



Performance Evaluation Report

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People's Republic of China: Tianjin Wastewater Treatment and Water Resources Protection Project

Independent Evaluation Department

Asian Development Bank

CURRENCY EQUIVALENTS

(as of 31 October 2010)

Currency Unit	–	yuan (CNY)
CNY1.00	=	\$0.15
\$1.00	=	CNY6.67

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	biochemical oxygen demand
COD	–	chemical oxygen demand
EA	–	executing agency
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
EOCC	–	economic opportunity cost of capital
FIRR	–	financial internal rate of return
IA	–	implementing agency
IED	–	Independent Evaluation Department
IEM	–	independent evaluation mission
LIBOR	–	London interbank offered rate
M&E	–	monitoring and evaluation
MIS	–	management information system
PCR	–	project completion report
PPER	–	project performance evaluation report
PMO	–	project management office
PRC	–	People's Republic of China
TA	–	technical assistance
TCEPC	–	Tianjin Capital Environmental Protection Company
TML	–	Tianjin Municipal Luanhe Drinking Water Source Protection Engineering
TSC	–	Tianjin Sewerage Company
TSISC	–	Tianjin Statistical Information Service Center
WACC	–	weighted average cost of capital

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
m	–	meter
m ²	–	square meter
m ³	–	cubic meter
t	–	ton

NOTES

- (i) The fiscal year (FY) of the government and its agencies ends on 31 December. "FY" before a calendar year denotes the year in which the fiscal year ends, e.g., FY2000 ends on 31 December 2000.
- (ii) In this report, "\$" refers to US dollars.

Key Words

adb, affected people, asian development bank, economic internal rate of return, eirr, financial internal rate of return, firr, ied, independent evaluation mission, resettlement, sludge disposal, tianjin, water resources protection, wastewater treatment

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In accordance with the guidelines formally adopted by the Independent Evaluation Department (IED) to avoid conflict of interest in its independent evaluations, the Director General of IED did not review this report and delegated approval of this evaluation to the Director of Independent Evaluation Division 2. Tse Yau Shing, International Water Supply Specialist, and Shaojun Chen, Resettlement Expert, were the consultants involved in the preparation of this report. To the knowledge of the management of IED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

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BASIC DATA

Loan 1797-PRC: Tianjin Wastewater Treatment and Water Resources Protection

Project Preparation and Institution Building

TA No.	TA Name	Type	Amount	Approval Date
3216	Tianjin Wastewater Treatment and Water Resources Project	PPTA	\$800,000	2 July 1999

Key Project Data (\$ million)	As per ADB	
	Loan Documents	Actual
Total project cost ^a	340.7	337.3
Foreign exchange cost	169.2	128.4
Local currency cost ^a	171.5	208.9
ADB loan amount and utilization	130.0	128.4
ADB loan amount and cancellation		1.6

Key Dates	Expected	Actual
Fact-finding		12–21 January 2000
Appraisal		15–26 May 2000
Loan negotiations		23–26 October 2000
Board approval		11 December 2000
Loan agreement		1 August 2001
Loan effectiveness	30 October 2001	30 October 2001
First disbursement		30 October 2001
Project completion		30 June 2007
Loan closing	30 June 2006	5 September 2007
Months (effectiveness to completion)		68

Internal Rates of Return (%)	At Appraisal	PCR	PPER
Financial Internal Rate of Return			
Wastewater treatment component (A)	10.7	6.0	4.7
Water resources protection component (B)	14.5	7.7	7.7
Economic Internal Rate of Return			
Wastewater treatment component (A)	15.2	16.2	13.2
Water resources protection component (B)	14.7	18.3	17.7

Borrower	People's Republic of China
Executing Agency	Tianjin Municipal Government

Mission Data	No. of Missions	No. of Person-Days
Type of Mission		
Fact-Finding	1	
Appraisal	1	
Project Administration		
Inception	1	20
Review	6	111
Midterm review	1	38
Special loan administration	1	18
Project Completion	1	34
Independent Evaluation	1	37

ADB = Asian Development Bank, PCR = project completion report, PPER = project performance evaluation report, PPTA = project preparatory technical assistance, TA = technical assistance.

^a Actual cost included interest during construction of \$4 million.

EXECUTIVE SUMMARY

The Tianjin Wastewater Treatment and Water Resources Protection Project was approved by the Asian Development Bank (ADB) in December 2000 and aimed to improve (i) the urban environment by reducing environmental contamination through improved wastewater management, and (ii) the quality of raw water supply in Tianjin. Secondary objectives included (i) strengthening the capacity of the raw water supply and wastewater operations to be more efficient and managed on commercial principles, (ii) introducing comprehensive watershed management approaches, and (iii) improving cost recovery from users through an improved tariff structure. The loan approved was for \$340.7 million, comprising \$169.2 million in foreign exchange costs and \$171.5 million in local currency, with 76% of foreign currency and 122% of local funding disbursed. The total project cost after completion was \$337.3 million, with local financing of \$208.9 million, through the government's equity and a loan from the China Development Bank.

The Tianjin municipal government was the executing agency (EA). The project had two components: (i) component A, focusing on wastewater treatment, under the implementation of the Tianjin Sewerage Company (TSC) and subsequently transferred to the Tianjin Capital Environmental Protection Company (TCEPC); and (ii) component B, focusing on water resources protection, under the implementation of Tianjin Municipal Luanhe Drinking Water Source Protection Engineering (TML). Outputs for component A included (i) construction of a wastewater treatment plant with a capacity of 100,000 cubic meters (m³) per day, with sludge-dewatering facilities, and capacity of treated water for reuse; (ii) laying 14.80 kilometers (km) of sewer pipes; and (iii) constructing a pump station with a 86,400 m³ capacity/day. The full capacity of the wastewater treatment plant has not yet been reached, pending the completion of the sewerage system of a World Bank-funded project. During postevaluation, its capacity was 65,000 m³ per day and expected to be fully utilized by 2011, when the World Bank sewerage system is completely in place.

Component B included (i) improving open channel works from the Jiuwangzhuang Gate to the Dazhangzhuang Pump Station, including structure maintenance and landscape works; (ii) constructing a closed culvert, with a total length of 34.14 km, encompassing a regulating gate, closed box culvert, outlet sluice gate, regulating tank, and maintenance gate to avoid pollution from the Zhou River; (iii) Yuqiao Reservoir works involving soil and water conservation, village waste treatment, hospital solid and wastewater treatment works, and water-quality protection works; and (iv) establishing a management information system, which consisted of a cable transmitting system from the Yuqiao Reservoir to the Tianjin, mostly for hydrological quality monitoring and pump station gate remote control. The project has attained a substantial level of capacity for raw water supply and wastewater operations, making them more efficient and well managed based on commercial principles.

The project experienced a delay in the implementation of the Yuqiao Reservoir subcomponent pertaining to fishpond removal. This was caused by the resistance of villagers to replace their original sources of livelihood for other alternatives; more consultation had to be done, hampering the planned removal. A total of 24,058 mu of fishponds were to be removed, inside and outside of the Wangguofan Dike. The ADB project completion report stated that the affected people have been compensated for the removal of the fishponds. Focus group discussions during the independent evaluation mission (IEM) reported that people are satisfied with their new sources of income like timbering, tree planting, and fish culturing.

The project is rated *successful*. The project is rated *relevant* since it is in line with the government's plan as stated in the Hai River Pollution Prevention and Control Plan of enhancing

environmental and public health conditions through wastewater treatment, and the protection of a single raw water source through ecological improvements under component B. However, the depth of understanding in what was to be achieved under the project's institutional reform was unclear in the original appraisal document. Therefore, ADB assistance in this area could not be assessed as *highly relevant* to the government's plans. The project design and standards, however, are continuously being upgraded to meet the level of quality in the wastewater and water resource components, keeping the project constantly relevant to the current times.

The project is rated *effective* since it has achieved its intended outcomes, and the technical options adopted during implementation were largely on a least-cost basis with most outputs attained. The project complied with the loan covenants stipulated, although there are still areas in the financial covenant, which need to be closely monitored (i.e., the current asset-liability ratio for TCEPC). The project is rated *efficient*, with both components hurdling the economic cost of capital of 12%. Component A has an economic internal rate of return (EIRR) of 13.2%, while component B has an EIRR of 17.7%, compared to appraisal estimate of 15.2% and 14.7%, respectively. However, the efficiency of the implementation process was somewhat compromised due to about a year delay in the implementation of the Yuqiao Reservoir subcomponent, owing to land acquisition and resettlement problems. Likewise, the efficiency of the wastewater treatment plant operations has not yet been maximized, pending the completion of the World Bank-funded sewerage system, expected to be done by 2011.

The project is rated *most likely* sustainable as the resulting financial internal rate of return (FIRRs) for each component surpasses the weighted average cost of capital (WACC). Component A has an FIRR of 4.7% compared to WACC of 2.8%, while component B attains an FIRR of 7.7% compared to a WACC of 3.8%. In addition, it was noted that there have been significant environmental improvements, and ecological protection works are continuously implemented, particularly for component B, which would further improve water quality.

During the earlier stages of project implementation, the EA made a proposal to ADB to transfer the implementing role for component A from TSC to TCEPC. However, this did not occur, since it would have been against the terms of the loan. At the time of the project's post-completion evaluation, there has been no formal change in the implementation arrangements, but TCEPC has been taking on the implementing role for component A. During 2008, the Ministry of Finance released an official document which approved that TSC may transfer assets to TCEPC in line with the latter's physical role of implementing the component. It also confirms that TSC is still the borrower, responsible for repaying the ADB loan.

A number of issues related to the project operations remain: (i) a need to explore new technology for sludge disposal; (ii) a pending contract signing between the Tianjin municipal government and TSC which involves compliance with performance measures, such as treated water capacity level and sewer discharge standard; (iii) monitoring and evaluation of outcomes; and (iv) overlap in project implementation across agencies.

The project points to a number of lessons regarding wastewater and water supply operations:

- (i) **Adequate consultation and better communication with affected people for projects experiencing resettlement issues can reduce implementation delays.** Historically, resettlement implemented for the Yuqiao Reservoir occurred in three phases: 1960–1967, 1973, and 1979–1982. It was complex. Delays in the implementation of the resettlement subcomponent of this project could have been mitigated if lessons from the past have been taken into account. This

included having closer consultation and ensuring that resettlement impact is better communicated with local officials, village committees and affected peoples, proposing reasonable resettlement or fishpond removal scope and compensation policies. The villagers would then be able to better understand the objectives and importance of projects, and would be more receptive to the resultant land acquisition and resettlement activities.

- (ii) **Involving communities in environmental improvements increases their sustainability.** The Yuqiao Reservoir subcomponent involved environment improvements to 68 villages. For such community-based subcomponents, community participation and self-management are effective gateways into sustainable implementation and operation. For similar projects, a community participation and self-management booklet should be prepared by villagers under the guidance of the social specialist at the project preparatory or implementation stage.
- (iii) **Bringing in private sector experience yields efficiency.** The eventual full participation of TCEPC in component A was a good demonstration of private sector participation, particularly in bringing about the required expertise in running a wastewater treatment plant. Aside from the Beicang wastewater treatment plant, TCEPC is also responsible for the operations of three other large-scale wastewater treatment plants in Tianjin. Prospects of private sector participation in component B should have been explored with other private groups or entities, particularly in enhancing ecological works around the Yuqiao Reservoir, which is currently financed by municipal funds. This could be a showcase to invite interest from private enterprises, particularly in the growing concern for the environment.
- (iv) **Receptiveness for gender development is context specific.** During appraisal, one of the benefits identified from the project was to provide employment opportunities to women through the All-China Women's Federation. At the project's completion, it was mentioned that women were employed as laborers during construction, and some were given permanent jobs in the implementing agencies (IAs). Moreover, there were training opportunities given for skills enhancement. Given the focus on the growing role of women in development, gender equality is inevitably mentioned in ADB projects. Emphasis on gender depends on the context and locale conditions.
- (v) **Complementarity of projects and donor coordination would improve operational efficiency.** Sewerage construction needs to be fully addressed in the early stage of the project, particularly as it affects the implementation of wastewater treatment operations. Further to this, when the two are implemented by different funding institutions, the need for inter-donor coordination is essential to ensure that project operations and targeted completion are not compromised.
- (vi) **A two-pronged approach focusing on developing institutions and training is needed to strengthen agencies.** Various trainings were given to the EA and IAs in water supply and wastewater treatment operations. Aside from training, emphasis on developing the institutions, such as review of the overall organization structures and terms of reference of management and staff, would be helpful in further strengthening the EA and IAs. The creation of the Tianjin Water Affairs Bureau can be regarded as a first step in overseeing the continued development of water-related IAs to focus efforts in building capacity in operational areas needed for the city's development. Furthermore, the commercialization of operations through TCEPC involvement is also another step in institutional strengthening.

No further follow-up actions are required following the suggestions made during the IEM on compensation to affected peoples and monitoring of income restoration. There were steps reportedly taken by the EA to comply with these suggestions, as per the resettlement livelihood restoration report for the Yuqiao Reservoir subcomponent, given by the EA to the People's Republic of China Resident Mission in August 2010.

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I. INTRODUCTION

A. Evaluation Purpose and Process

1. The Independent Evaluation Department (IED) of the Asian Development Bank (ADB) evaluated the Tianjin Wastewater Treatment and Water Resources Protection Project, which contributed to broader studies on the multisector approach, and a special evaluation study on water policy. The primary objectives of the project, approved in 2000, were to improve the urban environment by reducing environmental contamination through improved wastewater management and the quality of raw water supply in Tianjin City.¹ Secondary objectives included (i) strengthening the capacity of the raw water supply and wastewater operations to be more efficient and managed on commercial principles, (ii) introducing comprehensive watershed management approaches, and (iii) improving cost recovery from users through an improved tariff structure.

2. The 2008 project completion report (PCR)² recommended an independent evaluation to (i) assess the full benefit impact of the wastewater treatment component (component A), which was only 30% operational at the time of the PCR due to a delay in a sewerage construction; and (ii) follow up monitoring reports regarding income restoration of affected people around the Yuqiao Reservoir for the water resources protection component (component B). Potential resettlement impacts were identified by a preliminary survey for the two components. A socioeconomic survey was subsequently conducted in 2007 to assess benefits of component B after completion.

3. IED's previous PCR validation concurred with the PCR's *successful* rating of the project.

4. Prior to the independent evaluation mission (IEM) of 3–13 June 2010, various project files were reviewed. An interview was held with the implementation officer at ADB headquarters who was responsible for the project before it was delegated to the PRC Resident Mission in 2004; a similar interview was conducted with the project officer from the resident mission. During the IEM, focus group discussions were conducted to obtain details of the project impact on certain groups of affected people. Data and information gathering comprised implementing agency (IA) presentations on each component, detailed question-and-answer sessions with IEM members, and field visits to physical facilities. This report is thus based on project document reviews; interviews; and consultations with the executing agency (EA), IAs, and related offices relevant to project implementation.

B. Expected Results

5. The project consisted of two parts: (i) component A, which concentrated on wastewater collection and treatment; and (ii) component B, which focused on water resources protection.

6. Component A was to provide trunk sewers and four sewage pump stations to serve the newly developing portion of Beicang District, as well as a wastewater treatment plant to serve the existing area (i.e., the eastern portion of Beicang District) and expected new sewerage areas (i.e., the central portion of Beicang District). During appraisal, component A was expected to operate at a capacity of 100,000 cubic meters (m³) per day. However, the resulting capacity during the IEM was only 65,000 m³ per day, since a World Bank sewerage project for the central portion of

¹ ADB. 2002. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Tianjin Wastewater Treatment and Water Resources Protection Project*. Manila (Loan 1797-PRC, for \$130 million, approved 11 December).

² ADB. 2008. *Completion Report: Tianjin Wastewater Treatment and Water Resources Protection Project for the People's Republic of China*. Manila.

Beicang, which was expected to connect to the wastewater treatment plant, had not yet been completed.

7. Component B had three main subcomponents: (i) improvement of the water quality in the Yuqiao Reservoir by reducing water pollution; (ii) construction of a new, closed box culvert to carry raw water from the Yuqiao Reservoir to the Jiuwangzhuang Gate to avoid pollution from the Zhou River; and (iii) improvements to the existing open channel from the Jiuwangzhuang Gate to the Dazhangzhuang Pump Station. Water quality in the Yuqiao Reservoir was expected to be improved with the (i) planting of appropriate vegetation within various ranges of ground elevation; (ii) construction of wastewater conveyance and treatment systems (by sewerage interception ditches) for rural villages, coupled with improvements in wastewater pretreatment in hospitals and enterprises; (iii) elimination of 730 hectares (ha), which was subsequently at 970 ha, after the detailed measurement survey, or the equivalent of 14,551 mu³ of fishponds in the reservoir; and (iv) improvement of fishponds behind the protective Wangguofan Dike within the reservoir.

II. DESIGN AND IMPLEMENTATION

A. Formulation

8. Tianjin City lies between Beijing and the coast of Bohai Bay, and at the mouth of rivers forming the heavy polluted Hai River Basin. The project was one of a number of planned wastewater treatment and water resource protection projects under the Hai River Basin Pollution Prevention and Control Plan, which is funded by ADB. This basinwide program comprised more than 600,000 projects, of which high-priority projects are implemented under the PRC Transcentury Green Plan.⁴ Tianjin is a priority area under the plan, and the components of the project were under the Hai River Basin Pollution Prevention and Control Plan.

9. In 1999, ADB approved technical assistance (TA) to help the Tianjin municipal government formulate the project.⁵ The TA reviewed feasibility studies and confirmed the need to improve wastewater collection and treatment to protect Tianjin's sole raw water supply source from an increasing threat of pollution. The results of the TA report, government feasibility studies, findings of the ADB missions, and extensive discussions with government officials and project beneficiaries formed the basis for the project's formulation.

B. Rationale

10. Tianjin is PRC's fourth-largest city and a municipality with the status of a province (similar to Beijing, Chongqing, and Shanghai). A high priority in Tianjin's development as a major industrial center has been to improve the urban environment, including developing a clean, high-technology industry. However, more than half of Tianjin's wastewater is discharged untreated into canals, rivers, and Bohai Bay. Component A aimed to contribute to a comprehensive wastewater management program and achievement of environmental benefits for the densely developed city center. Implementation of this component would also help mitigate pollution in Bohai Bay, which was suffering from the detrimental effects of untreated wastewater effluent.

³ "Mu" is a unit of measurement in PRC, equivalent to 1/15 ha.

⁴ This is a state plan which includes programs on environmental protection.

⁵ ADB. 1999. *Technical Assistance to the People's Republic of China for the Tianjin Wastewater Treatment and Water Resources Protection*. Manila (TA 3216-PRC, for \$800,000, approved 2 July).

11. All major urban areas of Tianjin are served almost exclusively by a single raw water supply source, the Luan–Tianjin water diversion system. However, high-risk pollution, arising from various locations, threaten this water source and risk Tianjin’s image as a modern, thriving metropolis that can effectively manage its water supply system and provide safe, clean water. Thus, component B aimed to eliminate the sources of pollution to the raw water system that are within Tianjin’s control.

C. Cost, Financing, and Executing Arrangements

12. At appraisal, the project was expected to cost \$340.7 million, comprising \$169.2 million in foreign exchange costs and \$171.5 million in local currency. The total project cost after completion was \$337.3 million, with local financing of \$208.9 million through the government’s equity contribution and a loan from the China Development Bank. The increase in local cost financing compared to the one envisioned during appraisal was due to increased material and labor costs. Originally, ADB loan was \$130.0 million for the project, of which \$128.4 million was subsequently disbursed. Because of lower interest rate payments and charges as a result of a change to London interbank offered rate (LIBOR)-based lending, \$1.6 million was canceled.

13. The EA for the project was the Tianjin municipal government. The two IAs were Tianjin Sewerage Company (TSC) for component A and Tianjin Municipal Luanhe Drinking Water Source Protection Engineering (TML) for component B. TSC eventually transferred the responsibility to the Tianjin Capital Environmental Protection Company (TCEPC).

14. During the early years of project implementation, a proposal by the Tianjin municipal government already existed to transfer the implementing role of component A from TSC, a state-owned enterprise, to TCEPC, a semi-private company listed on the Hong Kong and Shanghai stock exchanges. In addition to the expected higher level of service and operation efficiency, and because of TCEPC’s experience in operating three other wastewater treatment plants in Tianjin (Dongjiao, Jizhuangzi, and Xianyanglu), the Tianjin municipal government wished to develop a strong wastewater treatment company in Tianjin with TCEPC, capable of expanding its business to other parts of PRC. Although ADB found the rationale for the proposal to be sound, it did not give consent to the official transfer of the implementing responsibility since it would be against the terms of the loan. It concurred, however, that a post-completion transfer would be possible.⁶

15. Accordingly, at the time of the IEM, there was no formal change in the implementation arrangements, but TCEPC began taking on the implementing role for component A. During 2008, the Ministry of Finance released an official document which approved that TSC may transfer assets to TCEPC in line with TCEPC’s physical role of implementing the component.⁷ Yet TSC would still be the borrower, responsible for repaying the ADB loan. The Ministry of Finance also requested that the Tianjin municipal government continue to strengthen project supervision and management to ensure that the debt is repaid fully and on time.

