financial sustainability, as well as in capacity building as highlighted in Annex 2 and in the main section of this report. The company's operating ratio improved from 2.81 in March 20, 2001 to 1.61 in March 20, 2008, while its working ratio improved from 2.28 in March 20, 2001 to 1.07 in March 20, 2008. A more detailed analysis of the TSC's financial performance can be found in Annex 3.

### **3.4 Justification of Overall Outcome Rating**

#### **Rating: Satisfactory**

76. The overall project outcome is deemed satisfactory, based on the degree to which the project's five specific objectives have been achieved as well as its efficiency as demonstrated in the ex-post economic analysis.

### **3.5 Overarching Themes, Other Outcomes and Impacts**

#### **(a) Poverty Impacts, Gender Aspects, and Social Development**

77. As mentioned above the project design targeted low income groups living in the southern area of Tehran. Project implementation gave priority to these areas, and low income groups were among the first ones to be connected to the sewerage network (about 65% of the connections were done in the south of Tehran). The connections for these lower income areas received cross-subsidies from differentiated connection charges applied to more affluent areas in the north of Tehran. No additional information is available on the proportion of low income population living in the south of Tehran.

#### **(b) Institutional Change/Strengthening**

78. The TSC clearly benefitted and was strengthened by the project's institutional development aspects, high level capacity building, and transfer of technical know-how through the various consultancies that have been contracted. The project supported the TSC in building extensive technical and financial capacity and benefited from working with foreign contractors and consultants and in managing large contracts. The project introduced new financial management practices to the TSC and upgraded key aspects of the company's financial management system.

79. The strong involvement of the private sector in maintenance activities and in the construction of the WWTP has enabled the TSC to become a much leaner organization (as demonstrated by number of employees per connection). The support provided for capacity building and institutional strengthening have been successful particularly in the areas of procurement, project planning, and financial management.

#### **(c) Other Unintended Outcomes and Impacts (positive or negative)**

80. This project was pioneering in the following: it was the first of its kind in Iran to introduce the participation of the private sector in the construction and operation of a wastewater facility through a DBO contract. Based on this experience, the GOI is mainstreaming the modality in other projects in the country. Since land use and electricity consumption were part of the DBO bid evaluation criteria, the DBO design compared to the original design of the local consultants has reduced the land needed for the treatment of 5.2 m<sup>3</sup>/second wastewater by almost half, leaving more space for future expansions and perimeter green areas. In addition, the hydraulic loss of the treatment plant was reduced from about 12 meters to around 5 meters, which along with the use of trickling filters for partial de-nitrification, result in substantial savings of electricity consumption during operation of the plant. Finally, a power plant using the sludge bio gas was constructed as part of the DBO design, and can supply more than 60% of the plant's required electricity.

81. In addition, the project was a pioneer in terms of helping the Iranian banking system to become familiar with the World Bank special commitments and working with letters of credit. Although it took 9 months for the WWTP letter of credit to be opened, subsequent letters of credit for this and other Bank operations were opened within weeks.

### **3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops**

82. Not applicable.

## **4. Assessment of Risk to Development Outcome**

### **Rating: Moderate**

83. At the time of writing this ICR, the risk that the improved efficiency outcome and other outcomes achieved by the project will not be maintained is considered modest, as the environmental and health benefits achieved through connection of 2 million people to the sewerage network is unlikely to be reversed.

84. From a technical perspective, the risks are deemed low, since the TSC has been capable of largely covering its operational costs, and recent tariff developments discussed in earlier sections will contribute to strengthening the company's revenue base and its capacity to operate and maintain the investments that have been completed to date. In addition, with regards to the operation of the WWTP, the NWWEC has demonstrated its commitment in financially supporting the TSC to retain the DBO contractor for 2 years in order to ensure a transfer of operating know-how between the contractor and the company's staff. However, there is a risk that after the two-year operation and maintenance contract is concluded there may not be sufficient financing to operate and maintain the WWTP due to low tariffs and the lack of a clear framework and mechanism to ensure the predictability on the availability of financial resources.

85. From an institutional perspective, the risks could be significant, given the uncertainty surrounding the future institutional structure of the TSC, its dependence on transfers from the TPWWC in order to cover its operating costs and continue its investment program, and the reduction of the connection charge in the simplified tariff structure if not corrected or supported by a GOI subsidy mechanism, could have a negative impact on the TSC's long-term viability as

a company. On the other hand, the project has received strong support during preparation and implementation from the central government, and it has continually expressed interest in supporting its finalization, including providing the needed US\$30 million budgetary allocation needed to finalize the works. However, as mentioned above, the TSC operates under an unclear budgetary support framework without predictability on the long-term availability of financial resources, which can be a threat to the company's long-term sustainability.

## **5. Assessment of Bank and Borrower Performance**

### **5.1 Bank Performance**

#### **(a) Bank Performance in Ensuring Quality at Entry**

##### **Rating: Moderately Satisfactory**

86. The project objective was relevant and consistent with the GOI's identified priorities for the sector. In spite of the difficult country context the design team was able to identify the critical institutional issues that would affect the sustainability of the Tehran Sewerage Company, and secured commitments from the GOI on issues such as: (a) tariff increases as specified in the side letter, (b) simplification of the complex tariff structure, and (c) ensuring that the transfer of 15% of the TPWWC's operating revenues and connection fees were undertaken as specified in the letter of sector policy. The political economy aspects of overall engagement in lending to Iran resulted in an intermittent approach to project preparation and was detrimental to project design, aside from delaying implementation.

87. Nevertheless, the shortcomings noted in the project's design had no major bearings in terms of impaling project implementation and outcomes, and were in fact consistent with the overall approach of World Bank operations at the time of preparation. In addition, although the institutional goals were overly ambitious, the project was ahead of its time in its design since it addressed the full wastewater cycle in line with principles of effective water resources management, by providing collection services at the household level, which were treated and then re-used for irrigation or groundwater recharge.

**(b) Quality of Supervision**

**Rating: Satisfactory**

88. The quality of the Bank's performance during supervision is satisfactory. The team was very experienced, had a good rapport with counterparts, and understood the country, sector issues and the conditions surrounding the project. In addition, there were no changes in task team leadership, and the team made efforts to maintain a good sector dialogue, even considering the political economy dimensions within the country and of the World Bank engagement in Iran. Supervision missions were carried out frequently and were adequately staffed. The team made proactive efforts on capacity building in the areas of procurement and financial management during early implementation, in addition to undertaking procurement ex-post reviews regularly and a solid financial management supervision effort. One shortcoming in the supervision, were delays in the process of awarding the WWTP contract due to its complexity and size, which prompted extensive internal discussions within the Bank, and delays in responding to client requests.

89. Without the close supervision imparted by the Bank team, the advanced stage of many of the works and the results achieved would have been jeopardized. In addition, the team was firm, particularly when it came to the implementation of ICB procedures, and showed tenacity throughout the supervision process. Finally, the team was diligent in pressing for action on lagging institutional and financial issues, while showing flexibility in its approach to this issue and insisting on the predictability in the availability of resources and on the approval of tariff increases that would allow at a minimum for the recovery of operation and maintenance costs.

**(c) Justification of Rating for Overall Bank Performance**

**Rating: Satisfactory**

90. Project preparation was satisfactory given the circumstances and priorities at the time. During supervision, the task team devoted substantial efforts to address project implementation issues. As such, and based on the above justifications, overall Bank performance is considered satisfactory.

**5.2 Borrower Performance**

**(a) Government Performance**

**Rating: Satisfactory**

91. This rating is assigned to the performance of the GOI, in particular the Vice Ministry for Water and Wastewater Affairs and the NWWEC. The GOI has demonstrated strong support to the project since its inception, and during implementation they have demonstrated strong support to the project by exerting pressure in order to ensure that the TPWWC's transfers were made to the TSC, and at the later stages of implementation have made available a substantial amount of financing (US\$30 million) to complete the project on-going works. Although the agreed tariff increases have not been implemented, the GOI has made an effort towards simplifying the tariff

framework, and is currently working towards fine tuning this framework in order to achieve a higher degree of cost recovery in the sector. These efforts if materialized will improve the long-term sustainability prospects of the TSC.

### **(b) Implementing Agency or Agencies Performance**

#### **Rating: Satisfactory**

92. The TSC and its established PMU performed satisfactorily within the constraints faced by its dependence on the TPWWC for the transfer of funds and on the MOE on tariffs adjustments. Although TSC's Managing Directors changed three times during project implementation, there was a relatively low turnover in the PMU staff, with the project manager being changed once after the mid-term review, ensuring the continuity of project implementation efforts. In spite of the issues encountered during implementation, the TSC was able to complete the construction of a large portion of the planned works, including the trunk mains, the networks and the first out of the four modules of the WWTP. In addition, the TSC made significant efforts during implementation to become more efficient and has achieved significant improvements as demonstrated by the performance indicators mentioned earlier in this report.

