



Performance Evaluation Report

Reference Number: PPE: PRC 2010-79
Project Number: 33177
Loan Number: 1995
December 2010

People's Republic of China: Harbin Water Supply Project

Independent Evaluation Department

Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – yuan (CNY)

		At Appraisal (January 2003)	At Completion (December 2008)	At Independent Evaluation (August 2010)
CNY1.00	=	\$0.12	\$0.15	\$0.15
\$1.00	=	CNY8.28	CNY6.85	CNY6.77

ABBREVIATIONS

AAOV	–	annual agricultural output value
ADB	–	Asian Development Bank
CPS	–	country partnership strategy
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
HDC	–	Harbin Drainage Company
HMG	–	Harbin municipal government
HWSD	–	Harbin Water Supply Department
HWSEC	–	Harbin Water Supply Engineering Company
HWWTC	–	Harbin Wastewater Treatment Company
NGWT	–	National Guidelines on Water Tariffs
PCR	–	project completion report
PMO	–	project management office
PPTA	–	project preparatory technical assistance
PRC	–	People's Republic of China
RAP	–	resettlement action plan
RMO	–	resettlement management office
RWP	–	raw water pipeline
TA	–	technical assistance
UFW	–	unaccounted-for water
WACC	–	weighted average cost of capital
WRF	–	water resource fee
WSF	–	water supply fee
WTP	–	water treatment plant
WWTF	–	wastewater treatment fee

WEIGHTS AND MEASURES

km	=	kilometer
m ³	=	cubic meter
mm	=	millimeter

NOTE

In this report, "\$" refers to US dollars.

Key Words

adb, asian development bank, china, prc, harbin, technical assistance, water treatment, raw water, distribution network, surface water quality, drinking water quality, songhua river clean-up

Director	H. Hettige, Independent Evaluation Division 2 (IED2), Independent Evaluation Department
Team leader	K. Thukral, Senior Evaluation Specialist, IED2
Team members	R. Lumain, Senior Evaluation Officer, IED2 R. Perez, Senior Operations Evaluation Assistant, IED2
Independent Evaluation Department, PE-739	

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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. Zhizhong Si and Jia Liang Yu were the consultants. 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 1995-PRC: Harbin Water Supply Project

PROJECT PREPARATORY AND LINKED TECHNICAL ASSISTANCE

TA No.	TA Name	Type	Person-Months	Amount (\$'000)	Approval Date
3571	Harbin Water Supply Project (Financed by JSF)	PPTA		720	12 Dec 2000
4061	Songhua River Water Quality and Pollution Control Management	PATA		1,000	19 Dec 2002
4061	Songhua River Water Quality and Pollution Control Management (Supplementary)	PATA		5	15 Sep 2006

KEY PROJECT DATA (\$ million)	As Per ADB Loan Documents	
	Actual	
Total Project Cost	399.5	461.7
Foreign Exchange Cost	100.0	98.6
Local Currency Cost	299.5	363.1
ADB Loan Amount/Utilization	100.0	98.6
ADB Loan Amount/Cancellation		1.4

KEY DATES	Expected	Actual
	Fact-Finding	
Appraisal		18 September–2 October 2002
Loan Negotiations		10–13 December 2002
Board Approval		11 March 2003
Loan Agreement		28 August 2003
Loan Effectiveness	28 November 2003	7 January 2004
First Disbursement		24 March 2004
Project Completion	December 2007	December 2006
Loan Closing	30 June 2008	24 March 2009
Months (effectiveness to completion)	49	36
Months (effectiveness to closing)	55	63

INTERNAL RATES OF RETURN (%)	Appraisal	PCR
Financial Internal Rate of Return	6.0	7.6
Economic Internal Rate of Return	12.6	14.5

BORROWER People's Republic of China
EXECUTING AGENCY Harbin Municipal Government

MISSION DATA	No. of Missions	No. of Person-Days
Type of Mission		
Fact-Finding	1	45
Appraisal	1	30
Project Administration	6	80
Inception	1	20
Review	4	36
Midterm Review	1	24
Project Completion	1	24
Independent Evaluation	1	34

ADB = Asian Development Bank, JSF = Japan Special Fund, PATA = policy and advisory technical assistance, PCR = project completion report, PPTA = project preparatory technical assistance, TA = technical assistance.

EXECUTIVE SUMMARY

Background

The Harbin Water Supply Project supported by the Asian Development Bank (ADB) was purposefully selected for evaluation by the Independent Evaluation Department more than 4 years after commissioning, which enabled an evaluation of the project outcomes. The project evaluation was expected to provide inputs into broader evaluation reports.