16. Even after project completion, the contract performance between the Tianjin municipal government and TSC, which was prepared in December 2005, still needs to be signed. Presently, the signing is dependent on the full completion of the World Bank-funded sewerage

⁶ ADB. 2002. *Back-to-Office Report of Loan Review Mission*. Manila. 18 December (Loan 1797-PRC).

⁷ Government of the People’s Republic of China, Ministry of Finance. 2008. *MOF Decree No. 214: Reply on Assets Transfer of ADB Loan Tianjin Wastewater Treatment and Water Resources Protection Project*. Beijing. 16 December.

system,⁸ which will be connected fully to the Tianjin Beicang wastewater treatment plant, increasing its operational efficiency as targeted. During the time of evaluation, the efficiency of the treatment plant was at 65% and is expected to increase to 100% by 2011, when the sewer system is targeted for completion.

D. Procurement, Construction, and Scheduling

17. An international firm undertook project preparatory TA for the project (footnote 5). Another international consultant company was appointed early in the implementation process, providing the project management office (PMO) and IAs with the necessary advice regarding ADB practices and guidelines. Qualified design institutes, tendering companies, and construction supervision companies were appointed to conduct the necessary local consultancy. ADB financed equipment and materials, which were procured using international competitive bidding and international shopping in accordance with ADB Procurement Guidelines.⁹ Further, civil works were procured with acceptable national competitive bidding procedures. Bidding was in accordance with the Procurement Guidelines.

18. The project experienced a delay of more than 1 year, particularly in component B, due to breach of contract by management information system (MIS) contractors. Originally, 10 contractors, both for software and hardware, were invited to bid for the MIS subcomponent under component B. The winning contractor subsequently encountered financial problems. The MIS subcomponent was then retendered to enhance TML's office running and facility operation control capability. Closely assessing a firm's financial position could uncover red flags that maybe encountered during implementation.

19. Component B was also extended due to a delay in fishpond removal. As targeted, only 970 ha or 14,551 mu of fishponds inside of the dike were to be removed. However, during implementation in 2004, the Tianjin municipal government suggested a revised plan, with 24,058 mu of fishponds to be removed, inside and outside of the Wangguofan Dike, to minimize water pollutants coming from the fishponds. This would have affected around 1,659 people. Meanwhile, there was also the planned land acquisition of 1,829 mu of land for the construction of the box culvert and open channel subcomponents, affecting potentially around 1,000 people.

20. For this revised plan, negotiations took time as public consultations needed to be done, explaining the process and the expected outcomes to villagers, many of whom were resistant to replacing their original sources of livelihood. Moreover, compensation problems in around 10 villages had to be handled through further negotiations.

21. Aside from the MIS and fishpond removal problems in component B, there were no peculiar construction or technical problems encountered during project implementation.

⁸ The World Bank's Tianjin Urban Construction Project (Second Phase) included construction of two wastewater treatment plants, urban roads, sewers, and a drainage system, with the loan totaling \$150 million. The project became effective on 8 October 2003 and is expected to close in 2010. Part of sewers under this project will directly serve the Beicang wastewater treatment plant. The World Bank project falls under the Tianjin Construction Commission, while the ADB project is overseen by the Tianjin Development and Reform Commission. The national government does not assign any foreign-funded projects to any local government. However, the Ministry of Finance has issued several guidelines on how projects are to be run. Some local governments have had the benefit of setting up long-term PMOs to coordinate donor-funded projects, so they have built up certain expertise. This is the reason why similar projects can often be under different funding institutions in the PRC.

⁹ ADB. 1998. Updating of the Bank's Guidelines for Procurement and Anticorruption Provisions for the Bank's Guidelines on the Use of Consultants. Manila. 28 July.

Component A even managed to shorten the construction duration by 3 months. Table 1 shows the duration of each project component.

Table 1: Project Duration, by Component

Item	Appraisal	Actual
Component A		
Start	June 2002	September 2003
Completion	March 2005	March 2006
Duration	34 months	31 months
Component B		
Start	June 2001	May 2002
Completion	December 2005	June 2007
Duration	55 months	62 months

Source: Asian Development Bank database.

E. Design Changes

22. Component A adopted design optimization by building only one pumping station instead of the original four envisaged during appraisal. The pipes were laid deeper to eliminate some of the pumping stations. This seemed to be a better design, since the capacity increased without increasing the cost. The single pumping station has a capacity of 86,400 m³ per day, compared to having four pumping stations of maximum capacities of 15,000 m³ per day each. Other than this, there were no other material changes in the design for this component.

23. Component B involved civil works in remote areas, concentrating on forestation and environmental improvement. This component's design was progressively finalized as construction proceeded and detailed site survey was undertaken, which is a reasonable approach. The original design of the project involved only three major subcomponents: (i) constructing a closed culvert; (ii) constructing an open channel; and (iii) incorporating the Yuqiao Reservoir Water Quality Improvement Program, with the MIS only a part of this subcomponent. However, during implementation, the EA assigned a higher importance to implementing the MIS, repackaging it as a separate fourth subcomponent. Eventually, 5 national competitive bidding and 12 international competitive bidding packages (versus the single national competitive bidding package targeted at appraisal) were procured for the MIS.

24. Design changes to the culvert alignment and buffer zones were made to minimize land acquisition and resettlement difficulties in component B. With the possible effect of income displacement to villagers, it was decided to revert to the original proposal of removing fishponds inside of the dike only (para. 19). However, mitigating measures were included to minimize pollution at the reservoir to ensure water quality.

F. Outputs

25. The breakdown of the project accomplishments for the two project components are described in Appendix 3, with a summary below.

1. Component A: Wastewater Treatment

26. Component A main works included (i) constructing a wastewater treatment plant with a capacity of 100,000 m³ per day, with sludge-dewatering facilities, and a capacity of 3,000 m³ per

day of treated water for reuse; (ii) 14.80 km total length of sewer pipes; and (iii) constructing a pump station with a 86,400 m³-capacity pumping station. The full capacity of the wastewater treatment plant has not yet been reached, pending the completion of the World Bank-funded sewerage system.

27. Currently, the plant reclaims 1,000 m³ per day of treated wastewater for landscaping, to avoid using potable water for this purpose. Further, the quality of the treated wastewater has generally reached class II standards¹⁰ before being discharged into the Yongdingxin River. The plant is continuously improving its discharge standards, particularly in light of recently tightened municipality standards (since 2008) that upgraded sewerage discharge standards to class IB. From 2006 to 2009, there was more than 60.7 million m³ of wastewater treated, removing tons of ammonia, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and phosphorus.

28. As targeted during appraisal, TML, TSC, and TCEPC staff have attended training to build capacity in implementing the project, including (i) training on ADB procedures regarding project implementation, economic and financial management, report preparation, and technical knowledge in wastewater treatment plant commissioning and operations; and (ii) training overseas on wastewater treatment works, advanced city planning, environmental protection, and project operation monitoring. Institutional-strengthening activities also yielded operational improvements, such as (i) completion of wastewater treatment standards, health and safety audits, efficiency improvements, operation and maintenance standards, and sewerage discharge standards; and (ii) development of business plans and human resources development policies and training plans. Similarly, ongoing efforts are also in place to continue cost-recovery efforts through gradual but affordable wastewater tariff increases for industrial and domestic wastewater consumers.

2. Component B: Water Resources Protection

29. The existing Luan–Tianjin water diversion system is the source of potable water for Tianjin's central urban area. Component B was designed to protect the water coming from the diversion system, which has been severely affected by pollution from Hebei Province. This project area lies in the north of Tianjin, from the Yuqiao Reservoir, in Ji county, ending at the Dazhangzhuang Pump Station—a total length of 124.34 km. This component (i) improved open channel works from the Jiuwangzhuang Gate to the Dazhangzhuang Pump Station, including structure maintenance and landscape works; (ii) constructed a closed culvert; (iii) conducted Yuqiao Reservoir works involving soil and water conservation, hospital wastewater treatment, and water quality protection; and (iv) established an MIS, which consisted of a cable transmitting system from the Yuqiao Reservoir to Tianjin, mostly for hydrological quality monitoring and pump station gate remote control. Capacity-building initiatives for familiarization with ADB procedures were generally the same as in component A. Specific overseas training, relating to water resource protection measures, water quality management, groundwater control, water-saving technology, and operational control of raw water supply systems, occurred. In contrast to the original training program, a fourth overseas training session (in Denmark, Finland, Norway, and Sweden) was added during implementation to gain more insights and technical know-how on project management, water resource management and protection, environmental protection, and project operation monitoring, which benefited the executing and implementing agencies.

30. Cost recovery has been possible for this component, as different tariff structures have been introduced for different water consumers since September 2002. As planned during appraisal,

¹⁰ Wastewater is classified as class II when it contains nitrogen and phosphorus that cause algae growth.

gradual but affordable water tariff increases have been set for consumers, with cost recovery to be achieved in 2005. However, cost recovery was actually achieved as early as 2003.

31. The ongoing improvements around the Yuqiao Reservoir (i.e., tree planting and other pollution-control initiatives) have maintained water quality, largely within class III standards. An environmental impact analysis done in 2007 showed that water quality was suited for class III.¹¹ Further, they have resulted in water treatment cost savings around CNY0.10 per m³, compared to treating class IV water. Raw water has also been conserved, with water loss in the closed culvert (due to evaporation, seepage, and theft along the Zhou River) reduced to 0.3%, and water loss in the downstream open channel (due to theft and seepage along the unlined river) has fallen to 0.6%.

32. As part of pollution control for this component, wastewater treatment plants for nine hospitals were originally planned to treat wastewater, which is drained into the reservoir. Eventually, only one treatment plant was built, applying membrane technology.¹² Pollution-control initiatives for the other eight hospitals were funded under the New Rural Reconstruction Fund of Tianjin municipal government. Pilot communal solid waste storage facilities were also intended for the project, with one pilot manure-processing plant installed in South Leigutai Village.¹³ However, it was less feasible to have further installations, as simpler, more practical devices are better suited for the local situation.

33. During appraisal, the measures for water-quality protection in the Yuqiao Reservoir comprised (i) planting appropriate vegetation within various ground elevations, (ii) restricting land use within a strip of land along the reservoir, and (iii) constructing low dams on small tributaries to retard soil erosion. During implementation, reforestation works were implemented not only around the Yuqiao Reservoir, but in the open channel as well, which helped conserve the topsoil since erosion could adversely affect water quality. Similarly, rubber dams were built along the Zhou River to improve the irrigation system; farmers can now access river water instead of depending on deep wells for pumping of poor-quality water for their farms.

34. The accomplished MIS physical works included instrument and equipment procurement, installation, and commissioning of 12 subsystems.¹⁴ Training for the MIS was also undertaken by the equipment supply contractor and MIS consulting contractor. Human resources development will continue to be an ongoing process in line with MIS development.

¹¹ The class III standard is one of five classes. Class I, the highest standard, is for water supply resources with limited treatment and national natural reserves (pristine); II and III are for fishing and recreation, and may be used as water supply sources where full treatment is employed; IV is suitable for industrial uses and recreational uses not involving contact between the water and human bodies; and V is for agricultural uses and scenic viewing.

¹² This is a mature technology that is commercially available in the United Kingdom from several equipment suppliers. The technology can be used to separate various mixtures of liquid materials in a growing range of applications. It involves (i) ultrafiltration, widely used for oil, water, and emulsion separations; paint recovery; and the separation of fats, oils, or greases in the food industry; (ii) reverse osmosis and nanofiltration for water purification, desalination, and disinfection; or (iii) microfiltration, applied to maintain degreasing process solutions for metal particle recovery and removal or to concentrate other particulate materials from liquids or slurries.

¹³ A composting plant was built as a pilot to treat household human feces collected from a village within the reservoir catchment. It was successfully installed and commissioned, but its operation was unsatisfactory due to running cost constraints. Therefore, the plan to promote other composting plants was ceased.

¹⁴ The MIS included a (i) optical cable link, (ii) network system, (iii) security system, (iv) voice communication system, (v) video monitoring system, (vi) video conference system, (vii) servers and data storage and backup, (viii) automation system, (ix) lighting protection system, (x) power supply system, (xi) decision-making system, and (xii) system integration.

G. Consultants

35. During project appraisal, provision was made for 65 person-months of international and 130 person-months of national consulting services to support the management and implementing units of the project. The terms of reference of international consultants included (i) developing a corporate management structure; (ii) conducting training in the development of standardized financial and accounting statements; (iii) conducting midterm and final reviews of retail water and wastewater tariffs; (iv) monitoring social, resettlement, and environmental impacts; and (v) advising on the method and procedures for benefit monitoring and evaluation, and resettlement. During implementation, an international consultant firm was commissioned by TSC and TML to provide consulting services. To enhance the efficiency and quality of the consulting services and to take local conditions into consideration, the international consultants were associated with a local consulting firm in Tianjin to fulfill their mandate.

36. Some coordination issues arose between the international consultants and the Tianjin municipal government, which affected the delivery of training in the financial and institutional modules. Coordination between the international consultants and the municipal government could have been facilitated by the local consulting firm. Team members were changed frequently, usually just as the consultants were getting used to the local environment. Further, consultants lacked experience regarding local conditions, as well as national and ADB resettlement policies. In hindsight it would have benefited the project's implementation if knowledge of local conditions has been emphasized during the selection of consultants. As stated in their terms of reference, the international consultants provided the EA and IAs training on ADB practices, procedures, and guidelines in terms of project implementation and monitoring. To develop the IAs' corporate structures, the consultants recommended institutional and managerial improvements, one of which is a revision of TML's organizational structure.

37. Some modifications in timing were made to the original consulting structure and schedule to better meet the project needs and to reflect the delay in loan effectiveness from 1 March 2001 to 31 October 2001. The adjustments were limited to the consultant team organization and the timing of consulting inputs. Consulting services were extended from the end of 2005 to the end of June 2007, because project implementation was behind schedule. No changes were made to the actual project deliverables defined in the terms of reference.

38. The performance of the consultants was *satisfactory*. However, there were some deficiencies in the performance of Tianjin Statistical Information Service Center (TSISC), the agency engaged for resettlement monitoring. TSISC conducted four resettlement monitoring and evaluation (M&E) exercises for components A and nine for component B. However, TSISC lacked experienced regarding ADB-funded resettlement projects, which resulted in a lack of monitoring data that could have been useful in evaluating resettlement effects (i.e., an income-restoration sampling survey for affected households).

H. Loan Covenants

39. Compliance with the loan covenants was substantial, although the timing of compliance for some conditions was delayed. A discussion on the compliance and noncompliance follows.

40. **Environmental.** For component A, the volume of effluents discharged at the Beicang wastewater treatment plant is much higher than the plant's design capacity, in terms of ammonia nitrogen, BOD, and COD concentrations. The plant meets most of the discharge standards for class II, except that of ammonia nitrogen. A contributing factor to this is that some industrial

discharges are not pretreated to a standard suitable for sewerage discharge. However, TCEPC is expected to finish upgrade of the plant's processes and facility by the end of 2010 to meet more stringent class IB discharge standards and to conform to the clause on this covenant.

41. For component B, the environmental covenant requires that pressure grouting (i.e., the process of raising sunken or deformed foundations by hydraulic pressure, and then filling in the voids created with concrete grout) be carried out at the Yuqiao Reservoir. A regular monitoring of this should also be conducted. In addition, a 450 m-long cutoff wall was completed in 2001–2002 at a total cost of CNY33 million to minimize leaks in the major Yuqiao Reservoir dam and is continuously monitored. Dam settlement and movement is monitored twice a year, in May and October, to ensure that the structure is sound.

42. **Cost recovery.** Tariff increases have been dutifully implemented in Tianjin to meet the cost-recovery covenants. Compared at appraisal, where tariffs were supposed to be implemented in 2005 for cost recovery, tariff rates instituted have been above cost-recovery levels since 2003. Tables 2 and 3 show the tariffs for cost recovery of raw water, recycled water, and wastewater.

Table 2: Tariff for Raw and Recycled Water (CNY/m³)

Date of Tariff Adjustment	Raw Water Tariff		Recycled Water Tariff	
	Actual	Estimate ^a	Actual	Estimate ^a
From 1 December 2003	1.00	0.61	0.30	0.20
From 1 December 2005	1.00	0.75	0.30	0.25
From 1 March 2007	1.03		0.30	
From 1 April 2009	1.05		0.30	

m³ = cubic meter.

^a Estimated at appraisal for full cost recovery

Source: Independent evaluation mission.

Table 3: Tariff for Wastewater (CNY/m³)

Date of Tariff Adjustment	Categories of Wastewater Discharge			
	Domestic		Nondomestic	
	Actual	Estimate ^a	Actual	Estimate ^a
From 1 December 2003	0.60	0.56	1.00	0.75
From 1 December 2005	0.80	1.06	1.10	1.06
From 1 March 2007	0.80		1.20	
From 1 April 2009	0.82		1.20	
From 4 April 2010	0.82		1.20	

m³ = cubic meter.

^a Estimated at appraisal for full cost recovery.

Source: Independent evaluation mission.

43. **Financial.** A financial covenant required the two IAs to maintain a current asset–liability ratio of not less than 2:1. While TML had a 4:1 ratio in 2009, TCEPC was unable to comply with this, with only a ratio of 1.02:1. It is currently stepping up efforts to increase its current assets or to lower short-term debt.

44. **Resettlement.** All of the resettlement covenants have been reportedly complied with, with a total budget of CNY144.9 million for associated activities. For people unavoidably affected, the project resettlement objective was to achieve equal, or better, income and living standards in line with not only PRC laws and regulations, but also ADB resettlement policies. The IEM held focus group discussions with some affected persons from Baizhuanzi and

Dongmafang villages. During these, the affected persons expressed their satisfaction with the compensation as well as their expectation of more income opportunities, views that validated previous M&E report findings. The Jixian County Resettlement Bureau has developed a proposed program, which includes ecological fishery and farming and tree and reed plantations, to provide further income opportunities for the villagers.

45. Due to the lack of TSISC's ADB-funded project resettlement experience, the independent domestic monitoring system and reports have been unsatisfactory, because the income-restoration sampling survey has not been conducted as stipulated in the loan covenant. Monitoring of income restoration is important, because various livelihood improvement programs have been instituted to ensure that income levels in the project areas are maintained or improved. These livelihood initiatives included generating employment opportunities during project construction and operations, promoting and developing new enterprises and secondary and tertiary businesses, and conducting technical training for migrant labor.

I. Policy Framework

46. As previously mentioned, Tianjin has been enforcing a more stringent sewerage discharge standard (from class II to class IB) since 2008, due to the strong industrial discharges spawned by manufacturing companies. Given this requirement, the Beicang wastewater treatment plant is undergoing improvements (i.e., upgrading of facilities) to meet the stricter standards. Related to this development is the need for closer coordination among different agencies, such as the Environmental Protection Bureau, TSC, TCEPC, and the World Bank agency responsible for the sewers, to ensure that the standards are adhered to.

47. Tianjin has been coordinating with officials from Hebei Province to understand the steps taken in upstream catchment control and protection of the water transferred to the Yuqiao Reservoir from the Luan–Tianjin water diversion system. More than 20 wastewater treatment plants, with around a 370,000 m³-per-day capacity, have been put into operation in Hebei Province upstream. Although the Yuqiao Reservoir has been able to generally attain class III standards for its water supply, efforts need to be made to sustain the standards through cross-border water resource management. Similarly, nutrient load discharge can be lessened in the Yongdingxin River, where the Beicang wastewater treatment plant discharges treated effluents. This could be done through the plant's ongoing process upgrade, while upstream catchment control in Hebei Province could further help lessen pollution discharged into the river.

48. In April 2009, the Tianjin municipal government introduced the recycling or reusing of water for use by power stations and consumers in the "special"¹⁵ category. There will be no further wastewater fee charged when using this water, a good approach for market-based instruments. Although Tianjin has a 190,000 m³-per-day capacity to treat water for reuse, only around 30,000 m³ per day is produced from the Jizhuanzgzzi wastewater treatment plant (another wastewater treatment plant in Tianjin) as the associated reused water distribution networks are not yet ready. The lack of coordination between the implementation of the treatment plant and pipelines is causing 160,000 m³-per-day capacity to treat water for reuse to remain idle, with interested consumers not being supplied with the lower-grade water at subsidized rates.

¹⁵ "Special" pertains to the luxury use of water for spas, saunas, car washes, and sometimes to 4- to 5-star hotels.

49. Government support and initiative is also needed for inviting investments in sludge disposal and animal and solid waste processing. The high capital investments and operation and maintenance budget in these areas is best suited for private sector participation.

III. PERFORMANCE ASSESSMENT

A. Overall Assessment

50. This project performance evaluation report (PPER) rates the project *successful* (Table 4), based on the standard evaluation criteria shown in Appendix 6.¹⁶ This PPER thus concurs with the PCR rating, except that the PPER rates it as only *relevant*, compared with the PCR's *highly relevant* rating. Further, the PPER rated the project *most likely* sustainable. Details of the assessment follow below.