93. Although, the TSC continues to depend on transfers from the TPWWC to cover its operating cost, during the project implementation period the TSC's has been able to maintain a positive cash flow and finance its share of the investment cost from connection charges and a share of the transfers it received from the TPWWC. The company's operating ratio improved from 2.61 in 2000 to 1.61 in the year ended on March 20, 2008, while its working ratio improved from 2.28 to 1.07 in the same period. The TSC also used private sector participation through outsourcing in order to improve its efficiency, as a result, the number of staff per 1,000 connections in the TSC reduced from 9 in 2000 to 1.3 in 2008.

### **(c) Justification of Rating for Overall Borrower Performance**

#### **Rating: Satisfactory**

94. Based on the satisfactory performance of the TSC and the GOI as highlighted above, the Borrower's overall performance is rated satisfactory.

## **6. Lessons Learned**

### *Project Design*

95. The establishment of the TSC as a separate and dedicated entity for the provision of wastewater services was done mainly to ensure adequate focus on the implementation of the ambitious wastewater investment program, including operation of wastewater facilities and improvement in service provision. Given the scale of the program and the political economy context of the sector in Iran, this institutional separation reflected the prominence the government wanted to place on this issue, and was effective in terms of ensuring that the long-planned large-scale investments were undertaken. In addition, this arrangement allowed for:

- a. Elevation of the relevance of wastewater service provision to the same level as water supply for Greater Tehran.
- b. Provision of dedicated management and technical teams to ensure effective and efficient implementation of the first phase of the Greater Tehran's Sewerage Master Plan.

96. However, given the close inter-linkages between water and wastewater service provision, a clear definition of roles as well as a clear framework and mechanisms to ensure the predictability in the availability of financial resources are pre-requisites in ensuring the long-term sustainability of such institutional framework.

### *Project Implementation*

97. Given the complexity of this operation, continuity within the team and the high level of supervision devoted by the Bank were adequate to ensure the achievement of project outcomes, even though at the formulation of this ICR some of the works were not fully completed. The assumption that a well designed program will need minimal supervision should not be made and adequate financial and human resources must be allocated to complex projects.

98. The project introduced new procurement and contractual modalities in the sector, and this normally entails higher transaction costs of implementation. The contracting process of the WWTP using a DBO approach suffered delays, which coupled with the lack of in-country experience in the issuance of letters of credit, resulted in the contract becoming effective four years after loan implementation had started. A pragmatic analysis should be carried out during preparation of complex projects to ensure adequate time is built into the implementation, particularly when new and innovative modalities are introduced in a county. As a result of this analysis, adequate provisions should also be made to ensure responsiveness on the Bank side during the procurement of large and complex works.

99. Furthermore, global experience demonstrates that projects that involve significant and complex water infrastructure, such as sewerage networks and wastewater facilities take, on average, almost ten years to implement successfully. The Bank must take this into consideration when designing operations in the sector, as shorter execution periods could impede the achievement of desired outcomes.

100. In addition, and specifically to the Iranian context, the differences between local procurement regulations and World Bank procurement guidelines became an issue. Even though a memorandum of understanding between the World Bank and the Ministry of Economy and Financial Affairs was signed on October 2, 2004, clearly stipulating the priority of World Bank procurement guidelines, one of the main challenges faced during implementation was the lack of awareness of monitoring bodies, such as the Supreme Audit Council<sup>23</sup> and the Inspectorate General with respect to the applicability of World Bank procurement guidelines, resulting in a number of warnings and non-compliance reports issued by these bodies, explaining in some instances the GOI's initial reluctance in following World Bank procurement guidelines. Any future engagement should incorporate relevant training on procurement to these monitoring

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bodies, in addition to adequate coordination amongst these organizations and the Bank during project preparation and implementation phases.

### *Performance Indicators*

101. It is important to set realistic objectives, especially in areas that are known to be controversial and politically sensitive, such as increase in tariffs and achievement of full cost recovery in a relatively short period of time. In this case, given the fact that the TSC was newly established and that this already represented a new approach to provision of wastewater services, objectives and targets related to institutional and reform aspects should have been set at lower levels.

102. In order to better guide design and supervision decisions, outcome indicators should be defined as closely as possible to direct measures of impact on beneficiaries, e.g., increase in the overall population served rather than length of network installed. The choice of a few key performance indicators should be guided by the quality of the baseline data and the assessment of existing institutional capacities to ensure the periodic gathering and analysis of data.

103. Measuring results, outcomes and impacts of projects is a complex process that requires consistent information throughout project implementation. For this project, the original list of performance indicators could have been streamlined in order to increase its effectiveness in tracking the project's progress towards the achievement of its development objectives. A good outcome matrix coupled with a monitoring and evaluation process to be implemented during project execution greatly facilitates the estimation of benefits; and, as a result, project-related arbitrages are made under a well-informed framework that takes into account overall impact to the beneficiaries.

104. Projects with strong objectives to improve ambient environmental quality should include support to establish a robust methodology to model and monitor water quality. A major stated benefit of this project is the improvement in groundwater quality derived from the closing of cesspools which avoid the filtration of domestic waste into the aquifers. As such, having the environmental monitoring system designed and operational in the early stages of implementation would have enabled the continuous monitoring of project improvements, impacts and outcomes. However, the lack of an established methodology and support to conduct research and monitor the quality of the existing groundwater wells represented a missed opportunity in terms of recording a major project impact. Future projects of this nature must ensure that adequate and systematic monitoring of ground and surface water quality is being undertaken.

## **7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners**

### **(a) Borrower/implementing agencies**

105. The TSC reviewed a draft copy of the ICR and provided comments along with a revised forecast of the estimated costs to complete the project, which were incorporated into the final version of the ICR. Excerpts from their own ICR which document the implementation experience and lessons learned can be found in Annex 7, while the ICR prepared by the TSC is available in the project files.

106. The NWWEC also provided comments to the ICR, which to the extent possible were incorporated in the report. In its comments, the NWWEC noted that the TSC applied for the loan almost independently and without the NWWEC supervision; and that although there was occasional monitoring of progress, the NWWEC was not formally involved as it currently is on the implementation of other World Bank financed operations in the sector. This lack of a formal link to the NWWEC limited the TSC's ability to obtain funds from the GOI, and also to find a timely resolution to some of the project challenges faced during implementation. In the past two years, the TSC has been able to obtain funding from the GOI as a result of the close follow up of the NWWEC on this issue. In any future engagement, the NWWEC suggests that a formal link be included to the central implementation/support unit at the NWWEC level<sup>24</sup>, in charge of following up on all World Bank financed operations in the sector.

**(b) Cofinanciers**

107. Not applicable.

**(c) Other partners and stakeholders**

108. Not applicable.

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<sup>24</sup> This unit was established in 2004, to assist the implementation of the Ahwaz and Shiraz Water Supply and Sanitation as well as the Northern Cities Water Supply and Sanitation Projects.



## Annex 1. Project Costs and Financing

### (a) Project Cost by Component (in USD Million equivalent)

Components	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
1. Interceptors and Laterals	209.30	127.10	60%
2. Trunk Main and Tunnels	46.60	83.09	178%
3. Wastewater Treatment Works	64.00	120.85	189%
4. Operation and Maintenance Equipment	2.70	1.71	63%
5. Technical Assistance, Consultant Services, PMU and Training	17.40	25.02	144%
6. Front-end Fee	1.45	1.45	100%
<i>Total</i>	<i>341.45</i>	<i>359.22</i>	<i>105%</i>

1. The cost of interceptors and laterals turned where 61% of what estimated at appraisal. This difference is attributed to the combination of the following factors:

- a. At the same time that the project begun its implementation phase, and based on economic conditions (not the project), the Country saw a large increase in the number of pipe manufacturers. By the time that the bidding process took place, the availability of new suppliers increased competition in the market, lowering costs.
- b. In anticipation to the needs in goods and services for the project, the TSC carried out workshops and fairs, informing potential manufacturers about the need for a large quantity of materials, including pipes, connections, manhole parts and covers, etc. This generated the interest of a large number of suppliers.
- c. The large number of packages (674 contracts), attracted a larger number of contractors from across the country than in earlier projects, further increasing competition.
- d. The procurement of interceptors and laterals was done under national competitive bidding procedures, in which Iranian public procurement documents were revised to comply with Bank requirements. This resulted in simplified bill of quantities which reduced the number of items and consequently, the overhead attached to them. This reduction in cost, did not affect the scope of the works or the project.

2. The higher actual than estimated costs for the construction of the WWTP and the eastern and western network trunks, were due to:

- a. Substantial delays during the implementation of the contract as explained in section 2.2 of this report,

b. Higher than anticipated inflation coupled with large increases in the prices of basic materials such as steel and cement in the global market, as these contracts were largely implemented after 2004.

c. Half of the contract for the construction of the wastewater treatment facility was in Euros. The appreciation of the Euro vis-à-vis the US Dollar in the last two years of project implementation increased actual costs.<sup>25</sup>

3. The scope of the component on operation and maintenance equipment was reduced, and the increase in the scope of the technical assistance component, as well as in the value of construction supervision contracts caused by construction delays contributed to the higher costs of the technical assistance component.