The project was envisaged to supply clean water to urban Harbin from a reservoir on the Lalin River as a viable alternative to the traditional but polluted water source, the Songhua River. The project was expected to begin operating several years before the Songhua River could be cleaned up. It was to be implemented in two phases, each to deliver 450,000 cubic meters (m³) per day, and both phases were to be operational by 2010. ADB supported phase I consisting of (i) a storage dam at Mopanshan mountain in the southeastern parts of Harbin City, (ii) a water treatment plant (WTP) in the southern part of the Harbin urban areas, (iii) a raw water pipeline (RWP) connecting the two, and (iv) expansion and refurbishment of the distribution network in urban Harbin. The project also included capacity-building measures for the Harbin Water Supply Engineering Company (HWSEC), the implementing agency, and the relocation of people affected by the project. A wholesale water purchase agreement was negotiated between HWSEC and the distribution network operator.

The institutional set-up of Harbin's water sector has changed since project appraisal in 2002. HWSEC, then an independent state-owned enterprise, is now a wholly owned subsidiary of the Harbin Water Supply and Drainage Group Company (the group company), a large and financially strong state-owned enterprise. The distribution network operator is now an operating department of the group company.

The actual project cost of \$461.7 million was higher than the appraisal estimate of \$399.5 million, owing to changes in the project's technical design, rising global steel prices, and an appreciating yuan. ADB approved a loan of \$100 million to cover the entire foreign exchange costs; actual foreign exchange costs and ADB loan utilization were marginally lower, at \$98.6 million. The 16% rise in overall capital costs was met entirely by increased counterpart funding. Domestic bank loans of more than \$290 million accounted for over 60% of the actual capital costs. The balance was provided by the governments of the People's Republic of China (PRC), Heilongjiang province, and Harbin municipality, and the group company.

Performance Assessment

Relevance. The project is rated *relevant*. The project design is consistent with the PRC's programs to reduce water shortages, and prevent and control water pollution in the 10th and 11th five-year planning periods (2001–2005 and 2006–2010). The project is also consistent with the national Water Law (2002), as it reinforces the PRC's objectives of rationally developing, using, conserving, and protecting water resources. There was strong ownership from the provincial and municipal governments.

At appraisal, ADB's operational strategy in the water sector focused on (i) improving the efficiency of water supply and distribution systems through investment in physical infrastructure; (ii) promoting corporate governance and commercial management to enhance the potential for private sector involvement; (iii) improving cost recovery by strengthening tariff systems and structures for raw water and treated water; and (iv) ensuring water resource conservation and

environmental protection through continuing support of legislative and regulatory provisions governing water pollution and natural resource management. By investing in physical infrastructure, the project was consistent with aims (i) and (iv), but the component relating to institutional strengthening did not give enough attention to corporate governance and related aspects to make the project more relevant to all its objectives. ADB's operational strategy at loan closing in 2009 is essentially unchanged, and so is the consistency of project design and achievements with ADB's strategic objectives.

Effectiveness. The project is rated *effective* in achieving the objectives, outputs, and outcomes. It has achieved the major objectives of improving water quality and reliability of supply. The project began alleviating the severe shortage of good-quality water by the end of 2006, i.e., 1 year earlier than envisaged at appraisal. The WTP's output increased from about 100,000 m³ per day in December 2006 to over 400,000 m³ per day in 2008 and 2009. The Mopanshan reservoir's water quality is within the acceptable range for municipal water supply (classes I and II), and several measures are in place to ensure the water quality does not deteriorate. While customers who receive water under the project are generally satisfied, it is noted that not all are aware of the reliability benefits of the project. Since phase I was commissioned, (i) the Mopanshan reservoir has met the requirements of environmental flows throughout the year, (ii) the RWP has operated without leaks or accidents, and (iii) there have been no chlorine leaks from the WTP. Although no incident has occurred so far, HWSEC has institutionalized standard operating procedures that apply in the event of an accident. It is clear that HWSEC staff have adequate skills to operate and maintain all physical components of the project.

The group company's management recognizes the need to make the entire water supply business (HWSEC and the distribution network department) commercially viable by addressing the inefficiencies of the distribution network operations. With a view to obtaining government support (in the event tariffs cannot be raised), the management also recognizes the need to improve transparency. Such issues are discussed further in the context of sustainability.

Efficiency. The project is rated *efficient*. The reevaluated economic internal rate of return is estimated at 12.5%, which shows that the project is economically viable. The project was commissioned about 1 year ahead of schedule and brought significant benefits to its customers. Although it was implemented in two phases, it was planned and designed as a single project to feed 900,000 m³ per day of clean and high-quality water into the distribution network in Harbin urban areas. The location and capacity of the water reservoir, pipeline route and diameter, water treatment technology, and distribution system expansion and refurbishment were designed to maximize the reliability of supply of high-quality water.