Table 4: Assessment of Tianjin Overall Performance

Criterion	Weight (%)	Assessment	Rating Value	Weighted Rating
Relevance	20	<i>Relevant</i>	2.0	0.4
Effectiveness	30	<i>Effective</i>	2.0	0.6
Efficiency	30	<i>Efficient</i>	2.0	0.6
Sustainability	20	<i>Most likely Sustainable</i>	3.0	0.6
Overall Rating		<i>Successful</i>		2.2

Note: The aggregate project performance is assessed as *highly successful* if the overall score is greater than or equal to 2.7, *successful* if it is greater than or equal to 1.6, *partly successful* if it is greater than or equal to 0.8, and *unsuccessful* if it is less than 0.8.

Source: Independent evaluation mission.

B. Relevance

51. The PPER rates the project as *relevant*, based on the following analysis.

52. The project is in line with the Tianjin municipal government's priority intervention within the Hai River Pollution Prevention and Control Plan. At appraisal, component A was important in enhancing urban environmental and public health conditions, with the intention of encouraging and demanding better wastewater management by upstream polluters, primarily in Hebei Province. Component B was necessary to protect the single raw water source, which was at risk of pollution from various locations. The project also offered capacity-building opportunities to make the IAs more efficient by project completion.

53. However, the sector goals and project objectives in the project's logical framework (footnote 1, Appendix 1 of RRP) appears to be too ambitious and were not easily monitored. As such, there was an element of disconnect in the way the project was presented. For example, the public health benefits directly contributed to the project are not easily monitored, since component B was basically an add-on to the city's grant-led ongoing water source management. For component A, TSC's institutional responsibilities evolved over the course of the project, with the subsequent transfer of its project assets and operation and maintenance responsibilities to TCEPC. The depth of understanding, in terms of what was to be achieved

¹⁶ Self-evaluation in the PCR (by the East Asia Department) was as follows: *highly relevant*, *efficacious* (equivalent to *effective*), *efficient*, and *likely to be sustainable*. The overall rating was *successful*.

within the project's institutional reform was unclear; thus, TA in this area could not be assessed as highly beneficial or relevant to government strategy and plans.

54. During evaluation, the IEM found that the project design remains relevant, with urban development a priority to the city's growth. Although the World Bank-funded sewerage system is not yet completed, resulting in the Beicang wastewater treatment plant's lower capacity, when the sewers are completed, the flows will build up. As such, component A's design remains relevant. Further although the discharge standard has become more stringent (class IB effluent standards are now required), the plant is being upgraded, to be completed by the end of 2010, to meet these new standards.

55. For component A, sludge disposal management was not a specific part of the project. Sludge generated from the Beicang wastewater treatment plant is presently disposed of at a temporary municipal landfill. However, it would have been more relevant for the project to include arrangements for a permanent and sustainable sludge disposal route or reuse arrangement for this plant and others in Tianjin.

56. Regarding component B, the improvement works protect the quality of the sole source of water supply for Tianjin, are vital to the city, and, as such, remain relevant. Originally the MIS for Component B was part of one the 3 subcomponents; only one NCB package was envisaged in the PPTA to implement it. During implementation TML assigned higher importance in implementing the MIS due to the need for monitoring and evaluating water quality, and water inflow and outflow.

C. Effectiveness

57. The project is rated *effective*, with improved water quality and reduction in wastewater pollution in compliance with required standards. The project has achieved its intended physical accomplishments. Technically, all options adopted during implementation were on a least-cost basis, and the majority of technical outputs have been achieved. Appendix 5 shows the status of compliance to covenants, updated where applicable by the IEM.

58. Regarding component A, wastewater is reported to be 90% industrial, from organic chemical plants, a fertilizer plant, and an electric components factory. Lesser contamination results in improved wastewater, generally complying with class II standards, with the exception of the standard for ammonia nitrogen. Currently, steps are being undertaken to upgrade the facilities to meet the more stringent class IB standards. Further, for component B, the ecological improvements along the open channel, as well as the area surrounding the Yuqiao Reservoir, helped maintain water quality at class III standards for the water supply.

59. In compliance with the loan covenants and to conserve water, a 450 m-long cutoff wall was completed in 2000–2001 at a cost of CNY33 million to minimize leaks in the Yuqiao Reservoir's main dam. Leaks are continuously monitored to prevent water wastage. Dam settlement and movement is monitored twice a year to ensure that the structure is sound.

60. For component B, an enlarged fishpond removal scope was prepared in accordance with ADB's resettlement policies and was approved in February 2007. However, to mitigate the impacts on the alternative households' livelihoods, the enlarged fishpond removal scope was not implemented. Removing only fishponds inside of the Wangguofan Dike as originally proposed was effective enough to minimize pollution at the reservoir.

61. The institutional strengthening introduced by the consultants was effective in meeting the training needs of the IAs. Structured and on-the-job training, covering procurement, contract management, disbursement, financial management, environmental control, and resettlement monitoring, was provided, enabling the project to be smoothly implemented. It was reported that training or knowledge transfer to TML in watershed management and cross-border water resources management was sufficient, with overseas and domestic study tours organized. Best results from these trainings can be achieved when properly assimilated and applied by the implementing agency. The Tianjin municipal government has also initiated coordination with the Hebei provincial government to analyze upstream catchment control to protect the quality of water transferred into the Yuqiao Reservoir.

D. Efficiency

62. The PPER rates the project as *efficient* in both its investment and implementation process.

63. **Efficiency of investment.** The project is still economically efficient due to the benefits stated in the PCR. Component A, with an economic internal rate of return (EIRR) of 13.2% is lower than at post-evaluation, as the full operating capacity operation of the Beicang wastewater treatment plant has not yet been reached. In addition to this plant, TCEPC has installed a 20,000 m³-per-day-capacity, membrane-based reclaimed water plant, which with the associated supply network is installed, will supply high-grade reused water for toilet flushing and industrial uses.

64. Meanwhile, component B has an EIRR of 17.7%, with improved raw water quality brought to water distributors due to environmental efforts along the Yuqiao Reservoir and the open channel.¹⁷ Owing to this, the resultant cost savings in water treatment of water distributors is CNY0.10 per m³. Yuqiao Reservoir flow data and water quality trends were used to gauge the benefits from this component.

65. Currently, operational issues affecting the efficiency of component A's performance is due to the delay in connecting sewers being implemented in the World Bank-funded Tianjin Urban Construction Project (Second Phase).

66. **Efficiency of implementation process.** Preliminary design for the Yuqiao Reservoir was approved by the Tianjin municipal government in September 2004. Subsequently, the fishpond removal scope was enlarged, resulting in more affected households. Because a resettlement exercise implemented for the Yuqiao Reservoir in the 1960s and 1980s was complex and problematic, several historical resettlement issues remained. Had the resettlement issues been better handled, negotiations and implementation for component B's fishpond removal resettlement would have been less difficult. The resettlement issue led to a 1-year extension for the project in 2007, affecting its efficiency.

E. Sustainability

67. The PPER rates the project as *most likely* sustainable.

68. The IEM noted in its visit to the Beicang wastewater treatment plant that the upgrading works are ongoing, which demonstrates the Tianjin municipal government's effort to keep the plant up-to-date and relevant to its increasingly stringent discharge requirements. Further,

¹⁷ Sensitivity analyses still yielded efficient results, as economic returns are still above 12%.

frequent, but affordable, tariff increases have exceeded the targets set in the loan covenants, illustrating Tianjin municipal government's commitment to market-based instruments, which, in turn, path the way for long-term sustainability of component A.

69. At site visits, the IEM noted that the assets related to component B have been well maintained and operated. Significant environmental improvements and ecological protection works have been implemented around the Yuqiao Reservoir and along the water transfer channel, reducing pollution into the water source from its direct catchment. Further sustainability of the project would highly depend on the need for continued environment protection around the reservoir. The Tianjin municipal government is stepping up efforts in protecting the Yuqiao Reservoir. These involve tree planting, fish rearing, village improvements, harvesting overgrown water plants, and rehabilitating tributaries.¹⁸ The reforestation works implemented under the project help conserve topsoil, improve water quality, and provide an additional revenue stream to the municipal government, with the need for controlled timbering when the planted trees mature.

70. Other than total nitrogen, all other water quality parameters of Yuqiao Reservoir water have been improved past class III, suitable for water supply. As of 2009, more than 20 wastewater treatment plants, totaling some 370,000 m³-per-day capacity, have been put into operation in Hebei Province upstream of the reservoir. These plants, though presently only of class II discharge standards, are the first important step in protecting Yuqiao Reservoir water quality. When these plants, in the future, are upgraded to class IB plants, further improvement of the Yuqiao Reservoir water quality can reasonably be expected.

71. The project is also financially viable. Component A has a financial internal rate of return (FIRR) of 4.7%, compared to the weighted average cost of capital (WACC) of 2.8%. The IEM gathered during the mission that TCEPC's proposed tariffs are still under discussion with the Tianjin Price Bureau. High sustainability of this component would depend largely on the approval of the proposed tariffs. To protect profitability levels, a cap on operating costs will also be instituted. Revenues are expected to increase with more connections made to the sewerage system and expected capacity expansion in the future. Component B's FIRR is at 7.7%, compared to a WACC of 3.8%. For this component, increasing the supply of water to the city from Yuqiao Reservoir at around 2% to 3% annually will contribute to a substantial revenue increase.

72. The compliance with the current asset-liability ratio covenant showed that TML has gained liquidity in its operations and is moving to becoming financially independent. However, TCEPC's financial figures show that its asset-liabilities ratio has not reached the necessary 2:1 level. Thus, efforts need to be taken by TCEPC to increase its current assets to meet the expected level (Appendix 5).

IV. OTHER ASSESSMENTS

A. Impacts

73. The project aimed to improve the needed infrastructure and services in line with the Tianjin municipal government's efforts to improve wastewater management and water supply for

¹⁸ Tianjin Development and Reform Commission. 2010. *Implementation Programs on Recent Control Works for Water Pollution Sources Around Yuqiao Reservoir*. TDRC Economic Division. August 2010.

a large part of Tianjin's population. The project has generated several impacts during its implementation.

74. **Environmental impact.** Tianjin was nominated in 2005 as the Model City of Environmental Protection and aspires to be the “most habitable city” in PRC by 2015. From its commissioning in 2006 to the end of 2009, the Beicang wastewater treatment plant has treated 60.7 million m³ of wastewater and removed 45,830 tons (t) of COD; 21,530 t of BOD; 16,950 t of total suspended solids; 1,280 t of ammonia; and 310 t of phosphorus. Further, it has assisted in maintaining the Yuqiao Reservoir water quality to be largely within class III standards, suitable for water supply.

75. **Health and gender impact.** The project has achieved its objectives of reducing pollution through improved wastewater management and protection of raw water quality, benefiting more than 5 million urban residents in Tianjin. Although the project did not directly reduce poverty, it has improved the quality of life by reducing the risk of waterborne diseases, provided employment opportunities during construction and operation of project facilities, and contributed to social and economic development. Women have also enjoyed equal employment and training opportunities due to their engagement with the executing and implementing agencies of the project. The focus group discussions revealed that women strongly supported the project and have benefited from improved living environments, new employment opportunities, and reduced incidence of water-borne diseases.

76. Regarding health, the IEM was unable to obtain other relevant statistics on the reduction of waterborne diseases and increase of income as a direct result of the project. However, the following statistics infer positive social and economic impacts, in which the project plays some part.

Table 5: Socioeconomic Indicators in Tianjin

Indicators	2001	2007	Positive Changes
Incidence of water-borne diseases (i.e., Cholera and hepatitis)			Decreased by 40% for cholera and 64% for hepatitis from 2001 levels
Lowest household income definition	Below CNY302	Below CNY6,171	20-fold increase
Highest household income definition	Above CNY1,306	Above CNY28,733	22-fold increase

Source: Tianjin statistical yearbooks, 2001–2009.

77. **Resettlement impact.** Project construction involved permanent land acquisition, temporary land use, demolition of buildings, fishpond removal, conversion of farmland to forest, and resettlement of affected persons. To avoid or minimize land acquisition and resettlement, consultations with local officials, village committees, and affected persons were conducted during the resettlement plan implementation stage. However, there is the need to ensure that the effects of the resettlement are properly communicated to avoid delays in implementing the actual land acquisition and resettlement. The total actual permanent land acquisition was 1,933 mu, or 86% of that in the revised resettlement plan, while the temporary land use was 6,821 mu, or 85% of that estimated in revised resettlement plan. In addition, the Yuqiao Reservoir subcomponent involved 14,551 mu of fishponds removed and 9,136 mu of farmland reforested, affecting only 764 persons. The decision not to remove fishponds outside of the Wangguofan

Dike and to change implementation options (such as encouraging the conversion of farmland to forestland) avoided affecting 8,705 persons. Focus group discussions were held with affected people in Dongmafang and Baizhuangzi villages, which demonstrated overall satisfaction with the compensation received because of the effect that the project had on their livelihoods. Income monitoring was eventually done to ensure that their current source of income can sustain their standard of living.

78. **Impact on institutions.** It was repeatedly expressed to the IEM by TMG that ADB's involvement was effective in (i) getting more attention and support from the Tianjin municipal government in the water sector; (ii) providing a substantial loan (over 50% for component A) in the total funding requirement; and (iii) transferring valuable knowledge on the ADB project implementation process, environmental protection, and involuntary resettlement safeguards. These activities have helped the EA and IAs to gain experience and absorb the concept and practical adaptation in dealing with communities and affected persons. Although these impacts are not readily quantifiable, the IEM felt that external assistance could still make a difference in capacity building to the officials and staff of water agencies.

79. TML will be taking on an implementing role in a Yuqiao Reservoir water pollution protection project initiated by the Tianjin municipal government. The nature of this new project is similar to the ADB project. As such, TML is applying the technical and management skills learned from the ADB project for environmental improvements to villages, ecological improvement of the Yuqiao Reservoir, rehabilitation of river tributaries, and monitoring of water quality. The IEM believes that the experience gained in implementing component B of the ADB project will contribute to the success of this subsequent project.

B. Asian Development Bank Performance

80. This PPER rates ADB's performance as *satisfactory*. Overall, ADB conducted eight monitoring missions for 229 days, which was adequate for the project. The project's delegation to the PRC Resident Mission in the first quarter of 2004 was also a major factor in ensuring more efficient management of the project. Assistance was given in providing guidance and action plans for resolving key concerns on ADB procedures, financial management, and environmental and resettlement monitoring and reporting. The resident mission staff was readily accessible and helpful whenever issues arose in the day-to-day operations of the project.

81. During the processing stage, issues concerning resettlement and social monitoring were not detailed in the report and recommendation of the President (footnote 1), causing a delay during implementation. However, ADB was helpful in intervening for the resolution of resettlement issues, particularly in convincing the Tianjin municipal government to remove fishponds inside of the Wangguofan Dike only. This placed less pressure in resolving more displacement concerns. However, ADB could have provided better and timelier assistance and advice on environmental and social monitoring of resettlement impacts to ensure that requirements for evaluating income restoration results were met. Long-term historical resettlement issues should also have been taken into consideration at the beginning of project implementation to avoid delays due to resettlement concerns.

C. Borrower Performance

82. The performance of the borrower, EA, and IAs is *satisfactory*. Construction programs, quality, and costs appear to have been well controlled, delivering the project outputs on time and under budget. Civil works and equipment were supplied on time and in accordance with

specifications. The Tianjin municipal government established a project leading group, headed by the deputy executive mayor of Tianjin City, to provide guidance to the project and an administrative office to coordinate all activities related to it. A PMO, established under the project leading group, was responsible for administering all matters related to the project, including managing and coordinating the work of TSC and TML. However, at project preparation, issues relating to resettlement, environment, and affected persons were not addressed with the same rigor as engineering issues. Further, a comprehensive baseline survey was not undertaken to determine the area of resettlement required, which subsequently affected the implementation timeline of the project.

83. The IEM noted during the second quarter of 2010 that the resettlement activities in component B were still not fully completed, and three specific action items were agreed to be followed up by the Tianjin municipal government and TML (footnote 2, Appendix 14, para. 28 of PCR). It was reported to the IEM that these three action items are being strictly conducted, which included those relating to compensation of villagers, livelihood, and income restoration. These were pending issues until the Tianjin municipal government reported compliance with the follow-up actions in August 2010.

V. LESSONS, ISSUES, AND FOLLOW-UP ACTIONS

A. Lessons Learned

84. **Adequate consultation and better communication with affected people for projects experiencing resettlement issues can reduce implementation delays.** Historically, resettlement implemented for the Yuqiao Reservoir occurred in three phases: 1960–1967, 1973, and 1979–1982. It was complex. Delays in the implementation of the resettlement subcomponent of this project could have been mitigated if lessons from the past have been taken into account. This included having closer consultation and ensuring that resettlement impact is better communicated with local officials, village committees and affected peoples, proposing reasonable resettlement or fishpond removal scope and compensation policies. The villagers would then be able to better understand the objectives and importance of projects, and would be more receptive to the resultant land acquisition and resettlement activities.

85. **Involving communities in environmental improvements increases their sustainability.** The Yuqiao Reservoir subcomponent involved environment improvements to 68 villages. For such community-based subcomponents, community participation and self-management are effective gateways into sustainable implementation and operation. For similar projects, a community participation and self-management booklet should be prepared by villagers under the guidance of the social specialist at the project preparatory or implementation stage.

86. **Bringing in private sector experience yields efficiency.** The eventual full participation of TCEPC in component A was a good demonstration of private sector participation, particularly in bringing about the required expertise in running a wastewater treatment plant. Aside from the Beicang wastewater treatment plant, TCEPC is also responsible for the operations of three other large-scale wastewater treatment plants in Tianjin. Prospects of private sector participation in component B should have been explored with other private groups or entities, particularly in enhancing ecological works around the Yuqiao Reservoir, which is currently financed by municipal funds. This could be a showcase to invite interest from private enterprises, particularly in the growing concern for the environment.

87. **Receptiveness for gender development is context specific.** During appraisal, one of the benefits identified from the project was to provide employment opportunities to women through the All-China Women's Federation. At the project's completion, it was mentioned that women were employed as laborers during construction, and some were given permanent jobs in the IAs. Moreover, there were training opportunities given for skills enhancement. Given the focus on the growing role of women in development, gender equality is inevitably mentioned in ADB projects. Emphasis on gender depends on the context and locale conditions.

88. **Complementarity of projects and donor coordination would improve operational efficiency.** Sewerage construction needs to be fully addressed in the early stage of the project, particularly as it affects the implementation of wastewater treatment operations. Further to this, when the two are implemented by different funding institutions, the need for inter-donor coordination is essential to ensure that project operations and targeted completion are not compromised.

89. **A two-pronged approach focusing on developing institutions and training is needed to strengthen agencies.** Various trainings were given to the EA and IAs in water supply and wastewater treatment operations. Aside from training, emphasis on developing the institutions, such as review of the overall organization structures and terms of reference of management and staff, would be helpful in further strengthening the EA and IAs. The creation of the Tianjin Water Affairs Bureau can be regarded as a first step in overseeing the continued development of water-related IAs to focus efforts in building capacity in operational areas needed for the city's development. Furthermore, it is also acknowledged that the commercialization of operations, through TCEPC involvement, is also another step in institutional strengthening.

B. Issues

90. **Sludge disposal.** Currently, only the Xianyan Road wastewater treatment plant, one of four main wastewater treatment plants in Tianjin, is practicing sludge drying. ADB did not seem to have contributed in exploring appropriate technology or cross-sharing best practices from other ADB projects within or outside of PRC. The Tianjin municipal government has already initiated some action, but given the urbanization pace and development in the city, it needs to look at other best practices very seriously. TSC and TCEPC may also seek guidance and support from the municipal government as well as external assistance for advisory opportunities.

91. **Contract performance between the Tianjin municipal government and TSC.** The contract performance between the Tianjin municipal government and TSC still has to be signed. It is unclear whether the signing needs to still rely on the World Bank sewerage completion, which is external to the ADB project and has no definite completion date.

92. **Monitoring and evaluation.** The project reportedly compensated affected people in the surrounding area of the Yuqiao Reservoir, but there have been gaps in the monitoring of income restoration. Although this monitoring has been complied with as of 31 August 2010, it took more than two years from the time of the project's completion for the monitoring to be done.

93. **Overlaps in project implementation.** This may not be unique to the PRC, but overlaps exist among agencies that implement the same type of projects, i.e., Tianjin Development and Reform Commission and Tianjin Construction Commission are overseeing similar projects (in

the same sector) across different donors. There could be implications to budgetary resources being allotted by the municipal government to these agencies, i.e., high overhead costs. Mitigation of costs and coordinative issues may be addressed with only one agency, since project implementation delays could ensue from having different coordinating agencies.