**(b) Financing**

Source of Funds	Type of Co-financing	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
International Bank for Reconstruction and Development	Loan	145.00	145.00	100%
Tehran Sewerage Company	Own Resources	196.45	119.69	107%
Transfers from Tehran Province Water and Wastewater Company	Grant		90.42	

<sup>25</sup> The original contract for the WWTP construction was in Euros and Iranian Rials (€31.3 million and IRR226,151 million). There was one amendment to this contract in the amount of €2.97 million and IRR159,421 million. The contract was not fixed in price and included clauses for adjustments based on inflation and price of key basic materials needed for the plant's construction.

## Annex 2. Outputs by Component

1. The primary project development objective was to improve the environmental conditions in Greater Tehran. Accordingly, the six project components were designed and planned to meet this objective. In physical terms the project accomplished the following:
2. Component 1 - Interceptors and Laterals. Overall the TSC signed 674 contracts for the construction of interceptors and laterals, out of which 141 were co-financed by the World Bank loan. These contracts were financed under national competitive bidding procedures, with half of the contracts being financed by the loan (at 75%), with 25% financed by the TSC, and the other half financed 100% by the TSC. Implementation of these works were somewhat delayed mainly due to the difficulties encountered in obtaining permits from the Tehran municipality in a timely manner. At the end of the project 2,444 km of interceptors and laterals had been constructed, which translates into about 2 million inhabitants being served by the network.
3. Component 2 - Western Trunk Main. The total length of the western trunk main was revised to 30 km, out of which 10 km would be financed by the loan. This work was tendered as one lot, and experienced delays of about 12 months due to delays non-performance of the first contractor hired to undertake the works. As of December 31, 2008, 27 km of the western trunk were in operation. The remaining 3 km at the northern end of the trunk will become operation when the construction of 300 meters located in a very busy area of Tehran is finalized. The TSC is having difficulties in obtaining permits from the municipality to finalize this work.
4. Component 3 - Eastern Trunk Main. The eastern trunk main's length was revised to 24.3 km, and the construction of this tunnel was divided into 5 lots. Construction of lots 0, 1 and 2 for a total of 5 km were completed; however, the 5 km still need to be lined before they are made operational. The completion of lots 3 and 4 (8.3 km and 9.3 km, respectively) has been significantly delayed due to difficulties encountered in obtaining municipality permits. Lot 3 is 95% complete, while Lot 4 has about 85% of physical progress. As of the date of this report, the eastern trunk was not in operation, and the TSC has estimated that it will take another 12 to 15 months from the date of this report for the eastern trunk to become operational.
5. Component 4 – Wastewater Treatment Works. The first of the four modules of the WWTP (1.3 m<sup>3</sup> per second) started operating in June 2009. The WWTP has a treatment capacity of 450,000 m<sup>3</sup> per day (5.2 m<sup>3</sup> per second) and is expected to be fully operational by December 2009. The wastewater collected is diverted by gravity to the WWTP site, and the treated effluent flows by gravity to the Varamin irrigation network. It is estimated that the treated effluents will allow for the irrigation of an additional 15,000 hectares of crops.
6. Component 5 – Operation and Maintenance Equipment. This component financed: (i) the purchase and installation of five closed circuit television sets, and (ii) the purchase and installation of 5 large water jets. The purchase and installation of 10 small water jets and recycle sewer cleaners were also planned under this component. The selected contractor for the 10 small water jets did not fulfill its contractual commitment of providing a bank-guarantee, while the bidding process for the recycle sewer cleaners yielded no bids. As such, the TSC decided to reallocate the loan funds from these activities to be used to finance the cost overruns of the

WWTP contract, and purchase the small water jets and the recycle sewer cleaner at a later date with its own resources.

7. Component 6 – Technical Assistance. This component financed:
  - a. Specialized technical support, particularly in the preparation of technical requirements, to the established PMU as needed, and training for the staff of the TSC in the areas of procurement, management, financial management and planning.
  - b. The design and implementation of a financial management system which significantly improved the TSC's financial reporting capacity.
  - c. The design of an environmental monitoring system that will monitor the WWTP effluents, this monitoring system will be implemented once the WWTP becomes fully operational. During initial operation, and until the laboratories are ready and functional, the TSC has signed a contract with the Sharif University to carry out effluent quality tests and check on the WWTP contractor's compliance as required under the DBO contract.
  - d. The preparation of standards for the discharge of industrial effluents into the sewerage network which have been adopted by the TSC.
  - e. The implementation of a public communications strategy aimed at disseminating project information and receiving public feedback that could be used to adjust project implementation. In order to disseminate information about the company and construction works the TSC: (i) established an advertisement commission, (ii) printed and distributed leaflets door-to-door and at public events, (iii) launched a web page ([www.tsc.ir](http://www.tsc.ir)), (iv) planned and implemented radio broadcasts and TV campaigns. In order to receive public feedback the TSC: (i) created and publicized an automated public complaint system that directed complains from the public to relevant departments, which are required to respond within 2 to 3 days, (ii) established a working relationship with the Health City Organization, an environmental organization connected to the Tehran Municipality, and joined efforts to educate the local population on the environmental and health benefits of having a proper sewage disposal systems, and the importance of connecting to the network.
  - f. A needs assessment, definition of requirements, as well as a master plan for the implementation of a comprehensive Management Information System at the TSC, including pre-qualification criteria and bidding documents to select a company to implement a new integrated management information system in the TSC. This activity is currently on hold pending availability of funding and a final decision from the government on the institutional framework for the company.
  - g. The contracting of an engineering consulting firm to prepare the bidding documents, assist in the bidding evaluation and supervise the construction of the WWTP under DBO procedures.
  - h. The contracting of engineering firms to supervise the construction of the network and main trunks.
  - i. An update of the Sewerage Master Plan for Greater Tehran, in which the second phase of Tehran Sewerage program has been identified.

- j. The feasibility study for the second phase of the Tehran Sewerage Program. For this assignment a draft final report is available, waiting for a final determination on the location of the proposed WWTP to be finalized.
- k. The environmental and social impact assessment of the second phase of the Tehran Sewerage Program, this assessment is also waiting for a final determination on the location of the proposed WWTP to be finalized.



## Annex 3. Economic and Financial Analysis

### *Economic Analysis*

1. The PAD estimated the project's **economic** rate of return to be between 17% and 25% (NPVs between US\$153 and US\$385 million), depending on the assumptions about direct benefits used. Estimated direct user benefits included the revenue from connection and use of the system as a proxy for user willingness to pay, cost-avoided when comparing the with and without project scenarios, and the value of net incremental output from irrigation of additional agriculture made possible through the use of treated effluent. The lower estimate (17%) was based on the use of agriculture gains and revenues only, since there is a partial overlap between the willingness to pay for the connection and use of the system and awareness of the costs, which can be avoided with the project. The higher estimate (25%) treats these benefit streams as independent.
2. The PAD states that during pre-appraisal there were extensive discussions about the use of the revenues as proxy willingness to pay, since there was an obligation to connect to the system when it is possible, and additional justification was provided. However, the use of a financial cost as a proxy of willingness to pay (WTP) is not consistent with economic theory. The explanation provided in the PAD, which concentrated on validating the use of the proxy based also on potential demand (as opposed to revealed or stated preference), is not adequate. WTP is the foundation of the economic theory of value, a concept very different from financial costs. WTP is based on utility theory, and it is a function of a set of socioeconomic variables. Each individual has its own WTP function. As such, these values cannot be compared to, as in the case of this project, the connection fees. In the economic appraisal section, there is no indication of the used of shadow price factors to convert financial to economic prices; representing another flaw in the analysis.
3. Based on the above-mentioned factors and newly acquired information, an ex-post economic analysis was undertaken. The main **assumptions** used in the analysis are:<sup>26</sup>
  - a. A large portion of the benefits begin accruing in the year 2010. This is due to the delays in the implementation of the project, the flow of O&M costs for large part of the sewerage system and the wastewater treatment plant, and the consequent lag in the reuse of water for irrigation purposes. .
  - b. The original analysis did not include any shadow price factors to convert financial into economic prices. Based on current estimates, a factor of 0.8 will be utilized for labor, goods and services. This conversion factor was applied to investment and operation and maintenance costs of the sewer network and the wastewater facility, and on the benefits side to related costs to agricultural production and investment and operation and maintenance of cesspits (avoided costs).
  - c. Operation and maintenance costs for the sewerage network are estimated at IRR 1,300 million per month until project is completed and in full operation and IRR 2,100 million

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<sup>26</sup> Detailed assumptions and calculations are available in the project files.

per month thereafter.<sup>27</sup> For the wastewater facility, the operation and maintenance costs used in this analysis are the ones presented in Schedule Number 7 of the DBO contract for Operation and Maintenance Services. Costs presented in the Schedule are for the first five years of operation. We assume constant costs thereafter. .