The last major expansion of water supply to urban Harbin had taken place in 1993, when a capacity of 250,000 m³ per day of treated Songhua River water was added. Significant water shortages were projected for 2007. The project was thus expected to have high capacity utilization right from the start. Phase I exceeded the 90% capacity utilization by 2008 (the second full year of operation), and the combined capacity utilization of phases I and II is estimated at about 80% in 2010 (the first full year of operation for both phases).

Sustainability. The project is rated *less likely* sustainable. Static water tariffs since late 2001 suppressed the financial attractiveness of the project. The group company suffers financial losses from its water supply business that not even a government subsidy has offset. HWSEC is nonetheless in a position to raise finances from the PRC commercial banks to meet working capital and planned capital investment requirements because (i) it is backed by the financially

strong group company whose overall profits exceed losses from the water supply business, and (ii) the revenue receipts of the project exceed the annual cash expenses for operation and maintenance.

However, after an average tariff increase of over 30% from January 2010, and an assumption that the weighted average tariffs across all customer categories will increase by 10% every 3 years, the financial internal rate of return is estimated at 7%, which exceeds the weighted average cost of capital of 3.4% and makes the project financially attractive. The assumption on future tariff increases is based on (i) water tariff increases once every 3–5 years in many cities; and (ii) the 2009 directive from the national government that local governments should avoid steep water tariff increases and strictly follow procedures on water tariff adjustments. Nonetheless, as per guidelines from the national government, the final decision on any tariff increase rests with the provincial government, so future tariff increases are beyond the reasonable control of the group company. Group company management appreciates that rising levels of unaccounted-for water (UFW) make it increasingly difficult to keep the water supply business financially sustainable, but it prefers to focus first on expanding the coverage of the centralized distribution network to all Harbin urban areas by 2013, and increase its revenue base. The group company management will turn its attention to UFW reduction after 2013 when it will be in a position to take a comprehensive view and establish system-wide priorities for water loss reduction at the feeder level.

The Harbin municipal government (HMG) adopted a comprehensive approach to protecting the Mopanshan reservoir and its watershed, and to reducing the risk of water contamination. Since project phase I began supplying clean water to Harbin urban areas, groundwater extraction has declined significantly, and the depleting underground water aquifers have begun to fill up. During project implementation, technical staff received training to efficiently operate and maintain the sophisticated and project-critical equipment (e.g., for quality monitoring, automation, water-flow, and pressure regulation). The project also institutionalized annual planning and scheduling of training for equipment operators and other technical staff.

The overall performance of the project is rated *successful* on the basis of the above four evaluation criteria.

ADB, borrower, and executing agency performance. ADB's policy dialogue under the project successfully supported the HMG in implementing measures to (i) improve the quality of the Songhua River and its tributaries, (ii) prevent and control pollution upstream of the Mopanshan reservoir, and (iii) monitor the progress of environmental management programs. The policy dialogue has also been successful in encouraging private sector participation in wastewater treatment. ADB's performance is rated *satisfactory*. The national, provincial, and municipal governments ensured timely availability of counterpart funds. HMG demonstrated strong leadership and made prompt decisions during implementation to facilitate the project works. HWSEC's project management office had begun to function long before the project management consultants came on board, and coordinated activities between ADB, HMG, contractors, and consultants. However, there was not enough policy dialogue on the matter of water supply tariffs to ensure that the water utility can meet all its operating costs and earn a reasonable profit. Nonetheless, it is recognized that water is a "public good" and a "merit good", and therefore, water tariffs need not always reflect only the cost recovery and profit making objectives of the water utility. Besides, it is recognized that water tariff adjustments are ultimately decided by the provincial government on the advice of the HMG (the executing agency) and are not within the reasonable control of the implementing agency (HWSEC).

Therefore, the overall performance of the borrower (the Government of the PRC) and the executing agency (HMG) is rated *satisfactory*.

Other Assessments

Impact. The project's institutional, environmental, and socioeconomic impacts are *modest*, and no significant negative impacts have been observed.