C. Follow-Up Actions and Recommendations

94. No further follow-up actions are required, following the suggestions made during the IEM regarding compensation to affected peoples and monitoring of income restoration. Steps have reportedly been taken by the EA to comply with these suggestions. In the resettlement livelihood restoration report,¹⁹ authored by the Tianjin municipal government in August 2010, the following actions were noted:

- (i) the disputed compensation funds in 10 villages have been allocated between village committees and fishpond contractors and developers, either through negotiation or the local court;
- (ii) income-restoration measures, including technical training, microcredit loans, employment opportunities, and fruit- and vegetable-based development, have been implemented to assist affected households in their income restoration; and
- (iii) a sampling survey of affected households' income and expenditure indicates that affected households have achieved income restoration.

¹⁹ The report was transmitted to the PRC Resident Mission by the Tianjin municipal government. The resettlement specialist in the resident mission reviewed the report and noted that the EA has taken steps to address the follow-up actions suggested for compensation and income restoration monitoring. The specialist also recommended that the EA and IAs continue to ensure that income-generation measures are completed to achieve sustainable development in the affected areas.

PROJECT DESIGN AND MONITORING FRAMEWORK AND ASSESSMENT RESULTS AT PROJECT COMPLETION AND PERFORMANCE EVALUATION

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
A. Sector Goal					
Improve urban environmental conditions in Tianjin	Environmental monitoring data	The Hai River Pollution Prevention and Control Plan is implemented by upstream governments.	Elimination of pollution threat to raw water supply, implementation of comprehensive wastewater management strategy	Capacity of 1 billion m ³ per year for clean raw water supply by the Yuqiao Reservoir, 1.49 million t of wastewater treatment capacity, four completed wastewater treatment plants	While 1 billion m ³ per year capacity of raw water can be supplied by the Yuqiao Reservoir, the required annual supply has been 400 million–650 million m ³ per year since 2005. In 2007, 1.785 million t per day wastewater treatment capacity was available, provided by 14 completed large and small wastewater treatment plants in Tianjin.
Improve public health in Tianjin	Socioeconomic surveys, public health statistics	Water-quality improvements are effective.	Reduced incidence of waterborne diseases by 2010, no incidence of disease attributable to poor drinking water quality	Raw water remained good quality in accordance with national standards; cholera decreased by 40% and hepatitis by 64% from 2001 to 2007	Other than total nitrogen, all other water quality parameters in the Yuqiao Reservoir have been better than class III standards for water supply.
Promote improved urban environment and amenities for business, tourism, and recreation	Socioeconomic surveys, visual surveys	Public awareness and education programs are implemented successfully.	Increase in public satisfaction with urban environment	Public satisfaction with urban environment increased	A socioeconomic survey conducted in 2008 revealed that 77.4% of 93 surveyed urban residents felt drinking water quality improved; of them, 50% felt that water pollution had decreased. Of 111 surveyed rural residents around the Yuqiao Reservoir, 78.4% claimed that the reservoir's water quality and surrounding environment had improved. Of 289 persons surveyed, 80.9% expressed that they had not been affected by the dust, noise, odor, or land erosion caused by the project construction and operation.
Achieve institutional development of utilities	Audited financial statements	Political support exists for reform process.	Self-sustaining management, operation, and financing by January	TML achieved by December 2005, TSC is to be achieved by the end of 2010	TML achieved self-sustaining management, operation, and maintenance by December 2005. In December 2008, TSC approved to

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
			2006		transfer assets to TCEPC, which is a self-sustaining entity.
B. Project Objectives					
Provide reliable, high-quality raw water supply and wastewater services to meet Beicang area demand at affordable prices	Project completion report, water quality monitoring program	Input water of quality is maintained.	Raw water quality improved to class III by January 2006	Achieved class III by 2005	Other than total nitrogen, all other water quality parameters of Yuqiao Reservoir water have been better than class III, suitable for water supply.
	Flow measurement	An adequate source of water volume exists.	Reliable yield of 1 billion m ³ per year (75% guarantee) by January 2006	Achieved by 2005	While the Yuqiao Reservoir can supply 1 billion m ³ per year capacity of raw water, the required annual supply has been 400 million– 650 million m ³ per year since 2005.
	Project and tariff reviews	Adequate political support for tariff reform process occurs.	Average raw water cost to customers not less than CNY0.75 per m ³ for water consumed and CNY0.25 per m ³ for recycled water by January 2005 (constant 2000 prices)	CNY1.03 per m ³ for raw water and CNY0.3 per m ³ for recycled water by 2007	The raw water tariff was increased from CNY1.03 per m ³ to CNY1.05 per m ³ from 1 April 2009. The recycled water tariff was increased from CNY0.18 per m ³ to CNY0.30 per m ³ from 1 July 2003.
	TSC management information system and World Bank report	The demand estimate for sewage flows is correct. Sewerage networks are completed by the World Bank.	95% of urban wastewater in Beicang area is collected by January 2005	50%–60% by the end of 2008, 100% by 2010	About 30% of wastewater in the Beicang catchment has been collected and treated since June 2006. About 60% was collected and treated by June 2008. By June 2011, 100% is expected to be achieved when the sewers are completed.
	Project and tariff reviews		Average wastewater charge to customers	CNY1.10 per m ³ by 2005 and CNY1.20 per m ³ by 1	The wastewater tariff for nondomestic customers was increased from CNY1.10

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
Reduce pollution in Tianjin and Bohai Bay	TSC management information system	Sufficient connections are installed.	not less than CNY1.06 per m ³ by January 2005 (constant 2000 prices)	March 2007	per m ³ to CNY1.20 per m ³ from 1 March 2007. The wastewater tariff for domestic customers was increased from CNY0.80 per m ³ to CNY0.82 per m ³ from 1 April 2009.
	Water quality monitoring program	Improved water quality management by TMG is effective and sustained. Upstream pollution prevention and control are adequately addressed.	95% of urban wastewater in Beicang is treated by January 2006	30% by 2007, 50–60% by the end of 2008, 100% by 2010	About 30% of wastewater in the Beicang catchment has been collected and treated since June 2006. About 60% was collected and treated by June 2008. By June 2011, 100% is expected to be achieved when the sewers are completed.
	Number of prosecutions		100% of water bodies meeting target by December 2005	100% of water in the Yuqiao Reservoir met target by December 2007	Other than total nitrogen, all other water quality parameters of the Yuqiao Reservoir water have been better than class III, suitable for water supply. As of 2009, more than 20 wastewater treatment plants operate, totaling some 370,000 m ³ per day capacity in Hebei Province upstream of the Yuqiao Reservoir. Wastewater generated in Beijing upstream is mostly treated before being discharged into the Yongdingxin River.
	Socioeconomic survey, visual perception survey	Public awareness and education programs are implemented successfully.	Incidents of illegal effluent use reduced	No incidents occurred	None reported.
			Increase in public perception of satisfaction with the urban environment by 2006	Public satisfaction with the urban environment was increased by 2006	A 2008 socioeconomic survey revealed that 77.4% of 93 surveyed urban residents felt the drinking water quality improved; of them, 50% felt that water pollution had decreased. Of 111 surveyed rural residents around the Yuqiao Reservoir, 78.4% claimed that the reservoir's water quality and surrounding environment had improved.

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
	<p>Flow monitoring, including Xia waterworks</p> <p>Records of operational use</p> <p>Records of operational use</p>	Continued unauthorized use is addressed.	<p>1 billion m³ per year of raw water supply protected from pollution and water losses by December 2005</p> <p>Reduction in water losses from 4% to 2% by December 2005</p> <p>Increase in transfer scheme availability from 10 to 12 months per year by January 2006</p>	<p>500 m³ averagely supplied from 2005–2007, attributing to reduced water consumption</p> <p>Reduction in water losses to 1% by December 2005</p> <p>12 months available since January 2006</p>	<p>The required annual supply has been 400 million–650 million m³ per year since 2005.</p> <p>Other than the unavoidable evaporation loss in the reservoir, water loss in the culvert is less than 0.3%, while that in the open channel is less than 0.6% as estimated by TML.</p> <p>The Yuqiao Reservoir is able to transfer water 12 months a year. However, its regular operation does not require 12 months of release.</p>
C. Outputs					
Component A	<p>Project implementation plan and reviews</p> <p>Discharge monitoring</p>	<p>The source water volume is adequate.</p> <p>Input water quality is maintained.</p> <p>Industries implement</p>	<p>The Beicang wastewater treatment plant completed with capacity of 100,000 m³ per day added by December 2005</p> <p>Sewerage collection and conveyance capacity of 100,000 m³ per day by December 2005</p> <p>Effective operating regime introduced: (i)</p>	<p>Wastewater treatment plant construction with capacity of 100,000 m³ per day completed by the end of 2005</p> <p>In total, 15.9 km of sewers were completed under the project. The construction of sewers under the World Bank loan was delayed, which affected the collection and conveyance of wastewater to the Beicang wastewater treatment plant.</p> <p>Efficiency was compromised due to</p>	<p>The plant has had a capacity of 100,000 m³ per day of class II standards since December 2005. Since June 2009, it has been undergoing process upgrades to have a capacity of 100,000 m³ per class IB standards by June 2011 (through Tianjin's own initiative and funding).</p> <p>14.8 km of sewers (and 1.1 km of effluent outfall) completed.</p> <p>Sewers under the World Bank loan have been significantly delayed, and are expected to be completed by mid-2011 to deliver more wastewater to the Beicang wastewater treatment plant.</p> <p>(i) Sewer standards more stringent than the national standards have been</p>

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
	<p>program, sludge disposal monitoring program</p> <p>Performance contracts, audited financial statements</p>	<p>adequate pretreatment.</p> <p>Enforcement powers and procedures are effective.</p> <p>Changes in disposal regulations occur.</p> <p>The government supports institutional reform.</p> <p>The government and public accept and support tariff increases.</p> <p>Tariff increases are affordable in a positive economic context.</p>	<p>compliance with sewerage discharge standards by January 2006, (ii) wastewater treatment plant effluent discharge compliance by January 2006, and (iii) sludge disposed of in accordance with legal requirements by January 2006</p> <p>TSC enterprise reform completed by January 2006, (i) full management and financial autonomy by December 2002, and (ii) self-financed wastewater treatment services by January 2006</p>	<p>delay of sewer construction: (i) only industrial water was collected and treated, (ii) the discharge is not stable due to overloaded effluent, and (iii) sustainable sludge solution is under study.</p> <p>TSC enterprise reform completed by January 2006, (i) full management and financial autonomy is expected by 2010, and (ii) self-financed wastewater treatment services are expected by January 2010</p>	<p>introduced in Tianjin since 2008; (ii) efficiency of the wastewater treatment plant has been compromised due to the delay of World Bank-funded sewerage construction, resulting in lower total flow, higher proportion of industrial wastewater, and treated effluent at times not complying with class II discharge standards; and (iii) sustainable sludge disposal and reuse options are under study but no firm solutions have been decided. The Beicang wastewater treatment plant sludge is dewatered and disposed of at a municipal solid waste landfill.</p> <p>TSC in December 2008 officially approved to transfer component A assets to TCEPC, which is a self-sustaining entity. (i) TCEPC has full management and financial autonomy; and (ii) TCEPC's wastewater operations are substantially financed by wastewater tariffs collected.</p> <p>The wastewater tariff for nondomestic customers was increased from CNY1.10per m³ to CNY1.20 per m³ from 1 March 2007 and that for domestic customers was increased from CNY0.80 per m³ to CNY0.82 per m³ from 1 April 2009.</p> <p>The combined water and wastewater bill for a poorest household in 2007 is estimated to be CNY47.84 per month, 0.94% of its disposal income, which is considered very affordable.</p>

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
Component B	<p>Project implementation plan and reviews, flow monitoring</p> <p>Water quality monitoring program</p> <p>Project implementation plan and reviews, flow monitoring</p> <p>Water quality monitoring program, pollution incident report records, number of prosecutions</p> <p>Project progress reviews, legal status, review missions, audited financial statements</p>	<p>The resettlement package is acceptable to those affected.</p> <p>The enforcement of powers and procedures is effective.</p> <p>The related dam safety program is completed.</p>	<p>New Zhou water diversion channel completed by end of 2005, with Zhou River section water losses less than 1% Yuqiao Reservoir works completed by 2004, with sustained class III water quality</p> <p>Slope protection and renovation completed by 2005, with lower section water losses less than 1%</p> <p>Environmental management program implemented by January 2006 with (i) sustained class III water quality at inlet to Tianjin water supply plants, and (ii) less than 12 pollution incidents per year</p> <p>Enterprise reform of TML: (i) full operational responsibilities assumed by June 2000, (ii) full management and</p>	<p>Fully achieved</p> <p>The majority of civil works was completed by the end of 2006 (except for a pump station finished in early 2007). The water quality has remained class III since 2005.</p> <p>Fully achieved</p> <p>Environmental management program completed by June 2007, and (i) water quality at inlet to Tianjin wastewater treatment plants remains at class III standards, and (ii) no pollution incidents occurred during the past few years.</p> <p>TML assumed full operational responsibilities and financial and management autonomy by 2002 and was operating on a self-</p>	<p>Culvert construction completed. Water loss in the culvert is less than 0.3% as estimated by TML.</p> <p>Yuqiao Reservoir works are completed.</p> <p>Other than total nitrogen, all other water quality parameters of Yuqiao Reservoir water have been better than class III, suitable for water supply.</p> <p>Slope protection and other works along the open channel are completed. Water loss in the open channel is less than 0.6% as estimated by TML.</p> <p>The environmental management program was completed by June 2007, and (i) water quality at the inlet to Tianjin water treatment plants generally achieves class III standards; and (ii) no pollution incidents have been reported in the past few years.</p> <p>TML assumed full operational responsibilities and financial and management autonomy by 2002 and was operating on a self-financed basis by 2006 (Appendix 5).</p>

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
		institutional reform. Tariff increases are affordable in a positive economic context.	financial autonomy by December 2002, and (iii) operating on a self-financed basis by January 2006	financed basis by 2006.	
D. Activities					
Component A	Project progress reports				
Beneficiary participation	Review missions		Start: October 1999 Completed: Ongoing Responsibility: TSC	Started in 1999 and still ongoing	Started in 1999 and still ongoing Responsibility: TSC, TCEPC
Land acquisition and resettlement			Start: Complete: Responsibility:	Start: 2002 Completed: 2003 Responsibility: TSC	Started: 2002 Completed: 2003 Responsibility: TSC
Project design			Start: June 2000 Completed: December 2003 Responsibility: TSC	Start: June 2000 Completed: December 2003 Responsibility: TSC	Start: June 2000 Complete: December 2003 Responsibility: TSC
Project construction			Start: April 2002 Completed: September 2005 Responsibility: TSC	The construction started in September 2003 and was completed by the end of 2005. The commissioning started in April 2006.	Start: September 2003 Completed: March 2006, Commissioning started: April 2006 Responsibility: TSC
Development of operational procedures and staff training (including monitoring and control procedures)			Start: December 2000 Completed: August 2003 Responsibility: TSC, consultants	TSC provided training for personnel on the operational procedures and system, including operational management, laboratory operations, and on-time monitoring.	In December 2008, TSC officially transferred component A assets to TCEPC. TCEPC provides structured training to existing and new personnel on operational procedures and system, including operational management, laboratory operations, and monitoring.
Operation and maintenance budget and staff			Start: December 2000 Complete: June	Start: December 2002 Complete: June 2005 Responsibility: TSC,	TCEPC prepares annual operation and maintenance budgets, and provides structured training to existing and new

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
development			2003 Responsibility: TSC, consultants	consultants	personnel.
TSC institutional reforms			Start: November 1999 Completed: March 2004 Responsibility: TSC	Start: November 1999 Completed: Ongoing Responsibility: TSC	In December 2008, TSC officially approved to transfer component A assets to TCEPC, taking the lead in the private sector participation initiative.
Sewage tariff reviews and increases			Start: November 1999 Completed: ongoing Responsibility: TSC, TFB	The wastewater tariff was increased in 2003, 2005, and 2007. The current tariff of domestic wastewater is CNY0.80 per m ³ , and the tariff of all other sources of wastewater is CNY1.20 per m ³ .	The wastewater tariff was increased in 2003, 2005, and 2007. For nondomestic customers, it was last increased from CNY1.10 per m ³ to CNY1.20 per m ³ from 1 March 2007; and that for domestic customers was last increased from CNY0.80 per m ³ to CNY0.82 per m ³ from 1 April 2009.
Component B	Project progress reports, review missions				
Beneficiary participation			Start: November 1999 Completed: ongoing Responsibility: TWRB, TML	Start: November 1999 Completed: ongoing Responsibility: TWRB, TML Completed: Ongoing	Start: November 1999 Completed: Ongoing Responsibility: TWRB, TML
Land acquisition and resettlement			Start: January 2001 Completed: June 2004 Responsibility: TML	Start: January 2001 Completed: June 2007 Responsibility: TML	Box culvert and open channel: Subcomponent: Start: January 2001 Completed: June 2007 Responsibility: TML Yuqiao Reservoir: Start: Late 2006 Completed: Three resettlement action items (PCR, Appendix 14, para. 28) are being strictly conducted, and the results

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
Project design			Start: October 2000 Completed: December 2003 Responsibility: TML	Start: October 2000 Completed: December 2006 Responsibility: TML	have been monitored and reported to ADB last 31 August 2010. Responsibility: TML Start: October 2000 Completed: December 2006 Responsibility: TML
Project construction			Start: September 2001 Completed: June 2005 Responsibility: TML	Started in 2001. Except for one pump station and the Yuqiao Reservoir subcomponent, which was completed in June 2007, the major works were completed in 2006.	Start: May 2002 Completed: June 2007, Responsibility: TML
Establish operation and maintenance budget and staff development			Start: June 2000 Completed: December 2005 Responsibility: TML, consultants	Start: June 2000 Completed: December 2007 Responsibility: TML	Start: June 2000 Completed: December 2007 Responsibility: TML
TML institutional reforms			Start: November 1999 Completed: June 2005 Responsibility: TML, consultants	Start: November 1999 Completed: June 2007 Responsibility: TML	Start: November 1999 Completed: June 2007 Responsibility: TML
Water tariff reviews and increases			Start: November 1999 Completed: Ongoing Responsibility: TML, TFB	The water tariff was increased in 2003, 2005, and 2007. The current water tariff for domestic use is CNY3.40 per m ³ , and the tariff for all industries and institutions is CNY6.20 per m ³ and for special uses, CNY20.60 per m ³ .	Water tariffs were increased in 2003, 2005, 2007, 2009, and 2010. For domestic customers, it was last increased from CNY3.40 per m ³ to CNY3.90 per m ³ from 1 April 2009; for nondomestic customers, it was last increased from CNY6.70 per m ³ to CNY7.50 per m ³ from 1 April 2009 when that for special uses was also increased from CNY21.10 per m ³ to CNY21.90 per m ³ .

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
E. Inputs					
1. Consultants	Project progress reports		65 person-months (international consultants) 130 person-months (domestic consultants)	65 person-months (international consultants) 130 person-months (national consultants)	65 person-months of international consultants 130 person-months of national consultants
2. Civil works		Counterpart funds and domestic cofinancing are available.	\$144.10 million	\$162.32 million	\$162.32 million
3. Equipment and materials			\$61.50 million	\$82.52 million	\$82.52 million
4. Project management, design, supervision, and incremental administration		Competent consultants who perform well are selected.	\$20.90 million	\$27.65 million, including training	\$27.65 million, including training
5. Training			\$0.20 million		Included above
6. Land and resettlement	Country and township governments and village committees, project implementation agencies, international specialist	National regulations on resettlement are observed, and adequate funds are provided for resettlement.	\$27.80 million	\$33.61 million	\$33.61 million
7. Others: Physical contingency Price			Physical contingency, \$25.50 million; price contingency, \$22.60	Front-end fee, \$1.30 million; and interest during construction and commitment charges,	Contingencies utilized in project costs: front-end fee, \$1.30 million; and interest during construction and commitment charges, \$29.93 million.

Design Summary	Monitoring Mechanisms	Assumptions and Risks	Performance Indicators and Targets		
			Appraisal	Reported in the Project Completion Report	Independent Evaluation Mission Assessment Remarks
contingency Front-end fee Interest during construction and commitment charges			million; front-end fee, \$1.30 million; and interest during construction and commitment charges, \$36.80 million	\$29.93 million	
Project Cost			\$340.70 million	\$337.33 million	Total project cost: \$337.33 million
TMG equity			\$122.90 million	\$121.11 million	TMG equity: \$121.11 million
Cofinancing			\$87.80 million	\$87.80 million	Cofinancing (China Development Bank): \$87.80 million
ADB			\$130.00 million	\$128.42 million	ADB: \$128.42 million

ADB = Asian Development Bank, km = kilometer, m³ = cubic meter, t = ton, TCEPC = Tianjin Capital Environmental Protection Company, TFB = Tianjin Finance Bureau, TMG = Tianjin municipal government, TML = Tianjin Municipal Luanhe Drinking Water Source Protection Engineering, TSC = Tianjin Sewerage Company, TWRB = Tianjin Water Resources Bureau.

Source: Independent evaluation mission.