- d. The benefits which are not consistent with economic theory (see paragraph above) are not included in this analysis. The benefits that are identified for the reformulation of the analysis are: (i) avoided costs from the construction and operation and maintenance of pits/boreholes in Tehran and (ii) the value of the net incremental output from irrigation of additional irrigated land through the use of treated effluents.
  - e. As for the avoided costs, the average cost of constructing a cesspit with capacity of 15 m<sup>3</sup> is US\$300 per household and one with 40 m<sup>3</sup> is US\$2,000 per building. Eight percent of all households are renovations; hence, the avoided cost included the construction and future operation and maintenance of new pits. In all remaining cases, the cost avoided is that of emptying the pit an average of five times per year. The cost of emptying the cesspits is estimated at 10% of construction costs.
  - f. For the new connections from 2009 until the useful life of the project, the average of the last 3 years is used, reflecting the capacity of the TSC to establish new connections.
  - g. For the benefits stemming from incremental agricultural production, the original estimate of 15,000 of new irrigated land was validated in the last mission by the Ministry of Agriculture. A lower bound estimate of benefits is calculated by assuming that the land will be cultivated with two traditional, low value crops (wheat and barley) equally distributed, even though in the area there is a large variety of higher value products (pistachios, pomegranate, figs, flowers, etc.). Yields for wheat have been estimated at 5 tons per hectare and for barley and 3.8 tons per hectare, which is consistent for areas irrigated with treated water. Additional benefits, which are not quantified, derive from a decrease in the use of groundwater and consequently energy use and pumping costs. However, given the difficulties involved in estimating these benefits they have not been calculated in the ex-post cost-benefit analysis.
  - h. The incremental improvements in groundwater quality and public health are significant benefits that were not originally estimated, and cannot be assessed due to the data requirements (primary data, stated preference models). Hence, benefit streams are deemed to be a lower bound estimate.
  - i. The benefits to agriculture, from water reuse, are highly dependent on the operation of the wastewater facility. Therefore, they will begin to accrue the same year that the plant begins to operate.
  - j. Exchange rates used are: US\$ 1.00 = IRR 9,694 (exchange rate used in this ICR, effective March 2, 2009). US\$1.00 = Euro 0.7939 (European Central Bank, Effective March 2009)
4. Based on the above, the results from the ex-post cost-benefit analysis are considered lower bound and indicate that the project has a net present value of US\$103.21 million, using a 12% discount rate.

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<sup>27</sup> Source: TSC

*Cost Benefit Analysis (in US\$ million)*

Year	COSTS				BENEFITS			
	Total Investment Costs	O & M Sewers	O&M WWTP	Total Cost	Cost Avoided	Agri-culture	Total Benefits	Net Benefits
2001	17.02	1.03	0.00	<b>18.05</b>	20.58		<b>20.57</b>	<b>2.53</b>
2002	16.56	1.03	0.00	<b>17.59</b>	13.48		<b>13.48</b>	<b>-4.11</b>
2003	17.34	1.03	0.00	<b>18.38</b>	10.97		<b>10.97</b>	<b>-7.40</b>
2004	25.98	1.03	0.00	<b>27.01</b>	19.80		<b>19.79</b>	<b>-7.22</b>
2005	24.99	1.03	0.00	<b>26.02</b>	37.42		<b>37.42</b>	<b>11.40</b>
2006	50.59	1.03	0.00	<b>51.62</b>	48.48		<b>48.47</b>	<b>-3.14</b>
2007	63.86	1.03	0.00	<b>64.89</b>	65.82		<b>65.81</b>	<b>0.92</b>
2008	32.03	1.03	0.00	<b>33.06</b>	47.00		<b>47.00</b>	<b>13.94</b>
2009	10.20	1.03	3.11	<b>14.33</b>	52.35	6.47	<b>58.82</b>	<b>44.49</b>
2010		1.67	6.56	<b>8.22</b>	52.35	14.78	<b>67.13</b>	<b>58.90</b>
2011		1.67	6.92	<b>8.58</b>	52.35	18.48	<b>70.83</b>	<b>62.24</b>
2012		1.67	7.28	<b>8.94</b>	52.35	18.48	<b>70.83</b>	<b>61.88</b>
2013		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2014		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2015		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2016		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2017		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2018		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2019		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2020		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2021		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2022		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2023		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2024		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2025		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2026		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2027		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2028		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2029		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
2030		1.67	7.64	<b>9.30</b>	52.35	18.48	<b>70.83</b>	<b>61.52</b>
							<b>Total</b>	<b>1,341.82</b>
							<b>NPV</b>	<b>103,21</b>

## *Sensitivity Analysis*

5. In order to estimate the effect of changes in values of the costs and benefits on the NPV of the project, sensitivity analysis was conducted. Values in the costs and benefits streams are adjusted downward and upward 10 and 25%.

Variable	Base Case	Resulting NPV (in million US\$)			
		-25%	-10%	+10%	+25%
<b>NPV</b>	<b>103.21</b>				
<b>Costs</b>					
<i>Investment</i>	258.60	108.19	105.20	101.23	98.24
<i>O&amp;M Sewers</i>	44.20	104.07	103.56	102.88	102.37
<i>O&amp;M WWTP</i>	161.41	106.37	104.46	101.97	100.11
<b>Benefits</b>					
<i>Cost avoided</i>	1,415.20	76.00	92.33	114.10	130.43
<i>Agriculture</i>	390.85	95.70	100.21	106.22	110.74

6. The results show that the NPV is rather robust to shifts in costs and benefits. An increase in 25% of the costs in operation and maintenance of the sewer network or the WWTP does not have a large effect on the NPV of the project. The major downward impact in NPV can be seen with a reduction of 25% of the cost avoided benefits. This will reduce the NPV by 27% to US\$ 76 million. Investment costs can also have a relative impact on the NPV of the project. However, these costs have already been incurred; hence, the NPV cannot be affected by changes in this variable. A point of discussion was the possibility of the plant to self-generate 60% of the energy consumption. Energy costs fluctuate between 30 to 50% of total operation and maintenance costs. Even in the most conservative of estimates, i.e., that 100% of the energy is self-generated and that energy costs represent 50% of O&M, the effect of the NPV is not significant: it decreases to US\$ 96 million (the sensitivity analysis increases the costs of O&M for the WWTP by a factor of 1.5 to reflect the effect, in isolation, of a 50% increase in the cost of energy).

## *Financial Analysis*

### Background

7. In order to support the project objective of developing the TSC into a fully autonomous entity to be operated on a commercial basis, the design of the project was centered on: (a) developing the technical, environmental, operational, financial, and managerial capacity of the TSC and (b) increasing significantly the company's financial revenues and streamlining its costs.

8. Performance indicators related to the financial aspects are featured as covenants both in the Loan agreement (Article IV) and in the Guarantee Agreement (Section 3.3). Tariff increases of 22% on an annual basis were agreed upon to take place during implementation and are mentioned in a side letter. Selected financial ratio targets were included in separate document and revised at mid-term review.

9. Article IV section 4.03 (a) of the loan agreement refers to full cost recovery of the TSC operation and maintenance, debt service as well as taking necessary action to meet such requirements. Section 3.3 of the Guarantee Agreement committed the GOI to making sure that the TPWWC transferred annually, until completion of the project, at least 15% of its total operating revenues and connection fees to the TSC. These revenues were meant, in principle, to complement the revenues obtained from connection charges and develop the investment program of the TSC, serving as part of counterpart fund for the Bank loan.

10. Although it is not specified in the Loan Agreement, it was agreed during project preparation that Government (Ministry of Energy) would make sure that assets related to wastewater collection and disposal system be transferred to the TSC.

### Analysis

11. The TSC has three main sources of revenues: a) sewage collection tariff, which is based on the consumption of water, a) connection fees, and c) transfer of resources from the TPWWC in the order of 15% of its total operating revenues and connection fees. The main financial indicators for the project are depicted in Annex 1 of the PAD. Results for each main revenue component discussed at appraisal can be considered satisfactory in general.

12. **Tariff revenues** (for sewage collection) are based on a percentage of the volumetric charge for potable water and cover the operational and maintenance expenses of the TSC. These revenues have increased from US\$680,000 equivalent for the year ended in March 20, 2001 to US\$4.79 million for the year ended in March 20, 2008, representing a 600% increase. This increase was mainly a result of the substantial increase in the number of subscribers during the course of project implementation.<sup>28</sup>

13. Increases in the tariff have also contributed, although to a lesser extent, to the increase in revenues. The target for the average sewerage tariff at project completion was estimated at appraisal to be 2,103 IRR/m<sup>3</sup>, against a baseline of 458 IRR/m<sup>3</sup> on average (the appraisal target was revised at the mid-term review to an average 691 IRR/m<sup>3</sup>). This average tariff is expected to further increase given that the GOI has recently allowed the charging of cost-recovery level tariffs to provincial and national government customers.