Institutional Impact. HWSEC, which is now a wholly owned subsidiary of the group company, has sufficient managerial autonomy to manage day-to-day operations. For more strategic aspects that require access to investment capital, it relies on the financial strength of the group company and needs to seek approval from the group company's board of directors. HWSEC's focus thus far appears to have been on improving its technical and engineering skills. A corresponding improvement in management systems, so as to strengthen operational and financial performance (e.g., through monitoring performance against benchmarks), would also be useful. The HMG made a major effort to oversee and monitor the progress in improving and sustaining water supply quality across Harbin City. Since its inception, and in coordination with the municipal Water Resources Bureau, the Water Resources Protection Division of the Harbin Environmental Protection Bureau is overseeing the clean-up of the Songhua River and its tributaries, and management of the Mopanshan reservoir's watershed.

Environmental impact. Since project phase I came on stream, water monitoring data shows that the quality of both the Mopanshan raw water and the treated water have consistently met national water quality standards. The Mopanshan reservoir has made it possible to maintain year-round environmental flows, whereas before, water flows in winter months used to fall below the required environmental flow of 5 m³ per second.

Resettlement impact. Physical resettlement and compensation was completed in line with the resettlement action plan and in conformance with various national, provincial, municipal, and local regulations. It involved resettlement of over 7,000 affected people (about 2,100 households), permanent land acquisition of about 42,500 mu (1 mu = 666.67 square meters), temporary land acquisition of about 10,600 mu, and a total cost of more than CNY560 million. HWSEC's resettlement management office continues to redress grievances of the resettled households.

Socioeconomic impact. Once urban Harbin households began to be supplied Mopanshan water treated under the project, they became aware of benefits that eluded the households that still received the polluted Songhua River water, while retail tariffs for water from both sources remained the same. Urban Harbin households were not harshly affected by the tariff increase in January 2010, as the incremental water bill was a miniscule fraction of their total monthly expenses.

Issues, Lessons, and Follow-Up Actions

The project has three main issues:

- (i) Water tariffs remained unchanged from December 2001 to December 2009—the tariff change that came into effect on 1 January 2010 was the only increase in 8 years even though HWSEC's operation and maintenance costs increased.
- (ii) UFW rose each year since 2002, owing not only to more construction activity on the distribution network, but also to the inability to properly maintain the network.

- (iii) Changes in the water sector's institutional set-up made the wholesale water tariff agreement redundant and the financial viability of the sector less transparent.

The main lessons from the project are:

- (i) If tariffs are regulated, the long-term viability of the water utility will be affected.
- (ii) If UFW is allowed to rise unchecked, it becomes difficult to improve and sustain the financial viability of the water utility.
- (iii) If close attention is given to sector and corporate governance aspects, the financial and operational performance of the utility is likely to improve.
- (iv) If ADB is not in a position to influence future water tariffs in the PRC, it should reconsider the seeking of assurances and covenants for tariff increases.

Based on these findings and lessons, the proposed follow-up actions and recommendations are:

S. No.	Follow-Up Actions	Responsibility	Time Frame
1.	Water tariff revisions (para. 76). In future interventions, ADB should support water tariff-related policy research to bring to the attention of responsible authorities, requisite information to facilitate decisions on water tariff revisions. Such policy research may focus on (i) financial and other consequences of a non-remunerative tariff regime, and (ii) assessment of willingness-to-pay for various customer categories.	EASS	2011
2.	Reducing UFW (para. 76). Initiate a twinning arrangement for the group company with a suitable water utility in the PRC or elsewhere to enable group company officials to learn modern practices in water accounting and NRW reduction.	EASS	2011

ADB = Asian Development Bank, EASS = East Asia Urban and Social Sectors Division, NRW = nonrevenue water, PRC = People's Republic of China, UFW = unaccounted-for water.

Hemamala S. Hettige
 Director
 Evaluation Division 2
 Independent Evaluation Department

I. INTRODUCTION

A. Project Description and Expected Results

1. The Harbin Water Supply Project was approved for support by the Asian Development Bank (ADB) in March 2003.¹ It was envisaged to begin providing good-quality drinking water to urban areas of Harbin City by 2007, while comprehensive efforts to improve the deteriorating quality of Songhua River water (the primary source of drinking water in urban Harbin) continued over the medium term. At appraisal, the project was planned to be implemented in two phases in quick succession, and to have both phases in operation by 2010. ADB's support extended to phase I, designed to reliably deliver 450,000 cubic meters (m³) per day of high-quality drinking water. The phase I infrastructure comprises (i) a storage dam at Mopanshan mountain in the southeastern parts of Harbin City, (ii) a water treatment plant (WTP) in the southern part of the Harbin urban areas,² (iii) a raw water pipeline (RWP) connecting the two, and (iv) expansion and refurbishment of the distribution network in Harbin urban areas. ADB funds were not used to construct the Mopanshan dam and reservoir, which are now shared with phase II of the project.³ The project also includes capacity-building measures for the Harbin Water Supply Engineering Company (HWSEC),⁴ the implementing agency, and for the relocation of people affected by the inundation of the reservoir area or displaced by the construction of other project infrastructure.