PROJECT COSTS, FINANCING, AND ACHIEVEMENTS

Component	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
A. Wastewater Treatment Component (Part A)						
1. Civil Works	3.90	5.90	9.80	5.89	12.38	18.27
2. Equipment and Materials	13.40	0.00	13.40	17.16	0.00	17.16
3. Land	0.00	6.10	6.10	0.00	0.12	0.12
4. Resettlement	0.00	1.30	1.30	0.00	0.22	0.22
5. Project Management, Design, and Training	0.70	3.50	4.20	0.52	7.47	7.99
Subtotal (A)	18.00	16.80	34.80	23.57	20.19	43.76
B. Water Resources Protection Component (Part B)						
1. Civil Works	53.70	80.60	134.30	22.90	121.15	144.05
2. Equipment and Materials	48.10	0.00	48.10	65.36	0.00	65.36
3. Land	0.00	2.20	2.20	0.00	7.57	7.57
4. Resettlement	0.00	18.20	18.20	0.00	25.70	25.70
5. Project Management, Design, Supervision, and Training	1.90	15.00	16.90	2.08	17.58	19.66
Subtotal (B)	103.70	116.00	219.70	90.34	172.00	262.34
C. Contingencies						
1. Physical	12.20	13.30	25.50	0.00	0.00	0.00
2. Price	11.70	10.90	22.60	0.00	0.00	0.00
Subtotal (C)	23.90	24.20	48.10	0.00	0.00	0.00
D. Other Charges						
1. Front-End Fee	1.30	0.00	1.30	1.30	0.00	1.30
2. Interest and Other Charges during Construction	22.30	14.50	36.80	13.20	16.73	29.93
Subtotal (D)	23.60	14.50	38.10	14.50	16.73	31.23
Total	169.20	171.50	340.70	128.41	208.92	337.33

Source: Independent evaluation mission.

SUMMARY OF ACCOMPLISHMENTS

Table A3.1: Project Achievements (Component A)

Accomplishment (Date of Completion)	Description
Physical Output (March 2006)	<ul style="list-style-type: none"> • Constructed 14.804 km total length of 300–1,200-mm diameter sewers • Constructed one 1 m³ per second-capacity pumping station • Constructed the 100,000 m³-per-day capacity Beicang wastewater treatment plant, with sludge-dewatering facilities and a 3,000 m³-per-day capacity to treat water for reuse.
Water Environment Improvement (ongoing since March 2006)	<ul style="list-style-type: none"> • Treated collected wastewater generally to a class II standard before discharging into the Yongdingxin River. Between 2006 and 2009, treated 60.71 million m³ of wastewater and removed 45,830 t of COD, 21,530 t of BOD, 16,950 t of total suspended solids, 1,280 t of ammonia, and 310 t of phosphorus • Reduced water content in sludge to 75% for ease of sludge disposal • Tightened sewerage discharge standard from 2008
Capacity Building for TSC (2006)	<ul style="list-style-type: none"> • Conducted training in ADB procedures, project implementation, contract management, economic appraisal methods, financial management, operational management, report preparation, and wastewater treatment plant commissioning and operations • Conducted training in Europe and United Kingdom covering wastewater treatment works management and processes • Conducted training in Australia and New Zealand covering wastewater treatment, wastewater treatment works management and processes, and advanced city planning system • Conducted training in Denmark, Finland, Norway, and Sweden on project management, environmental protection, and project operation monitoring
Operational Improvements at TSC (2006)	<ul style="list-style-type: none"> • Completed an operational review covering a full spectrum of sewerage network operation and wastewater treatment, health and safety audit, efficiency improvements, operation and maintenance standards, plans and procedures, materials management, and sewerage discharge standards • Developed a performance contract • Developed a business plan for 2005–2010 • Developed a human resource development policy and training plans
Cost Recovery (ongoing)	<ul style="list-style-type: none"> • Introduced wastewater tariffs on 1 December 2003 of CNY0.60 per m³ for domestic consumers and CNY1.00 per m³ for nondomestic consumers • Gradually but affordably increased wastewater tariffs to CNY0.80 per m³ for domestic consumers and CNY1.20 per m³ for nondomestic consumers
Financial Benefits (ongoing)	<ul style="list-style-type: none"> • The Beicang wastewater treatment plant reclaims 1,000 m³ per day of treated wastewater into irrigation water for landscaping work, reducing potable water consumption.
Private Sector Participation (December 2008)	<ul style="list-style-type: none"> • Officially approved to transfer the ownership and operation and maintenance responsibilities of component A assets from TSC to TCEPC after project completion

ADB = Asian Development Bank, BOD = biochemical oxygen demand, COD = chemical oxygen demand, km = kilometer, m = meter, m³ = cubic meter, t = ton, TCEPC = Tianjin Capital Environmental Protection Company, TSC = Tianjin Sewerage Company.

Source: Independent evaluation mission.

Table A3.2: Summary of Accomplishments (Component B)

Accomplishment (Date of Completion)	Description
Physical Output (June 2007)	<ul style="list-style-type: none"> • Improved the environment through lining work along 64.2 km of the open channel • Constructed a 34.14 km of a three-cell closed culvert to transfer the reservoir water to the existing downstream open channel • Focused on ecological improvements around the Yuqiao Reservoir • Created an MIS to monitor water quality and outflow, among others
Capacity Building for TML (2006)	<ul style="list-style-type: none"> • Conducted training on ADB procedures, project implementation, contract management, economic appraisal methods, financial management, operational management, report preparation, and MIS operations • Conducted training in Europe and the United Kingdom covering water resource protection measures, operation and management models for water distribution systems, operational control of raw water supply systems, government policy, environmental protection, and project operation monitoring • Conducted training in Australia and New Zealand covering water resource protection measures, water quality management, groundwater control, water-saving advanced technology, operation and management models for water distribution systems, operational control of raw water supply systems, and advanced city planning system
Operational Improvements at TML (2006)	<ul style="list-style-type: none"> • Completed an operational review covering raw water supply process from the Yuqiao Reservoir to Tianjin, health and safety audit, efficiency improvements, operation and maintenance standards, plans and procedures, and materials management, with due consideration of the pending management change • Developed a performance contract • Developed a business plan for 2005–2010 • Developed a human resource development policy and training plans
Water Environment Improvement (ongoing)	<ul style="list-style-type: none"> • Maintained the water quality in Yuqiao Reservoir to be generally class III, suitable for water supply • Converted the Zhou River from serving as a water supply channel back into a natural river • Because of the environment-related gains of this project, there was an initiative for the Tianjin municipal government to give annual CNY20 million incentive subsidy to Hebei Province, which has contributed to the operation of more than 20 wastewater treatment plants, totaling some 370,000 m³ per day capacity upstream of the Yuqiao Reservoir by the end of 2009.
Social Benefits (ongoing)	<ul style="list-style-type: none"> • Protected water supply quality benefiting more than 5 million urban residents in Tianjin • Two rubber dams built along the Zhou River have improved irrigation systems. Farmers along the river are using the river water and are no longer dependent on deep-well (some 60 m) pumping of poor-quality water for irrigation.
Cost Recovery (ongoing)	<ul style="list-style-type: none"> • Introduced different tariffs for different water consumers on 1 September 2002 • Gradually but affordably increased water tariff from CNY1.40 per m³ in 1999 to currently CNY3.90 per m³ for domestic consumers • Implemented a stepped and significant increases in water tariff from CNY1.40 per m³ in 1999 to currently CNY21.90/m³ for special consumers

Accomplishment (Date of Completion)	Description
Financial Benefits (ongoing)	<ul style="list-style-type: none"> • Conserving raw water; TML estimated that water loss in the culvert (previously through evaporation, seepage, and theft along the Zhou River) has been reduced to only 0.3%, and water loss in the downstream open channel (previously through seepage and theft along the unlined river) has been reduced to 0.6%. • By maintaining the Yuqiao Reservoir water quality to be largely within class III, the Tianjin Water Affairs Bureau estimates the resultant cost savings in water treatment will be CNY0.1 per m³ (compared to treating class IV water). • Reforested areas around the Yuqiao Reservoir and along the open channel, which will provide an additional revenue stream to the Tianjin municipal government with controlled timbering when the planted trees mature

ADB = Asian Development Bank, km = kilometer, m = meter, MIS = management information system, m³ = cubic meter, TML = Tianjin Municipal Luanhe Drinking Water Source Protection Engineering.
Source: Independent evaluation mission.

**PHOTOGRAPHS OF PROJECT FACILITIES FROM THE
INDEPENDENT EVALUATION MISSION**

A. Component A: Wastewater Treatment Plant

**Photograph A4.1: Screening Discharge at
Inlet**



Photograph A4.2: Sedimentation Tanks



Photograph A4.3: Aeration Tanks



**Photograph A4.4: Sludge-Dewatering
Centrifuges**



Photograph A4.5: Dewatered Sludge Discharge



B. Component B: Water Resources Protection

Photograph A4.6: Open Channel



Photograph A4.7: Start of Open Channel



Photograph A4.8: Outlet Gate of Closed Culvert



Photograph A4.9: Turn of Open Channel



Photograph A4.10: ADB-Funded Road Near the Open Channel



Photograph A4.11: Reforestation Near Open Channel



**Photograph A4.12: Site of
Removed Fishpond**



Photograph A4.13: Yuqiao Reservoir



C. Sites in Component B before the Project

Photograph A4.14: Along the Yuqiao Reservoir



STATUS OF COMPLIANCE WITH LOAN COVENANTS

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
A. General			
1	TMG shall carry out the Project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, water resource protection and wastewater treatment practices. (LA, Article IV, Section 4.01[a])	Complied with.	
2	TMG shall make available to TSC and TML, promptly as needed, the funds, facilities, services, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project. (LA, Article IV, Section 4.02)	Complied with.	
3	The Borrower shall furnish, or cause to be furnished, to the Bank all such reports and information as the Bank shall reasonably request concerning (i) the Loan, and the expenditure of the proceeds and maintenance of the service thereof; (ii) the goods and services and other items of expenditure financed out of the proceeds of the Loan; (iii) the Project; (iv) the administration, operations and financial condition of TMG, TSC and TML; (v) financial and economic conditions in the territory of the Borrower and the international balance-of-payments position of the Borrower; and (vi) any other matters relating to the purposes of the Loan. (LA, Article IV, Section 4.04)	Complied with.	
4	The Borrower shall exercise its rights under the Subsidiary Loan Agreement, and shall cause TMG, TSC and TML to exercise their respective rights under the Subsidiary Loan Agreement and the On-lending Agreements, as applicable, in such a manner as to protect the interest of the Borrower and the Bank and to accomplish the purposes of the Loan. (LA, Article IV, Section 4.07)	Complied with.	
5	The Project Executing Agencies shall carry out the Project in accordance with plans, design standards, specifications, work schedules and construction methods acceptable to	Complied with.	

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
	<p>the Bank. The Project Executing Agencies shall furnish to the Bank, promptly after their preparation, such plans, design standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as the Bank shall reasonably request.</p> <p>(PA, Article II, Section 2.04)</p>		
6	<p>TSC and TML shall each take out and maintain with responsible insurers, or make other arrangements satisfactory to the Bank, for insurance of the Project facilities for their respective parts of the Project to such extent and against such risks and in such amounts as shall be consistent with sound practice.</p> <p>(PA, Article II, Section 2.05[a])</p>	<p>Complied with. Both agencies insured the project facilities in accordance with national laws.</p>	<p>Construction phase insurance was provided by contractors in accordance with clause GCC13 in contract documents. Completed component A facilities are insured by TCEPC as obligated by law. Completed component B facilities are under the ownership of TMG, which has a policy of self-insurance.</p>
7	<p>TSC and TML shall each (i) maintain separate accounts for its part of the Project and for its overall operations; (ii) have such accounts and related financial statements, audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to the Bank; and (iii) furnish to the Bank, promptly after their preparation but in any event not later than six months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditors' opinion on the use of the Loan proceeds and compliance with the covenants of the Loan Agreement and, as applicable, on the use of the imprest account procedures), all in English language. (PA, Article II, Section 2.09[a])</p>	<p>Complied with.</p>	<p>(i) Separate project accounts were maintained by TSC and TML during project implementation, and now, during operation, TCEPC and TML are maintaining separate company accounts; (ii) an independent auditor, Tianjin Audit Bureau, was appointed by TCEPC and TML; and (iii) audited reports were submitted for FY2001–FY2007.</p>

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
B. Implementation Arrangements			
1	<p>TMG shall be responsible for the overall carrying out and coordination of Project activities and TSC and TML shall be respectively responsible for detailed day-to-day implementation of Parts A and B of the Project. The Project Leading Group (PLG), headed by the Deputy Executive Mayor of Tianjin City, shall provide guidance and direction during the Project implementation. TMG shall ensure that the PLG shall remain constituted, in a manner satisfactory to the Bank, throughout the period of Project implementation.</p> <p>(LA, Schedule 6, para. 1)</p>	Complied with.	The PLG was set up in August 1999.
2	<p>The Project Management Office (PMO) shall act as the Secretariat of the PLG. TMG will ensure that the PMO is provided with, and continues to maintain during Project implementation, adequate staffing and resources to carry out Project activities including a Project Director, a full-time Deputy Director, and five full-time professional staff satisfactory to the Bank, in action to support staff, as necessary, with sufficient English language skills to ensure that all communications with the Bank are carried out in English. (LA, Schedule 6, para. 2)</p>	Complied with.	The PMO was set up in August 1999 and staffed with a project director, a full-time deputy director, and five full-time professional staff members.
3	<p>TSC and TML shall each (i) appoint commercial auditors, acceptable to the Bank, to undertake, at a minimum, annual independent audits; and (ii) within 3 months of the Effective Date, establish an Audit Committee comprising selected members of each of their respective Boards of directors to review internal and external audit reports and to consider other issues of corporate governance; and (iii) require each audit Committee, so established, to meet at least once every six months.</p> <p>(LA, Schedule 6, para. 5)</p>	Complied with. Audit committees have been established in both companies. Regular meetings are held.	(i) An independent auditor, Tianjin Audit Bureau, was appointed by TSC, TCEPC, and TML; (ii) the audit committees for TSC and TML were set up in April 2002; and (iii) regular biannual meetings were held.

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
4	The PIAs shall implement their respective Framework Contracts in accordance with the terms of each detailed action plan and timetable specified therein and, as agreed pursuant thereto, shall enter into Performance Contracts on or before 31 December 2002, on terms and conditions satisfactory to the Bank (LA, Schedule 6, para. 19).	Complied with.	A performance contract for TML was signed in December 2005. A performance contract for TCEPC with similar terms as that for TSC has not yet been signed.
C. Resettlement			
1	TMG will ensure that no later than 3 months of the Effective Date, the RAP shall be amplified to reflect details of preliminary technical design and shall include a livelihood restoration program, in each case satisfactory to the Bank (LA, Schedule 6, para. 6).	Complied with.	Resettlement plans for both components were updated on the basis of the preliminary design and were submitted in 2002 to ADB for approval. Meanwhile, the Yuqiao Reservoir preliminary design was approved by TMG in September 2004. Accordingly, the Yuqiao Reservoir resettlement plan and its alternative livelihood development plan were prepared in 2006 and later approved by ADB in February 2007.
2	TMG will ensure that (a) all necessary measure have been taken to ensure timely implementation of the RAP; and (b) every affected person is fully compensated and assisted prior to displacement from housing, land, livelihood sources and assets. (LA, Schedule 6, para. 7)	Complied with.	(a) TSC and TML resettlement offices were established to be responsible for timely implementation of the RAP. (b) It was reported in the monitoring and evaluation reports that every affected person was fully compensated and assisted.
3	TMG will ensure and cause each PIA to ensure timely provision of counterpart funds for land acquisition and resettlement activities specified under the RAP, including funds for compensation entitlements for affected persons under Part B of the Project. TMG will ensure and cause each PA to ensure, that counterpart funds for compensation entitlements under the RAP are provided without deduction directly to affected persons	Complied with.	A total of CNY144.94 million in resettlement costs from counterpart funding was provided, and the compensation entitlements for affected persons were in accordance with the approved resettlement plans and alternative livelihood development plan.

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
	and the relevant village organizations as applicable. (LA, Schedule 6, para. 8)		
4	<p>TMG will ensure, and cause each PIA to ensure, that (a) the Bank is provided with an updated RAP after completion of detailed construction design; (b) adequate staff and resources are committed for internal monitoring during, and subsequent to, implementation of the RAP; (c) such internal monitoring reviews referred to under (b) will be undertaken at least every six weeks during RAP implementation and at least every three months subsequent to RAP implementation under Project completion; (d) an independent domestic monitoring agency, to be selected in accordance with procedures acceptable to the Bank no later than 3 months of the Effective Date, will carry out monitoring and evaluation of RAP implementation and will undertake at least bi-annual reviews during RAP implementation and for a period of 24 months thereafter covering no less than 15 percent of affected households; and (e) a resettlement and monitoring system and a methodology for socio-economic assessments of the impacts of resettlement under the Pro</p>	Complied with.	<p>(a) Updated RAPs for components A and B were submitted in October 2002 and March 2002, respectively; (b) TSC and TML resettlement offices with adequate staff and resources were set up with 2% of the total resettlement costs as management fees, and the Jixian County and Baodi District resettlement offices were responsible for the resettlement activities and fishpond removals; (c) Halcrow and Tianle consulting companies provided 4 person-months of international and 9 person-months of national input to assist and guide the PMO and two implementing agencies in undertaking internal monitoring reviews; (d) the Tianjin Statistical Information Service Center was engaged as an independent domestic monitoring agency, and four resettlement monitoring reports were prepared for components A, and six for component B; and (e) the independent domestic monitoring system and reports were unsatisfactory, as the income-restoration sampling survey has not been conducted and its results have not been incorporated into the reports. In August 2010, a follow-up report was</p>

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
			submitted by TMG to ADB, with reported compliance on issues related to compensation and income restoration.
D. Environment			
1	TMG will ensure that the Project facilities are constructed, operated, maintained and monitored in strict conformity with: (a) all applicable government laws and regulations; (b) all environmental mitigation and monitoring measures detailed in the environment impact assessment (EIA) / summary environment impact assessment (SEIA) for the Project; and (c) all applicable Bank requirements. (LA, Schedule 6, para. 12)	Complied with.	Mostly complied with, except that the treated effluent quality of the Beicang wastewater treatment plant at times does not meet class II standards. TCEPC is presently upgrading the wastewater treatment plant processes for it to meet the more stringent class IB discharge standards, targeted to be completed by the end of 2010.
2	Each PIA will ensure that: (a) their respective environmental monitoring offices shall include an adequate number of full-time environmental management personnel, and sufficient resources, to monitor and record the implementation of the environmental monitoring program; (b) annual environmental reports are prepared and submitted to the Bank, within 3 months of the close of each calendar year, from the start of Project implementation and until commencement of commercial operation of the Project facilities; and (c) detailed engineering designs and civil works and other contracts for Project facilities incorporate applicable environmental mitigation measures identified in the EIA/SEIA. (LA, Schedule 6, para. 13)	Complied with.	(a) TSC: Prior to construction, two officers of the TSC project management unit took charge of environmental issues. During construction, the TSC project manager onsite was assisted by three staff members with environmental management responsibilities. TML: The head of the Yuqiao Division was responsible for environmental management. He was supported by the Water Quality Monitoring Centre of the Yuqiao Reservoir Division with about 10 staff members. (b) Annual environmental reports were submitted for 2002–2006. (c) Complied with.