14. In order to be connected to the system, customers need to pay **connection fees**. Revenues from these connection fees increased from US\$5.93 million for the year ended in March 20, 2001 to US\$35.49 million for the year ended in March 20, 2007. For the year ended in March 20, 2008, revenues from connection fees dropped considerably to US\$22.58 million, as a result of the application of the new tariff structure approved by the GOI. While this new structure represents a simplification in the way the tariff was calculated, it represented as well the GOI's policy to decrease the cost connection fee to users. This policy, if not corrected, will have a negative impact on the TSC's future investment program, particularly the second phase currently under preparation, as it represent a significant reduction in income earmarked for investments.

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<sup>28</sup> The volume of wastewater collected increased from 11.3 million m<sup>3</sup> in 2000 to 125.7 million m<sup>3</sup> by March 20, 2009.

15. The GOI was committed to ensure that the TPWWC transfers to the TSC were an amount equivalent to 15% of its operating revenues and connections fees (10% as mandated by the law and an additional 5% as declared in the letter of sector policy signed by the Minister of Energy). These transfers have grown from US\$4.71 million for the year ended in March 20, 2001 to US\$15.82 million for the year ended in March 20, 2007. A slight decrease to US\$14.28 million occurred in the year ended March 20, 2008, potentially as a result of the new tariff structure approved the government. The exact amount of the revenues and the formula to estimate this transfer has been an issue throughout the life of the project and, as of today, this has not been resolved.

16. The transfers are not subject to an external and independent audit and hence depended mainly on the goodwill and management of the TPWWC. Even though the amount of these transfers have been significant throughout the project (totaling US\$90.42 million over the past 8 years), the lack of transparency in the calculation and inexistent verification of these amounts, added to the uncertainty surrounding the value of the transfer for each particular year and its timing, limit the TSC's capacity to perform efficient mid- and long-term planning of its investments.

17. The TSC has contracted an independent auditor, and as a result of this audit is disputing with the TPWWC an outstanding transfer balance of approximately US\$20 million. During its supervision visits, the Bank has tried several times to reconcile the dispute between the two organizations by consistently recommending that an independent review and audit, contracted by NWWEC, is carried out and its recommendations implemented; however, no such audit has been undertaken.<sup>29</sup>

18. **Main findings.** Overall, the performance of the TSC is positive in terms of improvement of key financial targets, which increase the likelihood of its long-term financial sustainability, as well as in capacity building as highlighted in Annex 2 and in the main section of this report. The company's operating ratio<sup>30</sup> improved from 2.81 in March 20, 2001 to 1.61 in March 20, 2008, while its working ratio improved from 2.28 in March 20, 2001 to 1.07 in March 20, 2008. Details of the TSC's income statement are presented in the table at the end of this Annex.

19. GOI's support for the project was demonstrated by exerting pressure on the TPWWC to transfer the agreed 15% of its total operating revenues and connection fees; and at the end of the project when it made available to the TSC the US\$30 million needed to finalize the works under the project.

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<sup>29</sup> The TPWWC disputes the findings of the auditor contracted by the TSC.

<sup>30</sup> Operating ratio represents the level of expenses, including depreciation, as related to revenues; i.e., expenses, including depreciation ÷ revenues.

**Tehran Sewerage Company**  
**Income Statement - 2001 - 2008 (year-end March 20)**

Particulars	Mar. 01 (1379) Audited		Mar. 02 (1380) Audited		Mar. 03 (1381) Audited		Mar. 04 (1382) Audited		Mar. 05 (1383) Audited		Mar. 06 (1384) Audited		Mar. 07 (1385) Audited		Mar. 08 (1386) Audited	
	M. IRR	M. USD	M. IRR	M. USD	M. IRR	M. USD	M. IRR	M. USD	M. IRR	M. USD	M. IRR	M. USD	M. IRR	M. USD	M. IRR	M. USD
<b>Revenues:</b>																
Sewage Disposal Revenues	3,900	0.49	4,836	0.61	7,186	0.90	8,736	1.04	11,862	1.36	17,554	1.94	19,918	2.16	33,094	3.54
Sewage Subscriptions Revenues	1,515	0.19	1,948	0.25	2,819	0.35	3,978	0.47	5,423	0.62	7,398	0.82	8,717	0.94	11,680	1.25
<b>Total Operating Revenues</b>	<b>5,415</b>	<b>0.68</b>	<b>6,784</b>	<b>0.86</b>	<b>10,005</b>	<b>1.26</b>	<b>12,714</b>	<b>1.52</b>	<b>17,285</b>	<b>1.98</b>	<b>24,952</b>	<b>2.75</b>	<b>28,635</b>	<b>3.10</b>	<b>44,774</b>	<b>4.79</b>
<b>Expenses :</b>																
Payroll	6,278	0.79	7,058	0.89	6,742	0.85	7,830	0.93	9,027	1.04	10,845	1.20	14,564	1.58	15,549	1.66
Contractual Services	2,936	0.37	5,729	0.72	4,523	0.57	2,547	0.30	3,365	0.39	4,540	0.50	4,414	0.48	6,435	0.69
Depreciation	2,862	0.36	2,861	0.36	2,642	0.33	9,621	1.15	12,836	1.47	18,550	2.05	25,145	2.73	24,100	2.58
Repair and Maintenance	889	0.11	1,102	0.14	1,851	0.23	4,329	0.52	3,716	0.43	5,398	0.60	9,675	1.05	10,190	1.09
Other Expenses	2,261	0.29	3,334	0.42	3,903	0.49	3,647	0.44	6,318	0.73	6,680	0.74	8,604	0.93	15,953	1.71
<b>Total Expenses before Capitalized &amp; Foreign Exchange Charges</b>	<b>15,226</b>	<b>1.92</b>	<b>20,084</b>	<b>2.54</b>	<b>19,661</b>	<b>2.47</b>	<b>27,974</b>	<b>3.34</b>	<b>35,262</b>	<b>4.05</b>	<b>46,013</b>	<b>5.07</b>	<b>62,402</b>	<b>6.76</b>	<b>72,227</b>	<b>7.73</b>
Capitalized expenses	(6,575)	(0.83)	(9,583)	(1.21)	(6,409)	(0.80)	(7,053)	(0.84)	(7,301)	(0.84)	(7,428)	(0.82)	(10,627)	(1.15)	(12,612)	(1.35)
Other Operating Revenues (Expenses); Foreign Exchange Gain(Loss)	-	-	-	-	-	-	-	-	-	-	(15,645)	(1.73)	(7,264)	(0.79)	54	0.01
<b>Total Expenses</b>	<b>8,651</b>	<b>1.09</b>	<b>10,501</b>	<b>1.33</b>	<b>13,252</b>	<b>1.66</b>	<b>20,921</b>	<b>2.50</b>	<b>27,961</b>	<b>3.21</b>	<b>54,230</b>	<b>5.98</b>	<b>59,039</b>	<b>6.40</b>	<b>59,561</b>	<b>6.37</b>
<b>Operating Income (Loss)</b>	<b>(3,236)</b>	<b>(0.41)</b>	<b>(3,717)</b>	<b>(0.47)</b>	<b>(3,247)</b>	<b>(0.41)</b>	<b>(8,207)</b>	<b>(0.98)</b>	<b>(10,676)</b>	<b>(1.23)</b>	<b>(29,278)</b>	<b>(3.23)</b>	<b>(30,404)</b>	<b>(3.30)</b>	<b>(14,787)</b>	<b>(1.58)</b>
Financial Expenses	-	-	50	0.01	24	0.00	2,423	0.29	3,308	0.38	-	-	-	-	-	-
Non-operating Revenues (Expenses)	1,314	0.17	1,627	0.21	(439)	(0.06)	1,307	0.16	4,515	0.52	1,238	0.14	3,202	0.35	(2,987)	(0.32)
Income Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Net Income (Loss)</b>	<b>(1,922)</b>	<b>(0.24)</b>	<b>(2,140)</b>	<b>(0.27)</b>	<b>(3,710)</b>	<b>(0.47)</b>	<b>(9,323)</b>	<b>(1.11)</b>	<b>(9,469)</b>	<b>(1.09)</b>	<b>(28,040)</b>	<b>(3.09)</b>	<b>(27,202)</b>	<b>(2.95)</b>	<b>(17,774)</b>	<b>(1.90)</b>

Operating Ratio	2.81	2.96	1.97	2.20	2.04	1.84	2.18	1.61
Working Ratio	2.28	2.54	1.70	1.44	1.30	1.10	1.30	1.07

Source: TSC's audited financial statements

Note: The exchange rate to translate TSC figures to US\$ is taken from IBRD Loan rates recorded in PMU accounting system.