2. The project's short-term objectives were to (i) supply 450,000 m³ per day of clean water in Harbin urban areas; (ii) improve public health by supplying clean and safe water; (iii) overcome water shortages in Harbin urban areas; (iv) strengthen the institutional systems of HWSEC and the Harbin Water Supply Department (HWSD);⁵ and (v) reform the water tariffs to achieve full cost recovery. The anticipated long-term objective was to improve the health and living conditions of the Harbin urban population by providing clean and safe drinking water. The impacts, outcomes, outputs, performance indicators, and other project achievements are in Appendix 1.

B. Evaluation Purpose and Process

3. The project provides clean drinking water, helps overcome water shortages, and contributes to urbanization and urban development. The evaluation covers both project-specific aspects and a broader set of water-pollution management and other issues that provided the rationale for the project. The project was purposefully selected for the performance evaluation report to provide inputs into a broader evaluation by the Independent Evaluation Department.

¹ ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Harbin Water Supply Project*. Manila (11 March).

² The Harbin urban areas include the five districts of Daoli, Daowai, Nangang, Pingfang, and Xiangfang. These districts were reorganized from the seven districts prevailing until 2005, and also include the three economic-industrial zones of Binxi, Pingfang, and High-Tech Park.

³ Other phase II infrastructure includes (i) a raw water pipeline that runs parallel to the phase I pipeline, (ii) a water treatment facility identical to the phase I facility and in the same premises, and (iii) further additions to the water distribution network in the Harbin urban areas.

⁴ The independent evaluation mission was informed that in the project completion report (PCR), HWSEC had been incorrectly named the Harbin Municipal Water Supply Construction Company.

⁵ Prior to project completion, the erstwhile Harbin Municipal Tap Water Company had come under the fold of the Harbin Water Supply and Drainage Group Company (the group company); it was renamed HWSD, and some of its staff were reassigned to other companies and departments within the group. HWSEC also came under the fold of the group company.

4. A desk review of the report and recommendation of the President, the project completion report (PCR), and other documentation available at ADB headquarters was followed by an independent evaluation mission to consult and gain information from the executing agency, the implementing agency, and other stakeholders in Beijing and Harbin City. The draft performance evaluation report was shared with the East Asia Department and the executing and implementing agencies for feedback and comment.

C. Major Findings of the Project Completion Report and the Validation Report

5. The PCR, which was finalized in June 2009, rated the project *successful*.⁶ It was rated *highly relevant, effective, efficient, and likely* sustainable. Taking into account the data provided and analyzed in the PCR, a subsequent PCR validation report by the Independent Evaluation Department rated the quality of the PCR *satisfactory*. Quality and quantity of drinking water were improved ahead of schedule. Technical, social, and environmental issues were found to have been well managed. The main concerns related to institutional and tariff-setting issues, and their impact on the project's economic viability. Overall, the validation report confirmed the ratings on effectiveness and efficiency but reduced the ratings on relevance and sustainability. The downgrade on relevance reflected the project design's lack of emphasis on critical aspects of water enterprise operations and management systems; while the inability to earn a reasonable profit underlined the lower rating on sustainability. Despite the downgrades, the overall project performance was rated *successful*.

6. The validation report agreed with the three main lessons from the PCR. First, the project was successful because its design had been developed over a long period of study by agencies of the People's Republic of China (PRC) and refined by ADB, clear guidelines had been laid down for all phases of the work, and both ADB and the PRC agencies were committed key players. Second, despite several years of dialogue and technical support, and the stated commitment to full cost recovery, this objective can be difficult to achieve. HWSEC should therefore continue to persevere with efforts to achieve full cost recovery, while sudden and massive tariff increases at any future date must be avoided. Third, an effort must be made to streamline consultant recruitment procedures when cost- and quality-based selection methods are used, and the role of all consultants should be clearly defined.

II. DESIGN AND IMPLEMENTATION

A. Formulation

7. In line with its long-term goal of improving living conditions in urban areas and expanding the supply of clean water, the Government of the PRC requested ADB to assist in increasing clean water supply to Harbin City—which the government had identified as one of the 108 cities with serious water problems. The project had also been included in the government's 10th Five-Year Plan (2001–2005) as a key water supply project and the technically viable least-cost alternative to continued reliance on the polluted Songhua River as the water source for Harbin.