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
3	<p>TMG will ensure, and cause TML to ensure, that (a) the detailed design of Part B of the Project adequately addresses Yuqiao Reservoir safety concerns and a program for completion of pressurized grouting of the Yuqiao Reservoir Dam, including regular monitoring thereof; (b) sufficient funds are made available for timely completion of the pressurized grouting program of the Yuqiao Reservoir Dam no later than the expiry of 36 months from the commencement of implementation of Part B of the Project; (c) a comprehensive study and evaluation of the modification of fish ponds located within the relevant protective dike at the inlet of the Yuqiao Reservoir shall be submitted to the Bank for review prior to construction of any biological treatment basin or commencement of other environmental improvement activities in connection with continued use of remaining fish ponds around the Yuqiao Reservoir. (LA, Schedule 6, para. 14)</p>	Complied with.	<p>(a) A 450-m concrete cutoff wall was completed in 2001, and twice-yearly movement and settlement monitoring is conducted to ensure dam safety; (b) the cost of the cutoff was CNY33 million; (c) an environmental emergency response action plan for Yuqiao Reservoir fishpond control was submitted to ADB in February 2007, and some 14,551 mu of fishponds were removed.</p>
4	<p>TMG will ensure the timely implementation of the industrial pollution sources management program requiring industries to improve pretreatment of wastewater to satisfy national wastewater discharge standards no later than 31 December 2000 in accordance with TMG directives dated 9 April 1997, 31 March 1998, 28 June 1998, 24 December 1998 and 11 June 1999. (LA, Schedule 6, para. 16)</p>	Complied with.	<p>Since 2008, Tianjin has been enforcing sewerage discharge class IB standards, which is more stringent than the class II national standards. The class 2 standards cover nitrogen and phosphorous, which cause algae growth.</p>
E. Counterpart Financing			
1	<p>The Borrower, through TMG, will ensure that (a) all local and foreign currency counterpart financing necessary for purposes of the Project, including equity contributions and cash advances, is provided on a timely basis to enable completion of Project activities; and (b) additional counterpart funding will be provided, as necessary, for any shortfall of funds or cost overruns (LA, Schedule</p>	Complied with. Counterpart funding is in place.	<p>Component A: \$20.19 million counterpart funding (versus \$16.80 million estimated at appraisal) was provided. Component B: \$172.00 million counterpart funding (versus \$116.00 million estimated at appraisal) was provided.</p>

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
	6, para. 17).		
2	TMG shall prepare and submit timely annual budgetary appropriation requests to the relevant authorities for the required amounts of TMG equity investment in the Project in accordance with the Financing Plan agreed with the Bank. (LA, Schedule 6, para. 18).	Complied with.	
	Cost Recovery		
1	The Borrower shall cause TMG, TSC, TML and any other authorities concerned, to undertake review of applicable tariff regimes, including water and wastewater, prior to the midterm review of the Project implementation (LA, Schedule 6, para. 21).	Complied with.	The tariff was reviewed and raised in 2003, prior to the March 2004 midterm review. It was further increased twice in 2005 and 2007, clearly indicating TMG's commitment to market-based instruments.
2	The Borrower shall cause TMG to ensure that, by 31 December 2005, the wastewater tariffs charged by TSC to all wastewater consumers are increased from the present levels to ensure full recovery of O&M, depreciation and financial costs, including debt service requirements, and a reasonable profit margin for TSC. To this end, TSC shall prepare and submit the necessary applications for tariff increased to government authorities concerned in order to ensure that the applicable wastewater tariff rates charged by TSC to wastewater consumers will be not less than Y0.56/m ³ for domestic customers and Y0.75/m ³ for other customers on or before 1 January 2003 and Y1.06/m ³ for all customers on or before 1 January 2005 (LA, Schedule 6, para. 22).	Complied with. The current wastewater tariffs are CNY0.80 per m ³ for domestic consumers and CNY1.10 per m ³ for other consumers, effective since 1 January 2006.	Wastewater tariffs were raised in 2003 to CNY0.60 per m ³ for domestic customers and CNY1.00 per m ³ for other customers. They were again increased in 2005 to CNY0.80 per m ³ for domestic customers and CNY1.10 per m ³ for other customers. In 2007, it was again increased for other customers to CNY1.20 per m ³ .

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
3	The Borrower shall cause TMG to ensure that, by 31 December 2005, the raw water tariffs charged by TML to consumers are increased from the present levels to ensure full recovery of O&M, depreciation and financial costs, including debt service requirements, and a reasonable profit margin for TML. To this end, TML shall prepare and submit the necessary applications for tariff increased to government authorities concerned in order to ensure that the applicable raw water tariff rates charged by TML to consumers will be not less than Y0.61/m ³ for water consumed and Y0.2/m ³ for recycled water on or before 1 January 2003 and Y.75/m ³ for water consumed and Y0.25/m ³ for recycled water on or before 1 January 2005 (LA, Schedule 6, para. 23).	Complied with. The current raw water tariffs are CNY1.03 per m ³ for domestic consumers and CNY0.30 per m ³ for recycled water.	Since April 2009, recycled water has been charged at CNY1.10 per m ³ to domestic consumers, CNY1.50 per m ³ to power stations, CNY3.10 per m ³ to industrial and commercial consumers, and CNY4.00 per m ³ to other consumers. Since December 2003, raw water has been charged at CNY0.22 per m ³ to all consumers. The raw water tariff was raised to CNY0.70 per m ³ from December 2005 for nondomestic consumers. From March 2007, it was further increased to CNY0.25 per m ³ for domestic consumers and CNY1.03 per m ³ for nondomestic consumers. From April 2009, it was further raised to CNY0.63 per m ³ for domestic consumers and CNY1.41 per m ³ for nondomestic consumers.
F. Training			
1	Prior to carrying out of training activities, the PIA shall submit their respective training plans to the Bank for prior review and approval. Upon completion of each training program, a report shall be furnished to the Bank describing such training and the benefits accruing therefore. (LA, Schedule 6, para. 25)	Complied with.	A training plan was submitted to ADB in March 2002. Training reports were submitted after each training session.
G. Project Performance Management System			
1	TMG and each PIA shall ensure that, within 6 months of the Effective Date, the PMO shall have developed a PPMS framework and related procedures, satisfactory to the Bank, to generate and monitor data on Project inputs, outputs and impacts systematically including, inter alia, application of indicators on service levels, water quality and consumption, user satisfaction,	Complied with. A PPMS framework has been established, and a PPMS has been set up in web format and can be accessed at tj-adbproject.com.	A PPMS was set up in June 2002, and was regularly updated during project implementation and included in quarterly progress reports.

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
	resettlement, institutional strengthening, and for socioeconomic and environmental concerns. Such PPMS framework and related procedures shall be designed to permit flexibility to adopt remedial measures during Project implementation, as necessary, particularly with regard to Project design, schedules, activities and development impacts. (LA, Schedule 6, para. 26)		
H. Financial			
1	Neither TSC nor TML shall incur any debt in any year commencing from the start of commercial operations of the relevant Project facilities, unless a reasonable forecast of the respective revenues and expenditures of TSC and TML shows that the estimated net revenues of each of TSC and TML in such year shall be at least 1.4 times their estimated respective debt service requirement in such year on all debt, including any debt to be incurred. (PA, Article II, Section 2.16[a])	Complied with.	Complied with. Debt has not been incurred by TML and TCEPC since the start of its commercial operations, other than the ADB loan.
2	Except as the Bank shall otherwise agree, neither TSC nor TML shall incur additional debt, in any fiscal year commencing from the start of commercial operations of their respective parts of the Project, if after the incurring of such debt the ratio of debt to equity in respect of either TSC or TML shall be greater than 65 to 35. (PA, Article II, Section 2.17[a])	Complied with.	Complied with. The ratio in 2009 was 65:35 for TML and 62:38 for TCEPC.
3	TSC and TML shall respectively maintain a ratio of current assets to current liabilities of not less than 2 to 1. (PA, Article II, Section 2.18[a])	Partially complied with.	<p>TML: Complied with. During 2009, the ratio was almost at 4:1 since cash and accounts receivable have substantially increased.</p> <p>TCEPC: Not complied with. The ratio in 2008 was less than 2:1 due to lower current assets. Current assets must be increased.</p>

Item Number	Covenants	Status of Compliance as of June 2007	Independent Evaluation Mission Assessment and Comments
4	TSC and TML shall each respectively establish a retention account, at a bank acceptable to the Bank, with 6 months of the Effective Date, and ensure that the minimum balances therein shall be, at all times, not less than amounts sufficient to cover 30 days of estimated Operations and Maintenance (O&M) expenditures and, commencing no later than 1 January 2004, such minimum balances therein shall be, at all times not less than amounts sufficient to cover 120 days of their respective estimated O&M expenditures. (PA, Article II, Section 2.19[a])	Complied with.	Complied with. The balance is sufficient to meet TML operation and maintenance expenditures. As of the independent evaluation mission, 6 months' value, or CNY30 million, exists.
5	TSC and TML shall each respectively establish a debt service account, at a bank acceptable to the Bank, no later than 1 March 2005 or within 60 days of incurring any long-term debt obligations and ensure that the minimum balances therein shall be, at all times, not less than amounts sufficient to cover 120 days of their respective estimated debt service obligations. (PA, Article II, Section 2.19[b]).	Complied with.	Complied with. The balance is sufficient to cover the debt service obligations. As of the independent evaluation mission, about CNY30 million was earmarked by TML.

LA = loan agreement, m = meter, m³ = cubic meter, PA = project administration, PIA = project implementing agency, PLG = project leading group, PMO = project management office, PPMS = project performance monitoring system, RAP = resettlement action plan, TCEPC = Tianjin Capital Environmental Protection Company, TMG = Tianjin municipal government, TML = Tianjin Municipal Luanhe Drinking Water Source Protection Engineering, TSC = Tianjin Sewerage Company.

Note: "Mu" is a unit of measurement in the People's Republic of China, equivalent to 1/15 hectare.

Source: Project completion report and independent evaluation mission.

OVERALL PERFORMANCE ASSESSMENT

Table A6.1: Rating Matrix of Core Evaluation Criteria

Criterion	Weight (%)	Definition	Rating Description	Rating Value
1. Relevance	20	Relevance is the consistency of a project's impact and outcome with the government's development strategy, lending strategy of the Asian Development Bank (ADB) for the country, and ADB strategic objectives at the time of approval and evaluation and the adequacy of the design.	<i>Highly relevant</i> <i>Relevant</i> <i>Partly relevant</i> <i>Irrelevant</i>	3 2 1 0
2. Effectiveness	30	Effectiveness describes the extent to which the outcome, as specified in the design and monitoring framework, either as agreed upon at approval or as subsequently modified, has been achieved.	<i>Highly effective</i> <i>Effective</i> <i>Less effective</i> <i>Ineffective</i>	3 2 1 0
3. Efficiency	30	Efficiency describes, ex post, how economically resources have been converted to results, using the economic internal rate of return, or cost-effectiveness, of the investment or other indicators as a measure and the resilience to risk of the net benefit flows over time.	<i>Highly efficient</i> <i>Efficient</i> <i>Less efficient</i> <i>Inefficient</i>	3 2 1 0
4. Sustainability	20	Sustainability considers the likelihood that human, institutional, financial, and other resources are sufficient to maintain the outcome over its economic life.	<i>Most likely</i> <i>Likely</i> <i>Less likely</i> <i>Unlikely</i>	3 2 1 0
Overall Assessment (weighted average of above criteria)		<i>Highly Successful:</i> The overall weighted average is greater than or equal to 2.7. <i>Successful:</i> The overall weighted average is greater than or equal to 1.6 and less than 2.7. <i>Partly Successful:</i> The overall weighted average is greater than or equal to 0.8 and less than 1.6. <i>Unsuccessful:</i> The overall weighted average is less than 0.8.		

Source: Asian Development Bank. 2006. *Guidelines for Preparing Performance Evaluation Reports for Public Sector Operations*. Manila.

Table A6.2 Assessment of Tianjin Overall Performance

Criterion	Weight (%)	Assessment	Rating Value	Weighted Rating
Relevance	20	<i>Relevant</i>	2.0	0.4
Effectiveness	30	<i>Effective</i>	2.0	0.6
Efficiency	30	<i>Efficient</i>	2.0	0.6
Sustainability	20	<i>Most likely sustainable</i>	3.0	0.6
Overall Rating		Successful		2.2

Note: The rating value is the average assessment of components A and B.
Source: Independent evaluation mission.

FINANCIAL REEVALUATION

A. Scope and Methodology

1. The financial viability of the Tianjin Wastewater Treatment and Water Resources Protection Project is assessed using financial statements and other information gathered during the independent evaluation mission. The financial internal rate of return (FIRR) is recalculated, using the weighted average cost of capital (WACC) as the hurdle rate. All costs and revenues are expressed in 2010 prices for the FIRR calculation. Calculation of financial viability includes the construction period with around 20 years of operation, after the start of trial operations in 2006. The project's residual value is assumed at 10% of the total project cost.

B. Component A: Wastewater Treatment

2. The capital cost of the component includes the upgrading of the treatment facilities to meet the class IB standards for wastewater treatment, to be completed in 2010. Revenues take into account the volume of wastewater treated multiplied by the tariff, which for the past 2 years has been at CNY0.80 per cubic meter (m^3) for domestic consumers and CNY1.2 per m^3 for nondomestic consumers. At the time of the evaluation, the Beicang wastewater treatment plant's capacity had not yet reached its full level (it was only at 65,000 m^3 per day, because the World Bank-funded sewerage project has not yet been completed). The original target for the full capacity operation of the wastewater treatment plant was in 2007, following the completion of the World Bank sewers. The revised completion date is targeted for mid-2011, after completion of the World Bank-funded sewerage project, which will facilitate its operation to 100,000 m^3 per day as envisioned during appraisal. This should increase the revenues projected for this component, which is assumed in the FIRR computation.

3. Given these assumptions, the recalculated FIRR is 4.7%, compared to the 6.0% during project completion report (PCR). Compared to the recalculated WACC of 2.8%, the project is financially viable. The variation in the FIRRs was primarily due to the inclusion in 2010 of the cost for the upgrading of the wastewater treatment plant in the recalculation. Even with an increase of costs by 10%, or a decrease in revenues by 10%, these would not deter the project from achieving its financial sustainability. In terms of cost recovery, the Tianjin Capital Environmental Protection Company (TCEPC) is discussing with the Tianjin Price Bureau an increase in tariff levels in 2011.

C. Component B: Water Resources Protection

4. The financial viability of this component takes into account capital cost, operating expenses, and revenues from consumption of raw and recycled water. Compared to appraisal, the assumption of recycled water consumed has decreased from 415 million m^3 per year to only 60 million m^3 per year. This is the result of a large number of power plants, steel works, and paper mill companies not pursuing their operations in Tianjin. Meanwhile, consumption of raw water is assumed to be growing at around 2% yearly, contributing to the revenue increase. In terms of tariff levels, the actual water tariff for raw water is CNY1.05 per m^3 , while recycled water is CNY0.30 per m^3 .

5. The recalculated FIRR yields 7.7%, similar to the estimated FIRR in the PCR. The WACC is recomputed at 3.8%. The sensitivity analysis has a viable component, even with a combined increase in cost and decrease in revenue, yielding an FIRR of 5.1%. Sustainability of this component's operations is expected with better cost control and the continuing improvements in the vicinity of the Yuqiao Reservoir to ensure protection of water quality.

D. Financial Performance of Implementing Agencies

6. The Tianjin municipal government subsidizes TCEPC's wastewater tariff through a compensation rate, so the tariff rate paid to TCEPC for water treated is CNY1.93 per m³, higher than the wastewater tariff charged to end-users. The subsidy may cease (subject to an agreement with the Tianjin Price Bureau on the revised tariff rate), when operations of the Beicang wastewater treatment plant become higher than its present performance or is at 100% of its intended capacity. This would mean that the revenues derived, due to the increased quantity treated, are able to finance operations of the treatment plant. However, although operations are most likely sustainable, given its FIRR, its balance sheet still needs to be managed properly. The current ratio is still below the covenant specified ratio of 2:1. Management of short-term borrowings and increased bank balances are some steps to be taken to hurdle the required ratio. Meanwhile, the debt–equity ratio remains at 65:35, which projects a stable business operation (Appendix 5).

7. Tianjin Municipal Luanhe Drinking Water Source Protection Engineering (TML), on the other hand, has a liquid operation with a current debt–equity ratio of 4:1 because of better management of its current debts, which have decreased substantially, starting 2008 (Appendix 5). Growth is financed both by shareholder money and debt, with a ratio of 53:47. Financial sustainability of the company is very likely, as measures to control operating costs are being instituted; costs have increased more than envisioned at the start of operations. The continuous environmental works along the open channel and within the vicinity of the Yuqiao Reservoir will likely ensure the higher quality of raw water, which should lessen cost of treatment.

Table A7.1: Financial Ratios

TCEPC	2005	2006	2007	2008	2009
Current ratio	0.71	0.73	0.81	0.90	1.02
Debt service coverage ratio	2.94	5.43	2.72	2.16	2.90
Debt–equity ratio	0.34	0.41	0.37	0.46	0.35
TML					
Current ratio	1.21	1.10	1.19	1.31	3.96
Debt service coverage ratio	2.94	4.20	1.84	1.87	1.89
Debt–equity ratio	0.34	0.24	0.54	0.54	0.53

TCEPC = Tianjin Capital Environmental Protection Company, TML= Tianjin Municipal Luanhe Drinking Water Source Protection Engineering.

Source: Estimates from financial statements of TCEPC and TML.

Table A7.2: Financial Internal Rate of Return of Wastewater Treatment

Year	Capital Expenditure	Operation and Maintenance	Revenues	Base Case: Net Revenue	10% Increase in Cost: Net Revenue	10% Decrease in Revenue: Net Revenue	Combined 10% of Cost and Revenue
2001	10.8	0.0	0.0	(10.8)	(11.8)	(10.8)	(11.8)
2002	19.3	0.0	0.0	(19.3)	(21.2)	(19.3)	(21.2)
2003	118.5	0.0	0.0	(118.5)	(130.4)	(118.5)	(130.4)
2004	104.4	0.0	0.0	(104.4)	(114.8)	(104.4)	(114.8)
2005	105.6	0.0	0.0	(105.6)	(116.1)	(105.6)	(116.1)
2006	41.6	4.7	13.2	(33.1)	(37.7)	(34.4)	(39.1)
2007	0.0	11.2	22.4	11.2	10.1	8.9	7.8
2008	0.0	13.5	34.0	20.4	19.1	17.0	15.7
2009	0.0	18.0	49.7	31.7	29.9	26.7	24.9
2010 ^a	190.0	17.4	47.9	(159.4)	(180.2)	(164.2)	(185.0)
2011	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2012	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2013	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2014	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2015	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2016	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2017	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2018	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2019	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2020	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2021	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2022	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2023	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2024	0.0	16.8	71.5	54.6	53.0	47.5	45.8
2025	(53.1)	16.8	71.5	107.7	111.4	100.6	104.2
Financial internal rate of return				4.7%	3.4%	3.3%	2.1%

() = negative.

^a Upgrading of facilities by 2010 to meet class IB standards.

Sources: Asian Development Bank estimates.

Table A7.3: Financial Internal Rate of Return of Water Resources Protection

Year	Capital Expenditure	Operation and Maintenance	Revenues	Base Case: Net Revenue	10% Increase in Cost: Net Revenue	10% Decrease in Revenue: Net Revenue	Combined 10% of Cost and Revenue
2001	77.3	0.0	0.0	(77.3)	(85.0)	(77.3)	(85.0)
2002	355.6	19.7	57.3	(318.0)	(355.5)	(323.7)	(361.2)
2003	544.6	2.7	116.8	(430.4)	(485.1)	(442.1)	(496.8)
2004	461.6	58.5	135.3	(384.8)	(436.8)	(398.3)	(450.3)
2005	308.7	54.2	169.9	(193.0)	(229.3)	(210.0)	(246.3)
2006	307.8	90.2	162.7	(235.2)	(275.0)	(251.5)	(291.3)
2007	300.4	50.0	220.1	(130.3)	(165.3)	(152.3)	(187.3)
2008	0.0	50.0	222.3	172.3	167.3	150.1	145.1
2009	0.0	50.0	224.6	174.6	169.6	152.1	147.1
2010	0.0	50.0	262.0	212.0	207.0	185.8	180.8
2011	0.0	50.0	256.4	206.4	201.4	180.8	175.8
2012	0.0	50.0	259.0	209.0	204.0	183.1	178.1
2013	0.0	50.0	261.6	211.6	206.6	185.4	180.4
2014	0.0	50.0	264.2	214.2	209.2	187.8	182.8
2015	0.0	50.0	266.8	216.8	211.8	190.1	185.1
2016	0.0	50.0	269.5	219.5	214.5	192.5	187.5
2017	0.0	50.0	274.9	224.9	219.9	197.4	192.4
2018	0.0	50.0	280.4	230.4	225.4	202.3	197.3
2019	0.0	50.0	286.0	236.0	231.0	207.4	202.4
2020	0.0	50.0	291.7	241.7	236.7	212.5	207.5
2021	0.0	50.0	297.5	247.5	242.5	217.8	212.8
2022	0.0	50.0	303.5	253.5	248.5	223.1	218.1
2023	0.0	50.0	309.6	259.6	254.6	228.6	223.6
2024	0.0	50.0	315.8	265.8	260.8	234.2	229.2
2025	(698.1)	50.0	322.1	970.1	1,035.0	937.9	1,002.7
Financial internal rate of return				7.7%	6.4%	6.3%	5.1%

() = negative.

Sources: Asian Development Bank estimates.