**Tehran Sewerage Company - Sources of Funds (Million US\$)**

Million USD

Description	Mar. 01 (1379) Audited	Mar. 02 (1380) Audited	Mar. 03 (1381) Audited	Mar. 04 (1382) Audited	Mar. 05 (1383) Audited	Mar. 06 (1384) Audited	Mar. 07 (1385) Audited	Mar. 08 (1386) Audited	Mar. 09 (1387) Estimate	Total
<b>1- IBRD Loan</b>	<b>12.82</b>	<b>8.42</b>	<b>10.27</b>	<b>14.98</b>	<b>8.87</b>	<b>25.15</b>	<b>35.06</b>	<b>25.45</b>	<b>3.98</b>	<b>145.00</b>
<b>2- TSC Funds</b>	<b>11.32</b>	<b>12.48</b>	<b>28.11</b>	<b>32.30</b>	<b>37.71</b>	<b>41.55</b>	<b>54.41</b>	<b>45.22</b>	<b>63.22</b>	<b>326.32</b>
2-1- 15% Transfers from TPWWC	4.71	3.41	10.54	14.13	13.89	13.64	15.82	14.28	16.75	107.17
2-2- Connection Fees	5.93	8.21	16.31	16.65	21.84	25.16	35.49	26.15	41.01	196.75
2-3- Sewerage Revenues	0.68	0.86	1.26	1.52	1.98	2.75	3.10	4.79	5.46	22.40
<b>Total Funds</b>	<b>24.14</b>	<b>20.90</b>	<b>38.38</b>	<b>47.28</b>	<b>46.58</b>	<b>66.70</b>	<b>89.47</b>	<b>70.67</b>	<b>67.20</b>	<b>471.32</b>

Note: With the exception of the sewerage revenues, these funds are recorded in the TSC's balance sheet.

**Tehran Sewerage Company - Debt Service (Million US\$)**

	Mar. 06 (1384) Audited	Mar. 07 (1385) Audited	Mar. 08 (1386) Audited	Mar. 09 (1387) Estimate
IBRD Loan	6.04	12.08	12.08	12.08

## Annex 4. Bank Lending and Implementation Support/Supervision Processes

### (a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
<b>Lending</b>			
Mohammed Benouahi	Lead Water and Sanitation Specialist		Task Team Leader
Fathi Ben Slimane	Financial Management Specialist		
Gilles Fabre-Rousseau	Financial Analyst		
Harvey Garn	Economist		
Lars Rasmusson	Sanitary Engineer		
Marie Ange Le	Operations Analyst		
Maurice Gress	Procurement Advisor		
Sanjeev Aggarwal	Environmental Specialist		
Thouria Nana-Sinkam	Language Program Assistant		
Vincent Guarne	Institutional & Private Sector Specialist		
Vijay Jagannathan	Lead Water and Sanitation Specialist		Peer Reviewer
David Hanrahan	Lead Environmental Specialist		Peer Reviewer
Guillermo Yepes	Water and Sanitation Specialist		Peer Reviewer
Richard Verspyck	Lead Financial Analyst		Peer Reviewer
<b>Supervision/ICR</b>			
Mohammed Benouahi	Lead Water and Sanitation Specialist	MNSSD	Task Team Leader
Alexander E. Bakalian	Lead Water Resource Specialist	MNSSD	
Diego Juan Rodriguez	Senior Economist	ETWWA	ICR Main Author
Farvad Navai	Consultant	MNSIF	Engineer
Hiba Tahboub	Sanitary Engineer	MNSIF	
Imad Saleh	Senior Procurement Specialist	EAPCO	
Keith Rennie	Social Scientist	MNSRE	
Khalid Boukantar	Program Assistant	MNSSD	
Lars Rasmusson	Consultant	MNSSD	Sanitary Engineer
Lizmara Kirchner	Water Supply and Sanitation Specialist	LCSUW	ICR Team Leader
Magalie Pradel	Language Program Assistant	MNSSD	
Maha Yahya	Consultant	MNSIF	Social Specialist
Maria Angelica Sotomayor	Senior Economist	LCSUW	ICR Peer Reviewer
Omar Hindi	Consultant	MNSSD	Environmental Specialist
Parviz Piran	Consultant	MNSSD	Social Specialist
Peter Kolsky	Senior Water and Sanitation Specialist	ETWWA	ICR Peer Reviewer
Randa Nemer	Consultant	MNSIF	Environmental Specialist
Robert Bou Jaoude	Senior Financial Management Specialist	MNAFM	
Sateh Arnaout	Environmental Specialist	MNSHD	
Sepehr Fotovat Ahmadi	Procurement Specialist	MNAPR	
Thao Nguyen	Disbursement Officer	LOAG1	



**(b) Staff Time and Cost**

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
<b>Lending</b>		
<b>FY00</b>	31	145.05
<b>Total:</b>	31	145.05
<b>Supervision/ICR</b>		
<b>FY01</b>	13	72.85
<b>FY02</b>	17	152.46
<b>FY03</b>	27	152.51
<b>FY04</b>	21	114.31
<b>FY05</b>	12	73.19
<b>FY06</b>	21	85.53
<b>FY07</b>	23	107.22
<b>FY08</b>	17	109.60
<b>FY09</b>	12	67.84
<b>Total:</b>	163	935.51

## **Annex 5. Beneficiary Survey Results**

Not applicable.

## **Annex 6. Stakeholder Workshop Report and Results**

Not applicable.

## **Annex 7. Summary of Borrower's ICR**

### **Summary of ICR Prepared by the Tehran Sewerage Company**

#### **Background**

1. Implementation of piped water supply networks were started in Tehran more than half a century ago and it was planned to carry out simultaneously the wastewater collection system. However, the wastewater collection system was postponed a number of times due to various reasons. Ultimately, with a view to look after the water and wastewater plans and investment programs in the capital city and its satellite townships, the Tehran Province Water and Wastewater Company (TPWWC) was established in 1991. To promote accountability and autonomy of its line management, the TPWWC commenced in 1996 a program for "spinning of" the line units into affiliated companies to operate as independent profit centers, but the TPWWC retaining the majority shareholdings. Thus, the Tehran Sewerage Company (TSC) was established in 1996 to carry out the ambitious program of wastewater collection and treatment services and to operate such facilities after they are built. Like TPWWC, the TSC is a corporate utility set up in accordance with the 1991 Act on formation of wastewater companies. It operates under Iran's Commercial Code, financially autonomous and audited by independent auditors.
2. TSC developed a program for wastewater collection and disposal in Greater Tehran to be executed with financial assistance (as Loan) from the World Bank (WB). The program was proposed to take place in five phases to cover to about 2030. For phases one and two covering the periods until 2006 and 2011 respectively, the development program was planned to be executed for wastewater collection networks in critical areas of Tehran to cover a population of about 4.2 million within a period of about 12 years. The wastewater collected through this network would flow southwards by gravity through a system of trunk mains to the treatment plant to be built in the outskirts of Tehran in the south where it would receive primary and secondary treatments allowing the safe agricultural re-use of the treated effluent for selected crops downstream. The southern treatment plant is planned to have an ultimate capacity of about 900,000 m<sup>3</sup>/day. It would be implemented in two stages with four modules in each stage. The timing for the second stage would depend on the progress made in connection to the collection networks in the first phase.

#### **Project Objectives**

3. The main development objective of the Project was to improve the environmental conditions in the Greater Tehran area, through the installation of wastewater collection, and treatment facilities, to improve public health, and further enhance irrigation systems in the surrounding areas. The objectives would be achieved through: a) Provision of satisfactory wastewater collection and treatment facilities for about 2.1 million people covering an area of about 16,500 hectares (ha); b) Improvements in public health and reduction of surface and ground water pollution; c) Provision of treated wastewater for irrigation of about 15,000 ha on the Varamin plain; d) Development of the TSC into a fully autonomous entity to be operated on a commercial basis; and e) Facilitation of

private sector participation in the sector through contracting out various TSC functions, such as engineering, execution, construction supervision, operation, and maintenance.

## **Implementation Status of Project Components**

### *Interceptors and Laterals*

4. In relation to the laterals and interceptors, one hundred forty one contracts were signed which are paid combined through the WB Loan and TSC resources. There are more other contracts in addition to the one hundred forty one contracts that are signed and financed with TSC 100% resources as counterpart.
5. More than 2,400 km of the interceptors and laterals with diameters ranging from 250 mm up to 1200 mm have been implemented until now. The contracts have been divided into small, medium, and large sizes. Most of these contracts, which are implemented in the Project period, are finalized until now.

### *Western and Eastern Trunk Mains*

6. The total length of the western trunk main was revised from 24 to 30 kilometers, of which 5.8 kilometers were laid by pipe jacking method. The diameter of the reinforced concrete western trunk main varies from 1,200 to 2,000 millimeters. The western line is completed up to Esfandiar Avenue in north Vally Asr Avenue until now and to connect this line to the northern part of Tehran, implementation from Esfandiar to Parkway crossing is in progress. As an annex to this line, a 2 km 800-1200 mm pipeline should also be implemented in Parkway and Javanan Street in order to connect the Velenjak area to the western line.
7. The eastern trunk main is being constructed as a tunnel. The size of the tunnel is from 2,000 millimeters inner diameter pipe equivalent in northern part to about 3,000 millimeters inner diameter pipe equivalent in the south. The route starts near the junction of Resalat and Niavavaran highway and moves down to Shahre Ray, south of Tehran. The Trunk connects to the two parallel reinforced concrete pipes, 2400 mm in diameter each, before reaching the treatment plant. Due to changes, which the consultants made in the route, the total length of the tunnel has increased to about 24 km compared to the original design.
8. The construction of Eastern Main Trunk is divided into five Lots (Lots 0 to 4). Construction of about 5.8 km (Lots 0 to 2) has been completed. Lot 3 was awarded in July 2004 with the duration of 721 days. The construction of this lot is ongoing now and due to disagreement between the Consultant and the Contractor regarding interpretation of terms and conditions of contract, the Contractor's claims are to be decided upon by the appointed Dispute Review Board. Lot 4 was awarded in January 2005 with the duration of 721 days. This contract is presently under construction and for resolving the contractor claims which has not been confirmed by the consultant, a Dispute Review Board was appointed for considering the claims. Lot 3 is expected to be finished in July 2009 and Lot 4 in September 2009.