8. In response, ADB provided project preparatory technical assistance (PPTA) to prepare a project suitable for ADB financing. The PPTA assessed the technical, environmental, financial, economic, social, and institutional feasibility of an investment in the construction of a water transfer scheme, water treatment plant, and distribution system in Harbin. The PPTA also

⁶ ADB. 2009. *Completion Report: Harbin Water Supply Project in the People's Republic of China*. Manila (Loan 1995-PRC, June).

specified institutional strengthening measures and necessary policy reforms to ensure the long-term sustainability of project facilities.

9. In particular, the PPTA (i) reviewed the technical options proposed under the pre-feasibility studies with an emphasis on quality control and safety aspects regarding dam construction and water demand analysis; (ii) confirmed project scope and components and prepared cost estimates, an implementation schedule, and a financing plan; (iii) updated the resettlement plans and related costs, and established a monitoring and evaluation framework; (iv) reviewed the poverty situation in the project area, including expected impact on the poor, and proposed measures to reduce poverty, including provision of a lifeline tariff and cross-subsidy; (v) reviewed and updated the environmental impact assessment and prepared a summary environmental impact assessment along ADB guidelines; (vi) undertook financial and economic analyses in accordance with ADB guidelines; (vii) estimated tariff levels that would be affordable, encourage water savings, and allow adequate cost recovery; (viii) evaluated the institutional requirements to implement and operate the new facilities on a sustainable basis, including water purchase agreements;⁷ (ix) analyzed provincial cross-border water pollution issues and prepared a complementary action plan to help reduce pollution in the Songhua River; and (x) examined the operational and legal framework for private sector participation and the role that ADB can play in strengthening such participation in partnership with the public sector.

B. Rationale

10. At the beginning of the 10th five-year planning period (2001–2005), water supply was irregular and of poor quality in parts of Harbin City. At appraisal in 2002, water deficits in Harbin City were projected to increase to at least 450,000 m³ per day by 2007, and at least 950,000 m³ per day by 2020. While the Songhua River—the nearest water source—had ample stream flow to meet this water demand, it was becoming one of the most polluted rivers in the country with discharges from various chemical, petrochemical, fertilizer, metallurgical, and food processing industries. Its water quality did not meet the minimum quality standards set for potable water.⁸ Trace organics were present in the water, and serious health risks were identified from some chemical pollutants. Although some consumers pumped groundwater from aquifers under the city, and many preferred bottled water for drinking, the Songhua River remained the major source. At the same time, many groundwater wells had begun to run dry. A clean water-supply alternative was urgently needed.

C. Design

11. The project's overall scope and its objectives did not change after appraisal, but the technical designs were modified. For instance: (i) the Mopanshan dam height and reservoir capacity were raised to improve flood protection in the Lalin River downstream of the dam, from a flood once in 10 years to once in 50–100 years; (ii) the RWP route in the north–northwesterly direction was modified (but locations of dam and WTP were unchanged), which increased the pipeline length by about 4.5 kilometers (km); (iii) the large-diameter pipeline in the distribution network was extended from 73.8 km to 76.2 km, part of which was for project phase II.

⁷ During project formulation, the Harbin Municipal Tap Water Company was a distinct state-owned enterprise. Later, it became an operational arm of the Harbin Water Supply and Drainage Group Company (the group company).

⁸ The water quality of the Songhua River had steadily deteriorated and by the early 2000s, it was classified as class IV during summer months, class V during the low-flow winter months, and considered unsuitable for municipal use in households. Water quality should conform to at least class III standards to qualify as raw water source for municipal (including drinking) use.

12. The following design features of the RWP enable it to function smoothly and efficiently: (i) its gradient aids gravity flow along the entire length and does not require energy for pumping; (ii) it is buried sufficiently below ground to prevent water from freezing even in winter; (iii) a pipeline leak detection system is an integral part of the project design; and (iv) a control system is built in to close the gates at the inlet point if off-spec (below specified quality standard) water is detected at the dam end. The design of the distribution network expansion works was based on the following principles: (i) mesh the existing network with the new pipeline laid; (ii) lay new pipeline along the shortest route to customers or customer clusters while minimizing inconvenience to customers; (iii) select network portions for simultaneous refurbishment to minimize inconvenience to customers; and (iv) minimize the need for pumping water and optimize the pump location.⁹ It is noteworthy that water-flow meters are largely absent on the distribution network (except at the customer end). The WTP, which removes contaminants from the untreated Mopanshan reservoir water, employs the flocculation and sedimentation process; the WTP's water losses are about 3%–4%.