Table A7.4: Consolidated Financial Statement: Tianjin Capital Environmental Protection Company (CNY)

Balance Sheet	2001	2002	2003	2004	2005	2006	2007	2008	2009	1st Qtr 2010
Cash and bank balances	20,877	51,551	40,006	125,962	54,446	60,714	8,663	27,544	23,435	13,235
Trade receivables	13,231	2,823	10,774	39,118	6,187	1,647	40,191	74,288	42,906	59,477
Prepayments	21,503	25	8,293	11,582	147	54	1,298	3,381	14,262	14,108
Other receivables	53	108	540	109	291	8,358	8,246	30,077	16,946	16,587
Inventories	251	244	212	177	261	270	303	336	356	363
Total current assets	55,915	54,751	59,826	177,192	62,954	71,043	58,702	135,626	100,406	106,270
Total Assets	188,886	265,524	297,486	442,113	430,068	498,863	478,386	595,591	522,674	537,876
Short-term borrowings			4,500	10,000	59,000	67,600	15,500	77,689	10,000	10,000
Short-term debenture									50,000	50,000
Trade payables	20	41	412	215	277	356	614	728	836	717
Total current liabilities	32,097	30,012	37,589	43,036	88,845	97,863	72,516	150,213	98,099	99,112
Long-term borrowings		50,000	58,000	55,500	57,500	107,100	103,500	125,900	82,400	91,200
Total non-current liabilities		50,000	58,000	175,500	112,710	161,184	118,227	140,217	102,092	111,014
Total Liabilities	32,097	80,012	95,589	218,536	201,555	259,048	190,743	290,430	200,191	210,126
Total shareholders' equity	156,789	185,512	201,897	223,576	228,513	239,816	287,642	305,161	322,483	327,750
Total Assets and Liabilities	188,886	265,524	297,486	442,113	430,068	498,863	478,386	595,591	522,674	537,876
Income Statement										
Income from operations	59,600	67,076	63,530	73,126	57,986	66,625	74,971	79,030	81,612	16,990
Less: Cost for operations	(13,165)	(14,614)	(12,861)	(13,246)	(14,989)	(22,810)	(26,656)	(26,990)	(29,406)	(6,761)
Business tax and surcharges	(3,278)	(3,689)	(3,505)	(4,019)	(3,142)	(3,617)	(4,230)	(4,114)	(4,020)	(829)
Administrative expenses	(3,239)	(4,371)	(3,660)	(4,339)	(4,552)	(5,416)	(7,086)	(5,916)	(5,576)	(1,437)
Financial expenses - net	113	(1,260)	(1,855)	(2,726)	(7,594)	(11,330)	(10,728)	(15,070)	(10,487)	(1,088)
Assets impairment losses							(2,200)		(450)	
Add: Investment income	(98)	(158)	(300)	(70)	(963)			591	20	
Operation profit	39,933	42,985	41,349	48,726	26,746	23,452	24,071	27,530	31,694	6,876
Add: Non-operating income	32	4	30	11	57	1	1	0	82	3
Less: Non-operating expenses	(19)	(118)	(52)	(465)	(87)	(46)	(7)	(52)	(926)	(118)
Including: Loss on disposal of non-current assets					-	(46)	(7)	(32)	(916)	-
Total profit	39,945	42,871	41,327	48,273	26,716	23,407	24,065	27,479	30,849	6,761
Less: Income tax	(13,182)	(14,148)	(13,638)	(15,953)	(9,134)	(7,738)	(8,488)	(6,722)	(7,819)	(1,690)
Net profit	26,763	28,724	27,689	32,320	17,582	15,669	15,577	20,757	23,031	5,070
Cash Flow										
Cash received from sales of goods and rendering of services	47,556	70,343	53,579	42,532	41,767	42,759	40,464	48,925	155,016	238
Cash received relating to other operating activities	413	5	829	11	185	3,340	7,849	2,960	973	4,455
Sub-total of cash inflow s	47,969	70,348	54,408	42,543	41,953	46,099	48,313	51,885	155,990	4,693
Cash paid for goods and services	(5,494)	(6,674)	(6,152)	(6,745)	(8,742)	(11,317)	(12,734)	(16,952)	(15,493)	(1,339)
Cash paid to and on behalf of employees	(3,009)	(3,630)	(3,201)	(2,906)	(3,421)	(3,683)	(4,252)	(5,134)	(6,009)	(2,289)
Payments of taxes and levies	(12,101)	(20,684)	(14,757)	(15,535)	(13,990)	(12,729)	(13,293)	(15,116)	(14,049)	(1,693)
Cash payments relating to other operating activities	(8,611)	(3,192)	(2,377)	(3,093)	(2,443)	(11,405)	(6,044)	(2,166)	(2,563)	(3,077)
Sub-total of cash outflow s	(29,215)	(34,180)	(26,487)	(28,278)	(28,595)	(39,134)	(36,323)	(39,368)	(38,115)	(8,398)
Net cash flow s from operating activities	18,754	36,168	27,921	14,265	13,357	6,965	11,990	12,518	117,875	(3,705)
Ratios										
Current Ratio	1.74	1.82	1.59	4.12	0.71	0.73	0.81	0.90	1.02	1.07
Debt Service Coverage Ratio	5.88	3.32	3.11	4.49	2.94	2.43	2.72	2.16	2.90	2.83
Debt-Equity Ratio	0.17	0.30	0.32	0.22	0.34	0.41	0.37	0.46	0.35	0.35

Source: Tianjin Capital Environmental Protection Company financial statements, independent evaluation mission of the Asian Development Bank.

Table A7.5: Consolidated Financial Statement: Tianjin Municipal Luanhe Drinking Water Source Protection Engineering

Income statement	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Revenue purchase	107	97	132	106	72	115	103	74	133	119
Operating expenses subtotal	259	287	319	355	314	426	277	392	371	390
Depreciation	10	11	80	86	84	85	99	113	142	156
Cost of sales	269	298	399	442	398	511	376	505	513	546
Operating income	90	115	41	24	109	1	214	112	126	104
Non-operating income	5	3	2	1	1	1	0	0	0	0
Non-operating income	11	10	8	1	3	3	0	0	0	0
Income before inc.tax	85	109	35	25	109	0	146	39	74	52
Net inc.	85	110	35	25	109	1	146	39	74	52
Cash flow statement										
Net income	85	110	35	25	109	1	146	39	74	52
Depreciation	10	11	80	86	84	85	99	113	142	156
Interest expenses	0	0	0	0	0	0	68	73	52	53
Working capital increase(decrease)	10	66	5	67	219	(58)	(31)	(17)	12	23
Net cash flow	94	53	(21)	(88)	(125)	(10)	129	(47)	116	94
Cash balance beginning	0	94	148	239	151	25	27	156	109	225
Cash balance ending	94	148	239	151	25	15	156	109	225	319
Balance Sheet										
Current assets	105	165	614	925	221	206	214	140	200	220
Total assets	497	2,185	3,200	3,867	3,437	5,435	3,932	3,774	3,777	3,898
Current liability	15	9	401	645	183	187	180	107	50	55
Long-term liability	41	238	592	905	985	1,108	1,955	1,915	1,946	1,854
Equity	441	1,938	2,207	2,317	2,269	4,140	1,797	1,752	1,781	1,988
Total liability and equity	497	2,185	3,200	3,867	3,437	5,435	3,932	3,774	3,777	3,898
Ratio										
Current ratio	6.88	18.49	1.53	1.43	1.21	1.10	1.19	1.31	3.96	3.96
Debt service coverage ratio	8.81	8.83	3.22	2.49	2.94	4.20	1.84	1.87	1.89	2.04
Debt-equity ratio	0.11	0.11	0.31	0.40	0.34	0.24	0.54	0.54	0.53	0.49

Sources: Tianjin Municipal Luanhe Drinking Water Source Protection Engineering financial statements, independent evaluation mission of the Asian Development Bank.

ECONOMIC REEVALUATION

A. Scope and Methodology

1. The economic reevaluation of the economic internal rates of return (EIRRs) of components A and B are based on benefits and costs, as gathered during the independent evaluation mission. Benefits and costs are expressed in 2010 prices, using the domestic price, in yuan. This entails the exclusion of taxes and depreciation factor for costs, and a shadow exchange price of 1.14 for tradable items valued in domestic prices. Depreciation is at 5%, and taxes are valued at 5% of capital cost. The EIRRs are compared with the economic opportunity cost of capital (EOCC), which is at 12%. Sensitivity tests test the efficiency level at a 10% increase in costs and a 10% decrease in revenues.

B. Component A: Wastewater Treatment

2. Economic benefits of this component include (i) the revenue derived from consumers who are willing to pay a certain amount in treating wastewater, and (ii) the benefits of using the recycled water for industrial use. Recyclable water, estimated at 3,000 m³ per day, is used for landscaping and cooling of power stations. The tariff is set at CNY0.30 per m³ for recycled water. Unquantifiable benefits include the safety of those who would be exposed to the polluted environment brought about by wastewater discharge. The upgrading of the facilities to improve the wastewater quality standard to hurdle class IB standards would benefit the urban population in the central district of Tianjin by mitigating hazards that could result from discharge below the standard level.

3. Due to the conceived benefits of the project, the recalculated EIRR is 13.2%, compared to the project completion report EIRR of 16.2%. Similar to the financial rate of return, the variation in the economic efficiency is due to the cost attributed to the upgrading of the wastewater treatment plant. Despite this, the EIRR at evaluation still hurdles the 12% EOCC. However, sensitivity analysis yields less efficient results. In particular, due to the cost of upgrading the plant, it would be more efficient if this resulted in enticing consumers to pay for the incremental benefit of a higher standard treatment of wastewater discharge.

C. Component B: Water Resources Protection

4. In the reevaluation of benefits for this component, the independent evaluation mission confirmed the benefits mentioned in the PCR: (i) the demand for raw water due to the improvement in the raw water quality, and (ii) cost savings of water treatment by water plants due to the improved water quality. The resultant cost savings in treatment is CNY0.10 per m³. Additional benefits, which are not quantified in this component, are the spurt in economic activities brought by the building of village roads and the health benefit of improving toilet facilities in the villages. The ongoing environmental works in the open channel and Yuqiao Reservoir (i.e., tree planting) would continue to improve the ecological balance and become a source of additional income through selective timber logging.

5. The recalculated EIRR yields an economically efficient component, of 17.7%. Even with the sensitivity analysis, the component still hurdles the EOCC of 12%.

Table A8.1: Economic Internal Rate of Return of Wastewater Treatment

Year	Capital Expenditure	Operation and Maintenance	Incremental Revenue	Recycled Water	Net Revenue	10% Increase in Cost: Net Revenue	10% Decrease in Revenue: Net Revenue	Combined 10% of Cost and Revenue
2001	10.4	0.0	0.0	0.0	(10.4)	(11.5)	(10.4)	(11.5)
2002	18.8	0.0	0.0	0.0	(18.8)	(20.7)	(18.8)	(20.7)
2003	115.6	0.0	0.0	0.0	(115.6)	(127.2)	(115.6)	(127.2)
2004	101.8	0.0	0.0	0.0	(101.8)	(112.0)	(101.8)	(112.0)
2005	89.3	0.0	0.0	0.0	(89.3)	(98.2)	(89.3)	(98.2)
2006	31.8	4.3	16.8	0.0	(19.3)	(22.9)	(21.0)	(24.6)
2007	0.0	8.8	25.5	0.0	16.6	15.8	14.1	13.2
2008	0.0	10.7	38.7	0.0	28.0	26.9	24.1	23.1
2009	0.0	14.3	56.6	0.0	42.4	40.9	36.7	35.3
2010	167.2	13.8	54.7	37.4	(88.9)	(107.0)	(98.1)	(116.2)
2011	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2012	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2013	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2014	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2015	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2016	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2017	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2018	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2019	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2020	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2021	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2022	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2023	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2024	0.0	13.3	92.9	36.3	115.8	114.5	102.9	101.6
2025	-48.6	13.3	92.9	36.3	164.5	168.0	151.6	155.1
Economic internal rate of return					13.2%	11.9%	11.7%	10.5%

() = negative.

Note: Upgrading facilities to meet class IB standards.

Sources: Asian Development Bank estimates.

Table A8.2: Economic Internal Rate of Return of Water Resources Protection

Year	Capital Expenditure	Operation and Maintenance	Resource Cost Savings	Water Treatment Cost Savings	Net Revenue	10% Increase in Cost: Net Revenue	10% Decrease in Revenue: Net Revenue	Combined 10% of Cost and Revenue
2001	67.3	0.0	0.0	0.0	(67.3)	(74.0)	(67.3)	(74.0)
2002	309.7	0.0	0.0	0.0	(309.7)	(340.7)	(309.7)	(340.7)
2003	474.3	0.0	0.0	0.0	(474.3)	(521.7)	(474.3)	(521.7)
2004	402.0	0.0	71.8	0.0	(330.2)	(370.4)	(337.4)	(377.6)
2005	268.8	0.0	168.2	0.0	(100.6)	(127.5)	(117.4)	(144.3)
2006	268.0	52.6	211.2	60.7	(48.8)	(80.8)	(76.0)	(108.0)
2007	261.6	48.8	321.4	57.9	69.0	37.9	31.0	(0.0)
2008	0.0	81.2	334.2	54.7	307.6	299.5	268.7	260.6
2009	0.0	45.0	349.5	58.8	363.3	358.8	322.4	317.9
2010	0.0	45.0	371.0	56.8	382.8	378.3	340.0	335.5
2011	0.0	45.0	395.5	55.0	405.5	401.0	360.5	356.0
2012	0.0	45.0	435.0	55.0	445.1	440.6	396.1	391.6
2013	0.0	45.0	478.6	55.0	488.6	484.1	435.2	430.7
2014	0.0	45.0	526.4	55.0	536.4	531.9	478.3	473.8
2015	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2016	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2017	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2018	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2019	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2020	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2021	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2022	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2023	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2024	0.0	45.0	579.0	55.0	589.1	584.6	525.7	521.2
2025	(683.0)	45.0	579.0	55.0	1,272.0	1,335.8	1,208.6	1,272.4
Economic internal rate of return					17.7%	16.1%	16.0%	14.5%

() = negative.

Note: Upgrading facilities to meet class IB standards.

Sources: Asian Development Bank estimates.

EVALUATION OF LAND ACQUISITION AND RESETTLEMENT ACTIVITIES

A. Introduction

1. The independent evaluation mission (IEM) reviewed project-related documents and reports, including the report and recommendation of the President (RRP), which provides details of the loan;¹ project completion report (PCR);² the project resettlement plans and updated resettlement plans; Yuqiao Reservoir resettlement and alternative livelihoods development plan; and external resettlement monitoring and evaluation reports. In addition to meeting with representatives from the project management office, Tianjin Sewerage Company (TSC), Tianjin Capital Environmental Protection Company (TCEPC), and Tianjin Municipal Luanhe Drinking Water Source Protection Engineering (TML), the IEM also conducted a field visit to Yuqiao Reservoir resettlement sites. It also met with resettlement implementation agencies and an external monitoring agency, and conducted focus group discussions with some affected persons.

2. The project comprised two components: component A, wastewater treatment implemented by TSC; and component B, water resource protection implemented by TML. Component A involved construction of sewers, a pumping station, and the Beicang wastewater treatment plant. Component B included four subcomponents: (i) constructing a box culvert to carry raw water from the Yuqiao Reservoir to avoid polluting the Zhou River; (ii) lining the banks and inverting the existing open channel downstream of the box culvert, and extensive tree planting along the banks; (iii) controlling pollution from villages and fishponds in areas surrounding the Yuqiao Reservoir and providing a greenbelt around the reservoir for nonpoint pollution and erosion control; and (iv) creating a management information system.

3. During the project preparation stage, resettlement plans in accordance with the Resettlement Policy of the Asian Development Bank (ADB) for the two components were prepared. They were approved by ADB in May 2000; after they were updated based on preliminary designs, they were approved again in 2002.

4. The preliminary design for the Yuqiao Reservoir subcomponent was revised and approved by the Tianjin municipal government in September 2004. Accordingly, a Yuqiao Reservoir Resettlement and Alternative Livelihood Restoration Program (YRRALP) was required, which was approved in February 2007. The fishpond removal scope was enlarged, resulting in more affected households. In addition, resettlement implemented for the Yuqiao Reservoir in the 1960s and 1980s was complex and problematic, leaving behind a number of resettlement issues. As a result, negotiations and implementation for component B's fishpond removal resettlement was very difficult, leading for ADB in May 2006 to agree to a 1-year extension for the project.

B. Resettlement Impact Assessment

5. Construction of the project involved permanent land acquisition, temporary land use, and demolition of buildings, removal of fishponds, conversion of farmland to forest, and resettlement of affected persons. To avoid or minimize land acquisition and resettlement, consultations with

¹ Asian Development Bank (ADB). 2002. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Tianjin Wastewater Treatment and Water Resources Protection Project*. Manila (Loan 1797-PRC, for \$130 million, approved 11 December).

² ADB. 2008. *Completion Report: Tianjin Wastewater Treatment and Water Resources Protection Project in the People's Republic of China*. Manila.

local officials, village committees, and affected persons were conducted during the resettlement plan implementation stage. The total actual permanent land acquisition was 1,933 mu,³ which is 86% of that in the updated resettlement plans, and temporary land use was around 6,821 mu, only 85% of that estimated in the resettlement plans. The impact of permanent land loss was equivalent to loss of livelihood for only 18 persons.⁴ Building demolitions required 11,959 square meters (m²), 64% of that estimated in resettlement plans, with 79 households or 413 people relocated. In addition, Yuqiao Reservoir subcomponent impacts included 14,551 mu of fishpond elimination and 9,136 mu of farmland conversion to forestry, affecting 764 persons. Changes to the implementation approach,⁵ and the subsequent decision of not removing fishponds outside of the immediate area of the reservoir,⁶ reduced the number of affected persons to 8,705.

Table A9.1: Project Land Acquisition and Resettlement Impacts

Item		Unit	Component A	Component B		Total
				Box Culvert and Open Channel	Yuqiao Reservoir	
Permanent Land Acquisition	Resettlement plan	mu	411	1,829		2,240
	Actual	mu	425	1,508		1,933
	Actual vs. resettlement plan	%	103%	82		86
Temporary Land Use	Resettlement plan	mu	48	7,935		7,983
	Actual	mu	0	6,821		6,821
	Actual vs. resettlement plan	%		86		85
Building Demolition	Resettlement plan	m ²	0	18,760		18,760
	Actual	m ²	990	10,969		11,959
	Actual vs. resettlement plan	%		58		64
Fishpond Removal	Resettlement plan	mu			24,058	24,058
	Actual	mu			14,551	14,551
	Actual vs. resettlement plan	%			60	60
Conversion of Farmland to Tree-Planting Belt	Resettlement plan	mu			4,944	4,944
	Actual	mu			9,136	9,136
	Actual vs. resettlement plan	%			185	185
Affected Persons						
by land acquisition	Resettlement plan	persons	18	976		994

³ "Mu" is a unit of measurement in the People's Republic of China (PRC), equivalent to 1/15 hectare.

⁴ Since the box culvert is buried 2 meters (m) to 4 m underground, farmers were only temporarily affected during construction. They were allowed to use the reinstated land after the construction.

⁵ Through consultation and participation, TML did not convert farmland under the 22-m reduced level into forest. Instead, farmers were supplied with saplings at no cost and encouraged to plant the trees, and provided with other subsidies and income from benefit sharing.

⁶ To avoid impacts on the livelihood of farmers, 9,507 mu of fishpond removal was not implemented.

Item	Unit	Component A	Component B		Total
			Box Culvert and Open Channel	Yuqiao Reservoir	
	Actual	Persons	18		18
	Actual vs. resettlement plan	%	100%	-	-
by house demolition	Resettlement plan	persons	0	342	342
	Actual	persons	0	413	413
	Actual vs. resettlement plan	%	-	121	121
by fishpond removal	Resettlement plan	persons		1,659	1,659
	Actual	persons		764	764
	Actual vs. resettlement plan	%		46	46
by conversion of farmland to greenbelt	Resettlement plan	persons		7,810	7,810
	Actual	persons		-	-
	Actual vs. resettlement plan	%		-	-

Note: "Mu" is a unit of measurement in the People's Republic of China, equivalent to 1/15 hectare.

Sources: Monitoring and Evaluation Report for the Yuqiao Reservoir Resettlement and Alternative Livelihood Restoration Plan, and ADB Project Completion Report for Tianjin Wastewater Treatment and Water Resources Protection Project.

6. It was observed that the implementing agencies made every effort to identify the land acquisition and resettlement scope to comply with the Resettlement Policy, although there were no such requirements in the People's Republic of China (PRC). All related land for the Yuqiao Reservoir subcomponent was permanently acquired by Tianjin government in 1959, 1973, and 1979. The income impacts and restoration measures for affected farmers were analyzed, and a detailed YRRALP was then prepared. Subsequently, during project implementation and upon realizing the difficulties and risks associated with income restoration for the large number of affected persons, 9,507 mu of fishponds located outside of the dikes were not removed. This was achieved through improving and regulating the overall reservoir management plan—considered a good practice.

7. Another lesson learned was that instead of forcing farmland to be converted into forest, farmers were encouraged to plant trees at the reservoir bank to improve the water quality and environment of the Yuqiao Reservoir. Thus, much of the negative social impact of converting farmland into forest was avoided.

C. Resettlement Policy, Compensation Rates, and Costs

8. For unavoidable affected persons, the project resettlement objective was to achieve equal, or better, income and living standards in line with not only laws and regulations of PRC, but also ADB resettlement policies. The requirements of ADB in resettlement policies, such as resettlement plan preparation, resettlement impact definitions, and resettlement monitoring and evaluation (M&E) mechanisms were fully satisfied.

9. The total actual cost of land acquisition and income restoration was CNY144.94 million. This was 94% of the CNY154.07 million estimated in the updated resettlement plan and Yuqiao YRRALP. The land acquisition and income restoration costs were included as part of total project costs and were funded by the Tianjin municipal government.