### Wastewater Treatment Works

9. The wastewater will be collected and delivered by gravity to the site for treatment works. Here inlet-pumping station will be located and, after preliminary and secondary treatments, the treated effluent will flow by gravity to the Varamin irrigation network. This is going to be a great help to the already existing irrigation water shortage in south of Tehran. In addition, a better irrigation water quality, based on Food and Agriculture Organization (FAO) standards, shall be provided for the agricultural use. The agricultural area to benefit from the treated wastewater is about 50,000 ha. The site of the treatment plant has been made available and there is no need for land acquisition for the site. The environmental impact of the treatment plant site is negligible for the Greater Tehran. The contract is ongoing by the relevant parties and the commissioning of the first module of the wastewater treatment plant started on June 15, 2009, while full and continuous operation of this module is planned for July 2009.

### Operation and Maintenance Equipment

10. The equipments are mainly small and large size water jets, recycle sewer cleaner, and closed circuit TV cameras as the relevant equipment for monitoring the sewerage pipeline. Five sets of closed circuit TV were purchased and are used by O&M department. Five large water jets were delivered to TSC and are used by O&M department.
11. For the ten small water jets, the contract was awarded to the selected company, but the seller refused to undertake his contractual commitments and therefore, the contract was cancelled. For the two sets of recycle sewer cleaner, three firms purchased the bidding documents, but none of them submitted their bids up to the submission deadline date and the bidding process was terminated.

### Consultant Services/Technical Assistance

12. Project Management: In order to facilitate the effective implementation of the Project in collaboration with the WB, a small PMU with the task of planning, coordinating, monitoring, and reporting was established within the TSC. The PMU is responsible for following up, supervision and managing the overall project execution including preparation of technical requirements, procurement and contracting, disbursements and financial management, planning, coordinating and performance monitoring, reporting, and control of work progress.
13. Project Financial Management System: To improve the quality of financial management system, TSC signed a contract with the consultant who obtained the best technical financial score to take over the task. A financial reporting system has been prepared and significantly enhanced and it is now capable of generating timely Project Management Reports (PMRs) as agreed with the Bank.
14. Strengthening of TSC: To strengthen the TSC capacity in monitoring the Project, TSC decided to implement a Management Information System (MIS). The MIS purpose was to design and develop a Project Management Information System that enabled the

transformation of all operational data into reports satisfying the TSC and PMU management as well as the World Bank.

15. The contract to prepare the definitions and need assessment for MIS implementation, and was awarded to the selected joint-venture company. After several months negotiations and meetings, due to inability of the implementer to fulfill the requirements, the contract was terminated without any claim from either side.
16. Engineering and Construction Supervision: To obtain high quality services, a 3 phase contract was signed with the consulting firm who obtained the highest combined technical and financial score. The first phase relating to engineering work was to study the available design criteria of the treatment plant, pre-qualify the contractors, prepare the tender documents for a DBO tender, evaluation of proposals, assistance in negotiations with the winner and study and confirmation of the contractor s design of the treatment plant. The second phase relates to the supervision on construction of the treatment plant. This phase is currently being implemented and due to delays in completion of the treatment plant, there have been three confirmed amendments to the contract. The third phase relates to O&M, which has not started yet. In addition, another contract was signed with a different consulting firm to prepare the eastern tunnel Lots 3 and 4 tender documents and to provide supervision services. The construction supervision is currently under implementation.
17. Preparation/Implementation of Environmental Monitoring Systems: A consultancy contract was signed in June 2002 to prepare the development of the Environmental Management Plan (EMP) reports. The objectives of this Environmental Monitoring System (EMS) report are as follows:
  - a. To establish monitoring criteria.
  - b. To identify monitoring activities that will be undertaken to (i) establish an environmental baseline (ii) monitor the environmental performance against this baseline during the construction and operational phases of the sewerage scheme and sewage treatment works, and (iii) monitor the environmental effects of reuse of treated effluent and sludge for agriculture. As part of this, to define monitoring parameters, sampling procedures, analytical methods, data reporting techniques and methods to validate results.
  - c. To conduct an assessment of the instrument/equipment and staff that will be needed for successful EMS implementation by the various agencies involved in this process. This component will be the subject of a more detailed Institutional Assessment Report to follow.
  - d. To estimate the implementation costs of the EMS.
18. Updating Sewerage Development Program: A contract relating to Updating Tehran Sewerage Development Program was awarded to the selected consultant in January 2006. The assignment is being under implementation by consultant and has had about 75% progress. The inception report, interim progress report and the draft final report have been submitted by the consultant. The main reason for delay in completion of the study is

due to difficulties in collection of data and uncertainty of the location of southwestern treatment plant site.

19. Engineering Phase two: Two consultancy contracts were signed in this respect. The first contract relates to preparation for the extension of wastewater collection and treatment plant. A Feasibility Study contract for Tehran Sewerage Project phase two awarded in February 2006. The consultant submitted the final version of feasibility studies for Tehran Sewerage Project Phase two to TSC and TSC submitted the report to the WB for their comments. It is necessary to mention that due to ignorance of consultant in considering the limitations imposed by Imam Khomeini's shrine on lands around the shrine, the location of southwestern treatment plant is not yet confirmed and after determination of the site, the consultant is to make the necessary corrections in the study results.
20. The second contract relating to Environmental Implementation Social Assessment Study was awarded through a competitive bidding in February 2007. The consultant is currently involved in the study, although, outstanding delay factor has been the location of southwest treatment plant, which should be finalized by TSC to facilitate the completion of this study.

### **Disbursements**

21. The company has used all disbursement methods for payments against all eligible expenditures. US\$5.41 million as direct payments, US\$30.24 million as Letter of Credits Commitment, US\$6.57 million as Retroactive, and the rest equal to US\$101.33 million as the replenishment of the DA. Also 1% of the Loan is withdrawn from the Loan as Front End Fee. The total sums up to US\$145.00 million.
22. In some cases, the WB was unable to transfers the funds to TSC on time due to limitation of US Dollar transfer to Iran and therefore TSC was unable to pay the contractors claims in due time. This caused delay in implementation and consequently extension of time in the Project completion. To solve the problem, the WB proposed amendment to all Iran Agreements for converting the US Dollar Designated Accounts to Euro (EUR) on May 2007. This proposal was accepted by the Islamic Republic of Iran.

### **Key Factors Affecting Implementation and Outcomes**

23. The background analysis was done well for the project breakdown/components. Financial needs, objectives, and organization was defined in a way that if everything had gone by what had been defined, the Project would have been finished on time in the best way, qualitatively and quantitatively
24. The risk assessment had also been defined well had all the requirements been met. Long delay in implementation and unforeseen obstacles from municipalities and police, and shortage of cash for payment of Borrower's forecasted share of funds partly due to freezing of tariffs deteriorated the original risk assessment



25. The risk to the beneficiary of the Project rose due to nature of work and increase in the time of implementation. Examples are, increased health hazards, inconveniences caused by the traffic jams, accidents due to occupation of parts of streets and sidewalks, extra pollution caused by delay in implementation hence wastewater infiltrating and polluting underground water, increasing the level of harmful chemicals and organic substances and parasites in the ground water.
26. The Project suffered delays due to instability of market specially the cement market that encountered a number of changes in the distribution system of cement causing drastic increase in cost and long delays in delivering to the site.
27. Regarding the shortage of local funds for payment to the contractors/consultants, a change in the subscriber s affairs department management and use of private sector for handling the administrative works and advocating sale of connections raised the level of revenues drastically.
28. Therefore, a temporary remedy for the short payments was provided even though the full objective of the Project depends on continuation of implementation of the remaining laterals and interceptors for collection of wastewater. This shortage of funds caused a stop to the implementation of this component. Lately, a budget of about US\$30.00 million equivalent has been allocated to TSC for continuation of the Project.

### **Transition Arrangements to Post-Completion Operations**

29. The transition arrangements to post-completion operation of the investment will be a continuation of the present DBO contract, which has provided for a five years operation of the plant by the present contractor. As far as collection of raw wastewater is concerned, presently there is an inflow of about 2 Cubic Meter/Second coming from the western line collecting wastewater from the central core and southern part of Tehran that at present is being delivered to the site for treatment in the temporary treatment plant(lagoons). The wastewater in excess of the capacity of lagoons is delivered to the Firozabad Canal, which delivers it to the Salt Lake in the desert, south of Tehran.