13. An underlying premise of the project design was full cost recovery. Related to it were the assumptions that HWSEC would be an autonomous enterprise that acts as the implementing agency, owns and operates all project assets, and manages all operations and maintenance costs, including debt servicing. In reality, full cost recovery has not been achieved. HWSEC is now a wholly-owned subsidiary of the Harbin Water Supply and Drainage Group Company (the group company) and has operational autonomy essentially for day-to-day operations. It has limited ability to service debt and raise capital for further investment in the water supply system. The erstwhile Harbin Municipal Tap Water Company, which was a signatory to the water purchase agreement with HWSEC, also became an operating arm of the group company. It was renamed HWSD. Appendix 2 provides more information on the group company. The water purchase agreement, now effectively between two arms of the same group, is no longer operational. The financial strength of the group company makes full cost recovery less of a concern for HWSEC, HWSD, and the Harbin municipal government (HMG).

D. Project Cost and Financing

14. Actual project cost was \$461.7 million, comprising \$98.6 million in foreign exchange cost and \$363.1 million in local currency cost. The actual cost was higher than the appraisal estimate of \$399.5 million because (i) Mopanshan dam height and reservoir volume were increased significantly; (ii) the RWP was lengthened and was affected by a rise in global steel prices¹⁰ and an appreciating yuan that increased the equivalent dollar costs and costs incurred in local currency, and the cost to temporarily resettle 372 people during implementation had not been budgeted at appraisal; (iii) the distribution network's expansion, originally amounting to 73.8 km of large-diameter pipeline, totaled 76.2 km and included a portion for project phase II.

15. The ADB loan financed the entire foreign exchange cost of the project. Of the \$100.0 million ADB loan, \$98.6 million was utilized, including the front-end fee (\$0.5 million) and interest during construction (\$10.7 million). All capital expenditure for the Mopanshan dam and reservoir was incurred in local currency and did not require ADB financing. The local currency cost was financed through a combination of equity and domestic loans. Equity was provided by

⁹ Apart from the water pumps in the WTP, only one pump station was built to maintain water pressure in the northeastern part of the distribution network.

¹⁰ One of the main reasons for the sharp rise in steel prices in the global market during 2004–2005 was the massive increase in steel demand in the PRC. Congressional Research Service (The Library of Congress), Report for the Congress. 2006. *Steel: Price and Policy Issues Update*. Washington, DC (31 August).

the national government's Ministry of Finance, by the provincial and municipal governments, and the group company. Appendix 3 compares project costs and finance plan at appraisal and at completion.

E. Outputs

16. The project was implemented as envisaged at appraisal, with minor changes in the technical design (paras. 11–12). Phase I of the project, as delivered, included (i) a dam of 49.9 meter (m) height capable of holding 523 million m³ of water in the Mopanshan reservoir, with a flooding water level of 319.7 m, an allowable operating level of 318 m (with an effective volume of 356 million m³) and a minimum water level of 298 m (with a dead volume of 33 million m³); (ii) 180 km of RWP of 2,200 millimeter (mm) diameter, with a maximum design flow rate of 477,000 m³ per day; (iii) a WTP in Pingfang District Economic Development Zone within the Harbin urban areas, with a design capacity to deliver 450,000 m³ per day of treated Mopanshan water; and (iv) 76.2 km of refurbished or new large pipes (800–1,600 mm diameter) and 18 km of small pipes (100–400 mm diameter) in the water distribution network (Appendix 4).

17. The WTP began to operate at about 25% capacity in December 2006, and achieved full capacity by December 2007. It can run at 100% capacity if so required, but the actual average output in 2008 and 2009 was in a range of 400,000–420,000 m³ per day. Since the phase-II WTP was commissioned in January 2010, the water requirements of households connected to the centralized distribution network have been met by both phases. This reflects the successful efforts to build capacity by training various contractors and equipment suppliers.

18. Physical resettlement and compensation was completed in line with the resettlement action plan (RAP) and in conformance with national, provincial, municipal, and local regulations. It involved resettlement of over 7,000 affected people (about 2,100 households), permanent land acquisition of about 42,500 mu,¹¹ temporary land acquisition of about 10,600 mu, and a total cost of more than CNY560 million. HWSEC's resettlement management office (RMO) continues to redress grievance issues of the resettled households.

F. Project Schedule

19. The loan was approved on 11 March 2003 and the loan agreement was signed on 28 August 2003. The loan was originally planned to become effective on 28 November 2003, but was delayed by late submission of legal opinions and finalization of the onlending and relending agreements. The loan was declared effective on 7 January 2004. The project was to be implemented over 5 years from early 2003 to the end of 2007.