10. The M&E reports indicated that compensation was adequately given and that the affected persons were generally satisfied with the project resettlement policy. From the focus group discussions with some affected persons from Baizhuanzi and Dongmafang villages conducted during the IEM, the respondents expressed their satisfaction with compensation and payment, and their expectation of more income opportunities. The focus group discussions also validated the findings reported in previous M&E reports.

D. Resettlement Measures for Income Restoration

11. Measures taken to assist the affected households in their income restoration and livelihood improvement included (i) readjusting remaining farmland within a group or village; (ii) since the box culvert is buried 2–4 m underground, permitting affected persons to have the land-use right after the land was reinstated after construction, although they had already received the permanent land acquisition compensation; (iii) providing 845,000 person-days of employment opportunities during project construction and operation; (iv) developing crops with higher economic values; (v) promoting and developing new enterprises and self-employed, secondary and tertiary businesses such as garment making, transport, small-scale shops, entertainment, and catering; and (vi) conducting free technical training for affected persons to enhance their skills in migrant laboring.

12. In addition, the persons affected by the Yuqiao Reservoir resettlement exercise have been included in the national post-resettlement support program since 2006.⁷ The local government has also integrated income-restoration activities into the new countryside construction program, public infrastructure, and community facilities (i.e., irrigation systems, inner roads, and well construction) to support the affected villages. The IEM was also informed of the Jixian County Resettlement Bureau's proposed program, including ecological fishery and farming and tree and reed plantation, to provide further income opportunities for the villagers.

13. Relocation for 76 households was completed before 2006. In addition to cash compensation and free residential plots in the same village, the affected households also received relocation subsidies and transition allowances. The focus group discussions revealed that new houses were built, and the quality of the buildings was better than the original ones.

14. Women have especially enjoyed the project benefits and income-restoration program, and were provided with equal employment and training opportunities in the project. The focus group discussions revealed that women strongly supported the project and have benefited from improved living environments, new employment opportunities, and reduced incidence of water-borne diseases.

15. Due to a lack of reporting, which has been substantiated by Tianjin Statistical Information Service Center (TSISC) survey and analysis, it is difficult to evaluate affected household income restoration. TML requested that TSISC conduct an income-restoration

⁷ Government of the People's Republic of China, State Council. 2006. Post Resettlement Support Policy for Large and Medium-Sized Water Conservancy and Hydropower Projects. Decree No. 17. Beijing.

sampling survey and evaluation, and prepare and submit a report to ADB by the end of August 2010. The report was submitted as requested on 31 August 2010.

E. Institutional Arrangements and Assessment

16. TSC and TML were responsible for land acquisition and resettlement coordination and management. The related county government established its resettlement office to implement land acquisition, house demolition, fishpond removal, and farmland conversion at the Yuqiao Reservoir. An international consultant and a national resettlement specialist from the implementation consulting team were responsible for resettlement policy training and resettlement implementation guidance. However, experienced consultants who understood not only PRC land and resettlement policies but also ADB resettlement policies would have been more helpful in preparing and implementing the project resettlement policy.

F. Monitoring and Evaluation

17. TSISC conducted the component resettlement M&E. Four resettlement monitoring reports were prepared for component A, and nine for component B. However, due to a lack of ADB project resettlement experience, the independent monitoring system and reports were unsatisfactory. The income-restoration sampling survey for affected households was not properly conducted and integrated into the monitoring reports. To rectify this deficiency and as reported above, TML has committed to conducting a survey on the affected households and assessing the data for inclusion in a report by the end of August 2010. The report was submitted to ADB on 31 August 2010, in compliance with this measure.

G. Participation and Information Disclosure

18. In general, the project performed well in resettlement participation and information disclosure. During the project preparation and resettlement implementation stage, the local government and resettlement implementation agencies adopted a participatory approach to disclose resettlement policies, negotiate with affected persons, and mobilize their participation in major resettlement activities. In addition, complaint channels were established and disclosed to the affected persons.

HIGHLIGHTS OF THE FOCUS GROUP DISCUSSION WITH AFFECTED PEOPLE

Time	8 July 2010
Location	Baizhuangzi Village
Organizer	Project Management Office
Participants	Sun Lianqi (household affected by returning farmland to forestry), Liu Chengfu (breeder), and Wang Jingbo (women's representative)
Topics	Village basic information, impacts of land acquisition and house demolition, livelihood and production restoration measures, public participation, and information disclosure
Contents and outcomes	<p>(i) There are 11 village teams in the village, with 506 people in 170 households. The village has 102 mu of land, all nonirrigated land, and fishponds measuring 327 mu. About 121.7 mu of farmland will be returned to forestry. The village's population is relatively large for farmland. Household incomes come mainly from villagers' outside employment or individual businesses, and per capita net income is CNY4,200 per year.</p> <p>(ii) The project involved no land acquisition—only fishpond removal and returning farmland to forestry. Of the 327 mu of fishponds, about 90% are used for fish culture and 10% are left unused. Fishpond removal has affected four households, whose average annual income is about CNY4,500. Few fish culturists have even suffered losses. The compensation rate for fishponds was CNY3,000 per mu. Compensation fees were disbursed by the water resources bureau (formerly the water company) to the reservoir management office, then to the town government. They were then paid to the affected villagers according to the agreement with the reservoir management office.</p> <p>(iii) The 121.7 mu of farmland returned to forestry was nonarable, because it is located below the water level line of 22 meters and will be inundated during impoundment. Therefore, this land is reservoir flat land, which was acquired and compensated for by the water resources bureau as early as the 1980s. This time, the water resources bureau has asked the villagers to plant trees on the flat, so they have planted poplars and willows as required. The water resources bureau has granted a subsidy of CNY600 per mu to them, provided saplings for free, and signed a conservation contract. When the trees grow into useful timber, the villagers can fell as required by the country forestry bureau, and the sales revenue of timber will be allocated between the water resources bureau and the villagers at a ratio of 2:8. By now, planting fees (CNY600 per mu) have been paid to them in full.</p> <p>(iv) Three relocations have occurred for the construction of the Yuqiao Reservoir, and the village was relocated during the second phase. The project involves no land acquisition and house demolition—only fishpond removal and surrounding landscaping. Social security is available; the Ji county government grants a subsidy of CNY600 per capita per year for every villager for 20 consecutive years. The county reservoir management office has set up a labor service center to train the resettled, registered laborers aged 18–35 years of the reservoir area and to provide employment information and guidance. It also recommended them to work at factories in the urban area and the Binhai New Area. A garment factory has also been set up in the town for women to work. The county agricultural radio station and the town agro-technical station provides productive development and training to villagers in the reservoir area every year, such as training on the planting of cuke and grapes, chicken breeding, and ecological fish culture.</p> <p>(v) The villagers all knew about the project, as well as the compensation and resettlement policies, through village meetings, brochures, and door-to-door explanations. The Ji county television station has also shown relevant programs.</p>

	(vi) In fact, the villagers acknowledged the close connection between the Yuqiao Reservoir and Tianjin citizens, and "support the government from the bottom of our hearts." Government policies are quite public in this regard, and they have no complaints. They only hope that the government remembers rural people while thinking about urban residents in the future, so that rural people will not always suffer losses. The villagers wonder if it would be possible to invest more in the surrounding area of the reservoir to set up some environment friendly plants for them to work, or if it can do something for them in terms of social security and endowment insurance like it does for the urban population.
Time	8 July 2010
Location	Dongmafang Village
Organizer	Project Management Office
Participants	Hua Liankui (breeder), Xu Shuangxi (breeder), and Liu Haiyan (household affected by returning farmland to forestry, women's representative)
Topics	Village basic information, impacts of land acquisition and house demolition, livelihood and production restoration measures, public participation, and information disclosure
Contents and outcomes	<p>(i) There are 28 village teams in the village, with 1,350 people in 412 households. The village has 234 mu of land (including 84 mu of nonirrigated land and 150 mu of orchards), and 538 mu of fishponds (80% used for fish culture and 20% left unused). About 110 mu of farmland will be returned to forestry. The village's population is relatively large for farmland. Household incomes come mainly from villagers' employment in the town or elsewhere, and per capita net income is CNY4,000 per year.</p> <p>(ii) Fishpond removal and returning farmland to forestry began in the village in March 2007 under the project, involving 538 mu of fishponds and 110 mu of land, affecting over 200 people in 50 households. The project affected the income of fish culturists by CNY4,000–CNY6,000 per capita per year. The compensation rate for fishponds is CNY3,000 per mu. Compensation fees are disbursed by the Ji county reservoir management office to the town government, and then paid to the affected people. The farmland returned to forestry is reservoir flat that is almost nonarable. As required by the water resources bureau, the villagers have planted poplars and willows, and the water resources bureau subsidizes CNY600 per mu and has entered into a conservation contract with them. When trees grow into useful timber, they can be felled at the interval required by the state, and the sales revenue of timber will be allocated between the water resources bureau and the villagers at a ratio of 2:8. By now, planting fees (CNY600 mu) have been paid to them in full.</p> <p>(iii) The village was relocated for the construction of the Yuqiao Reservoir in the 1960s. The current project involves no land acquisition but only fishpond removal and surrounding landscaping. However, the government is granting some safeguards to the village, such as a subsidy of CNY600 per capita per year for every villager for 20 consecutive years.</p> <p>(iv) The county reservoir management office has set up a labor service center to train the resettled labor of the reservoir area and registered villagers aged 18–35 years for employment. It recommended them to work at factories in the urban area and the Binhai New Area. The county agricultural radio station and the town agro-technical station gives planting and breeding training (e.g., mushrooms, grapes, fruit trees, and cuke planting, and chicken and fish culture) to villagers in the reservoir area, including women, two to three times a year. A garment factory has been set up in the town for women to work, who are paid about CNY1,500 per month. The water resources bureau is rumored to be investing in the management of the</p>

	<p>Yuqiao Reservoir, putting fish net in the reservoir for bait-less culture, and issuing a fishing permit to fish culturists whose fishponds have been removed first to increase their income.</p> <p>(v) The villagers knew of the project's general situation, and also of the compensation and resettlement policies, through village meetings, door-to-door publicity by village officials, and broadcasts. The Ji county television station has also shown relevant programs.</p> <p>(vi) The villagers understand and support the government's effort to solve the drinking water problem as long as a clear explanation is given to them. The villagers support the project and are satisfied with the compensation policies and their implementation. In future projects, they expect the government to disclose the policies clearly as occurred this time. They also hope that the government remembers the rural people when thinking about urban residents, because rural people have greater difficulties than urban residents. For example, they wonder if it can do something in terms of social security and endowment insurance.</p>
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Note: Mu is a unit of measurement in China, equivalent to 1/15 hectore.

Source: Independent evaluation mission.

ENVIRONMENTAL IMPACT ANALYSIS

1. **Component A.** The wastewater treatment component was implemented by the Tianjin Sewerage Company (TSC). It involved construction of 14.8 kilometers (km) of sewers, a 1 cubic meter (m³) per second pumping station, and the Beicang wastewater treatment plant with a capacity of 100,000 m³ per day and 1.1 km of treated effluent outfall. After commissioning in March 2006, TSC in December 2008 officially approved to transfer these assets to the Tianjin Capital Environmental Protection Company (TCEPC), which has since been responsible for the operations and maintenance of the sewerage facilities.

2. **Component B.** The water resources protection component was implemented by Tianjin Municipal Luanhe Drinking Water Source Protection Engineering (TML). It included four subcomponents: (i) construction of a 34.2-km three-barrel concrete box culvert to carry raw water from the Yuqiao Reservoir to avoid pollution of the water from the Zhou River; (ii) lining the banks and invert of the existing 64.2 km-long open channel, downstream of the box culvert, as well as extensive tree planting along the banks; (iii) control of pollution from villages and fishponds in areas surrounding the Yuqiao Reservoir, and provision of a greenbelt around the reservoir for nonpoint pollution and erosion control; and (iv) a management information system comprising a cable transmitting system from the Yuqiao Reservoir to Tianjin, network platform hydrological data and water quality monitoring, and remote controls for pumping stations and gates.

3. The project was classified as environmental category A. In February 2000, a summary environmental impact assessment (EIA) was submitted to the Asian Development Bank (ADB), which was based on full EIA reports for the two components approved by the State Environmental Protection Administration in January 2000. The summary EIA concluded that the project would have substantial positive environmental benefits for the environment and drinking-water quality in Tianjin and the adverse impacts, mostly during construction, on the physical and natural environment would be insignificant and could be mitigated through appropriate measures.

A. Environmental Protection and Management during Construction

4. TSC and TML were responsible for the components' overall coordination of environmental management and supervision. Environmental monitoring during construction occurred at two levels: (i) onsite daily environmental monitoring by contractors and construction supervision companies, and (ii) periodic environmental monitoring by specialists who took samples for analysis in accordance with monitoring procedures and guidelines. Adverse environmental impacts during construction were mitigated through appropriate measures as proposed in the EIA. The total investment for environmental protection during construction was about CNY3.5 million for component A and CNY152.9 million for component B.

B. Environmental Impacts during Operation

5. **Component A.** An environmental monitoring plan for the operation phase was created mainly covering the Beicang wastewater treatment plant's treated odor emission, effluent discharge, and sludge disposal.

- (i) **Odor emission.** Odor emission from the wastewater treatment plant is minimized or remedied through greenbelt plantation, rational facility arrangements, and covering facilities.

- (ii) **Effluent discharge.** The treatment efficiency of the wastewater treatment plant has been compromised due to the delay of World Bank-funded sewerage construction, resulting in lower total flow and a higher proportion of industrial wastewater. The treated effluent, therefore, does not always comply with class II discharge standards before it is disposed of into Yongdingxin River. It is expected that 100% flow will be achieved by mid-2011 when the World Bank sewers are completed. By then, the domestic proportion in the sewage flow should increase, and the wastewater treatment plant should be better able to meet the class II standards. Further, after commissioning, some influent and treated effluent water quality data, as abstracted from the 2006 annual environmental report, are tabulated in Table A11.1, which shows that the strength of the influent was much higher than the plant's design capacity in terms of the key parameters, such as biochemical oxygen demand, chemical oxygen demand, and ammonia nitrogen concentrations. The plant, however, has been performing well, and its effluent generally meets the class II discharge standards except for ammonia nitrogen.
- (iii) **Sludge disposal.** Sludge is digested and then dewatered to 20% dry solids before being trucked to a temporary landfill 50 km away from the wastewater treatment plant for co-disposal with municipal solid waste.

6. **Component B.** The Yuqiao Reservoir Management Office regularly monitors water quality in the reservoir, box culvert, and open channel during operation. Table A11.2 contains some water quality data at the reservoir abstracted from the 2006 annual environmental report, showing that other than total nitrogen, all other water quality parameters in Yuqiao Reservoir have been better than class III, suitable for water supply.

7. The following protective measures implemented under component B are improving the water quality of Yuqiao Reservoir and controlling soil erosion and sedimentation along the open channel.

- (i) **Improvements to toilet facilities.** In 68 villages, a total of 27,442 household toilets were renovated. Each household is equipped with a simple septic tank and soak-away to reduce nonpoint pollution.
- (ii) **Wastewater treatment for hospital.** One membrane-based plant has been installed to treat wastewater generated from a hospital to a high standard suitable for reuse. There are eight more hospitals that also need this service within the Yuqiao Reservoir catchment.
- (iii) **Rural waste management.** One pilot composting plant has been built for animal, agricultural, and domestic wastes. However, local practices and an insufficient operating budget have resulted in low performance of the composting plant. More efforts should be made to devise a practicable approach to solid waste treatment for the villages within the Yuqiao Reservoir catchment.
- (iv) **Elimination of fishponds.** Approximately 970 hectares of fishponds were removed, which were located below the 22-meter elevation within a protective dike near the main inlet of Yuqiao Reservoir.
- (v) **Soil and water conservation.** Greenbelts have been planted around Yuqiao Reservoir and along the open channel. Engineering structures, including check dams, terraces, and protective forests, have also been constructed to control erosion on slopes and in gullies.

C. Sustainability

8. **Component A.** The discharge standard has become more stringent in Tianjin; a class IB effluent is now required. TCEPC is presently upgrading the wastewater treatment plant processes so it can meet the more stringent discharge standard, targeted to be completed by the end of 2010.

9. The Tianjin municipal government is studying sustainable sludge disposal and reuse options, but no firm solutions have yet been decided.

10. **Component B.** TML will be taking on an implementing role in the Yuqiao Reservoir Water Pollution Protection Project initiated by the Tianjin municipal government. The nature of this new project is similar to the ADB-funded project. TML intends to apply the technical and management skills learned from the project for environmental improvements to villages, ecological improvement of the Yuqiao Reservoir, rehabilitation of river tributaries, and water quality monitoring, among others in the proposed CNY300 million project. It is believed that the experience gained in implementing component B of the project will contribute to the success of this subsequent project, which will contribute to safeguarding the water quality in the Yuqiao Reservoir.

11. The Tianjin municipal government has been paying an annual CNY20 million incentive subsidy to Hebei Province to promote environmental control. It has also taken initiative to coordinate with Hebei Province to understand what actually has been done in regard to upstream catchment control and protecting the quality of water transferred into the Yuqiao Reservoir. As of 2009, more than 20 wastewater treatment plants, totaling some 370,000 m³ per day capacity, have been put into operation in Hebei Province upstream of the Yuqiao Reservoir. These wastewater treatment plants, although presently only of class II discharge standards, are an important step in protecting Yuqiao water quality. When these Hebei Province wastewater treatment plants are upgraded to class IB plants, further improvement of the Yuqiao water quality can be expected.

D. Conclusions

12. The project has improved the living environment of residents in project areas and contributes significantly to the water pollution control program of the Hai River Basin.

13. Component A is an important link in overall sewerage management for Tianjin's urban areas. From its commissioning in 2006 to the end of 2009, the Beicang Wastewater Treatment Plant has treated 60.71 million m³ of wastewater and removed 45,830 tons of chemical oxygen demand; 21,530 tons of biochemical oxygen demand; 16,950 tons of total suspended solids; 1,280 tons of ammonia; and 310 tons of phosphorus, contributing to pollution reduction in the lower reaches of the Yongdingxin River.

14. Component B safeguards the drinking water quality for Tianjin. Other than total nitrogen, all other water quality parameters of the Yuqiao Reservoir water have been better than class III, suitable for water supply. The Yuqiao system is able to transfer water to Tianjin 12 months per year; however, its regular operation does not require 12 months of release. While a capacity of 1 billion m³ per year of raw water can be supplied from the reservoir, the required annual supply to Tianjin has been 400 million–650 million m³ per year since 2005.

Table A11.1: Beicang Wastewater Treatment Plant Influent and Effluent Quality (2006)

Parameter (mg/l)	Design Influent Quality	Class II Standard	September		October		November		December	
			Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Biochemical Oxygen Demand	200.00	30.00	332.00	29.00	357.00	20.00	361.00	20.00	433.00	25.00
Chemical Oxygen Demand	450.00	120.00	654.00	87.00	730.00	62.00	675.00	59.00	826.00	83.00
Suspended Solids	200.00	30.00	149.00	15.00	126.00	12.00	151.00	13.00	284.00	15.00
Ammonia Nitrogen	30.00	25.00	78.45	37.41	89.53	48.66	87.22	53.99	97.60	63.60
Total Phosphorus	5.00	3.00	5.69	0.68	3.48	0.63	3.93	0.62	4.21	0.63

l = liter, mg = milligram.

Source: Tianjin Capital Environment Protection Co., Ltd.

Table A11.2: Water Quality at the Yuqiao Reservoir in 2006

Parameter (mg/l, unless otherwise stated)	Class III Standard	January	February	March	April	May	June	July	August	September	October
pH (value)	6.00–9.00	8.00	7.90	8.10	8.40	9.00	9.30	8.70	8.60	8.40	8.30
Chloride	250.00	26.20	12.10	15.60	25.30	27.60	23.20	23.80	24.60	22.70	25.20
Ammonia Nitrogen	1.00	0.13	0.05	0.14	0.13	0.12	0.14	0.15	0.15	0.25	0.33
Total Nitrogen	1.00	1.67	0.60	1.30	1.76	2.90	2.38	1.72	1.09	1.03	1.25
Dissolved Oxygen	> 5.00	15.30	7.30	9.80	11.60	14.90	11.30	9.50	9.30	7.60	8.10
Permanganate	6.00	3.60	1.80	2.70	4.20	2.90	4.20	4.80	4.20	6.30	5.60
Biochemical Oxygen Demand	4.00	2.80	1.10	1.00	1.60	1.20	2.00	1.70	1.50	2.60	2.00
Total Phosphorous	0.05	0.02	0.02	0.02	0.03	0.03	0.05	0.03	0.04	0.05	0.04
Coliform (count/l)	10,000.00	130.00	20.00	40.00	130.00	70.00	20.00	140.00	50.00	80.00	490.00

l = liter, mg = milligram.

Source: Tianjin Municipal Luanhe Drinking Water Resources Protection Engineering Ltd.