### **Actions Taken in Response to Problems**

30. The cement problem and the drastic increase in price were compensated for through provisions of clause 36 of General Conditions of Contract of the DBO contract. For the increase in the price of steel, the contractor asked for the change of escalation formula provided in the Appendix to the Contract that was agreed upon using the indices originally used in the escalation formula considering a breakdown of materials as a whole into 4 components of Rebar, Steel plates, Concrete, and other materials. The consequence of such change cost the Employer over US\$4.50 million, which is about 5% of the amount of the DBO contract value.
31. The O&M deputy of TSC is responsible for up keeping of the sewer lines using mostly private sector on contract basis. The financial resources for the O&M of the Project will be provided for by the sewerage disposal revenues that are 70% of the water bills for residential and up to 100% of the water bills for commercial subscribers. The 15% of the

TPWWC total income will be spent nearly all for repayment of the Loan installments. Therefore, lack of funds for future expenditures of the Project or shortage of fund for O&M should be compensated for either by a proportional increase in tariffs or should be provided for from public funds should the government decide not to increase tariffs. It is worthy to mention that the government has decided to inject about US\$30.00 million to complete the present Project.

32. After the O&M period that will be done by the contractor, TSC in 3 months prior to the termination will provide the required technical staff to be trained by the contractor for the taking over by TSC after training. The O&M period is foreseen for maximum 5 years even though the employer is allowed to terminate at any time after a minimum 6 months prior notice to the contractor. At present, TSC will have the minimum presence by appointing a plant supervisor and perhaps 2 to 3 technical supervisors for the control room.

### **Lessons Learned**

33. Due to the fact that management system of the borrower is used to working according to local regulations which differs from the WB regulations, it is suggested that before the effectiveness of a loan, all the management levels of the borrower which in any way might have any influence on the expenditure of the loan to be briefed about the WB regulations and commitments of the borrower government after signature of the loan agreement.
34. It is most desirable that the borrower government to minimize the management change in the organization of the implementing agency to prevent future shortcomings due to misunderstanding or unfamiliarity with the loan agreement.
35. Should the loan be needed for procurement of the goods from outside the country of the borrower, all agencies that will have a hand in issuance of permissions for payment of foreign currency for such contracts should be informed of the loan agreement and government commitments. As an example, unfamiliarity of the Central Bank of Iran experts with the payment process of Tehran Sewerage Project loan caused a delay of about ten months in effectiveness of the treatment plant contract, about US\$6.00 million extra cost, over 300 days delays in start of the treatment plant contract and 358 days delay due to dispute over payment of cost of related delays to the contractor.
36. Limitation of liquidated damages due to delay in the Bank standard contracts gives the convenience of working at slow rate, once the deductions for delays reaches the ceiling of the maximum liquidated damages. In this case, the employer becomes desperate and the contractor using this limitation pushes for getting further commitments from the employer in order to complete the job sooner, since at no time it is to the benefit of the employer to terminate the contract and have a third party for completion.
37. Control of the WB disbursement department over payments according to the Special Commitments issued to the banks handling the contractual payments. As an example, payment of 90% of the invoice instead of 80% by the commercial bank to the wastewater

treatment plant contractor in spite of the fact that Performa Invoice and the contract had been mentioned to be the integral part of the letter of credit and their condition to be enforced.

38. Use of standard bidding documents of the WB for selection of consultants and contractors gave the opportunity for use of a sound selection process to the Project Management and a clear and undisputable outcome. So was the use of the WB standard contracts which due to its clarity and consideration of all involved parties rights, while reducing the prices due to reduction of risk for the contractor, guaranteed the employer rights for a sound competition of the Project.
39. Use of the WB regulations for selection of contractors in National Competitive Bidding process resulted in lower offered prices and an environmentally safe implementation.

## Annex 8. List of Supporting Documents

### Project Documents:

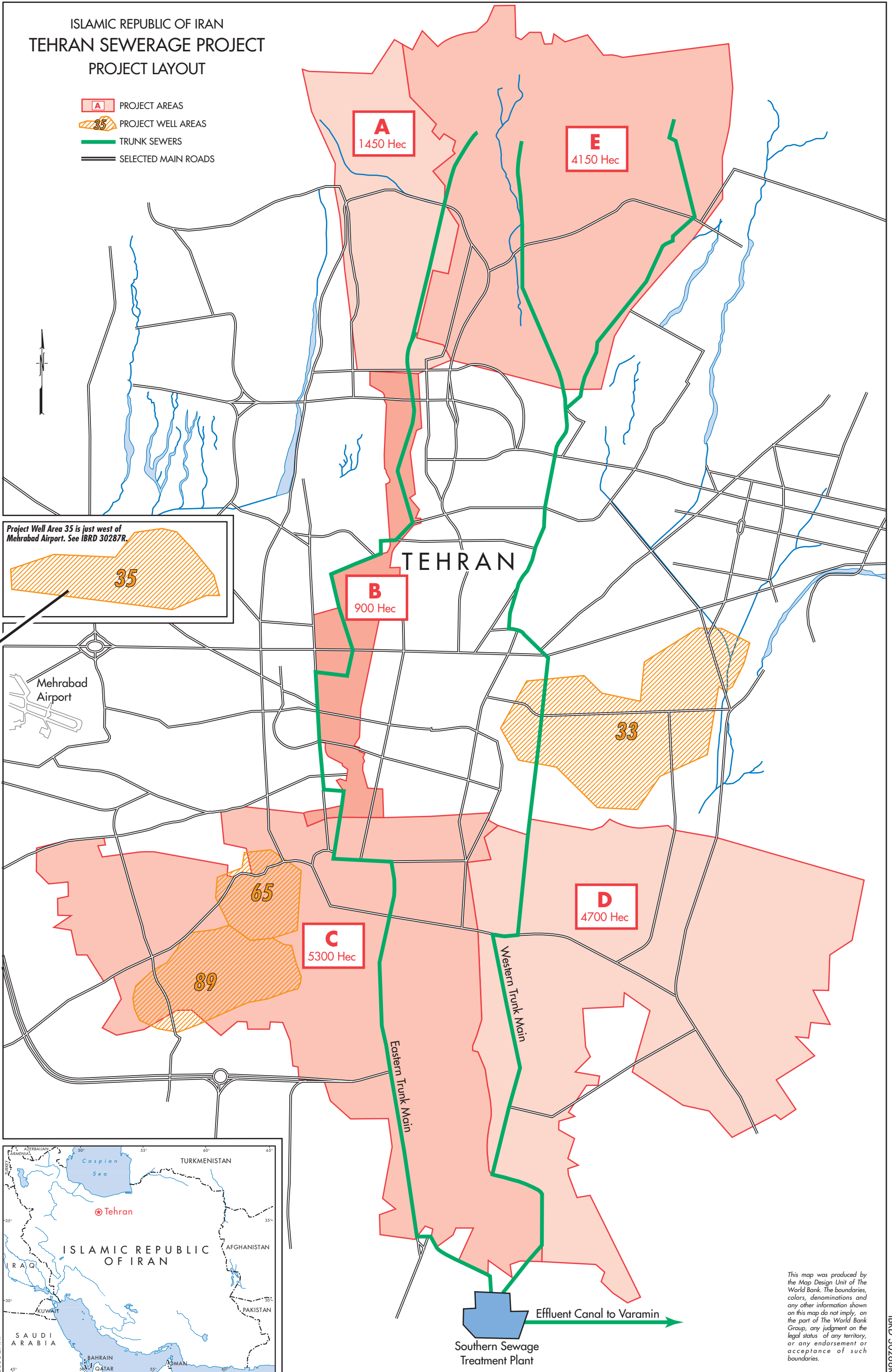
- Project Appraisal Report
- Project Progress Reports
- Auditing Reports
- PSRs and ISRs
- Quality of Supervision Assessment
- Aide Memoires
- Environmental Impact Assessment and Monitoring Plan

### Other Background Information:

- Kolahi, Ali A. May 2005. *The Effects of Using Urban Sewerage System on Incidence of Diarrhea in Children 6-60 Month Olid in 17 and 18 Zones in Tehran*. Final Report prepared for the Tehran Sewerage Company. Shaheed Beheshti University of Medical Sciences. Tehran, Iran.
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- World Bank. 2005. *Islamic Republic of Iran: Cost Assessment of Environmental Degradation*. Report No. 32043-IR. Washington, D.C.: World Bank.
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ISLAMIC REPUBLIC OF IRAN  
TEHRAN SEWERAGE PROJECT  
PROJECT LAYOUT

- A PROJECT AREAS
- 35 PROJECT WELL AREAS
- TRUNK SEWERS
- SELECTED MAIN ROADS



Project Well Area 35 is just west of Mehrabad Airport. See IBRD 30287R.

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