20. Considerable progress had been made on preparatory work before the loan effectiveness date—including detailed engineering design, bidding documents, and even some construction work. Equipment installation and construction works also progressed smoothly after loan effectiveness. As a result, the project was physically completed about 1 year ahead of the estimated completion date of December 2007. The Mopanshan dam, the RWP, and the WTP began commercial operations in December 2006. The expansion and renovation program for the distribution network associated with phase I had begun by 2004.

21. As is customary in the PRC, the contractors and equipment suppliers are paid the last 10%–15% of the contracted amounts 2 years after completion and testing—during these 2

¹¹ One mu equals 666.67 square meters and is referred to as "Chinese acre."

years, the construction quality is guaranteed by the contractors and suppliers. Therefore, about 86% of the total ADB loan disbursements occurred by December 2006 (the date of physical completion). After some delays in the completion of scheduled training programs and a resettlement completion report, the remaining 14% of the ADB loan was disbursed by March 2009.

G. Implementation Arrangements

22. As the executing agency, the HMG had overall responsibility for the project. A high-level committee provided overall guidance during implementation; it comprised the mayor of Harbin City, a representative from the provincial government, and the heads of municipal entities such as the Water Resources Bureau, Environmental Protection Bureau, and Finance Bureau.

23. HWSEC, a limited-liability company incorporated under the PRC Company Law, was responsible for day-to-day activities and construction management. HWSEC had set up the project management office (PMO) during project processing; it began start-up activities before loan effectiveness and mobilization of project implementation consultants. As a corporate body, HWSEC was governed by a board of directors appointed by government shareholders. The board, chaired by the vice mayor of the Harbin City, reviewed work performance regularly, gave timely approvals for upcoming project investments, and managed other issues. While the project was being implemented, HWSEC came under the fold of the group company, but this did not affect its focus on implementing the project.

H. Procurement and Construction

24. Consultant procurement followed ADB's *Guidelines on the Use of Consultants* using quality- and cost-based selection methods. The PMO consultant, estimated at appraisal to be appointed for about 190 person-months, was appointed in March 2005 for 176 person-months. By the time the PMO consultant was mobilized,¹² about 50% of the project had been completed. The actual inputs of the PMO consultant were therefore significantly lower. Nonetheless, the PMO consultant did contribute substantially to the preparation of quarterly and annual progress reports, annual environmental reports, and the establishment of frameworks for a management information system and a project performance management system. The PMO consultant also advised on tariff setting, billing, and collection. Dam and resettlement specialists were also engaged. The dam specialist inspected the dam and associated structures during construction. The resettlement specialist monitored and advised on the resettlement program. HWSEC deemed their performances highly satisfactory.

25. There were 18 ADB-funded international contract packages, which resulted in the selection of 12 distinct international equipment suppliers through international competitive bidding procedures for (i) large-diameter pre-stressed concrete cylinder pipes and steel pipes for the RWP; and (ii) selected parts of the WTP, specifically the electronic controls and other automation. All international contract packages were for goods contracts. Other equipment and materials were locally procured with counterpart funds and using local competitive bidding procedures. National consultants, financed by counterpart funds, were engaged for detailed engineering design and construction supervision. The PCR notes that all procurement followed ADB guidelines, no major problems were encountered in the packaging of contracts, preparation of bidding documents, and evaluation of bids.

¹² The delay was caused by the lengthy recruitment procedures using a combination of quality- and cost-based criteria.

I. Loan Covenants

26. Of the 58 covenants listed in the PCR, those related to project management, project construction, counterpart funding, resettlement, and environmental issues were complied with. To meet some of the financial covenants, HWSEC improved financial control and management systems as per ADB requirements, although it need not have maintained, each year since loan approval, the required ratio of net revenue to debt service at 1.2 or more. Nothing affected HWSEC's ability to discharge its loan obligations after it came under the fold of the group company. HWSEC continues to maintain financial autonomy over costs, as well as managerial autonomy over its day-to-day operations, but needs to seek approval from the group company's board of directors to access capital for investment purposes. Cost-recovery-related covenants have not been complied with; although the tariff increase in January 2010 and a CNY40 million subsidy from the HMG in 2010 are likely to improve the situation, full cost recovery has not been achieved.

J. Policy Setting and Framework

27. Since loan approval in 2003, the stated strategy of the Government of the PRC has been to balance economic growth with environmental protection. The national government frames environmental protection policies and supporting regulations, establishes standards for surface water quality, drinking water quality, effluent discharge, and the monitoring methodologies. All these regulations and measures are required to be implemented across the PRC; the provincial and municipal governments frame corresponding regulations that may call for the same level or more stringent environmental protection. Of particular interest are comprehensive plans to (i) improve the water quality of the Songhua River, and (ii) protect the watershed of the Mopanshan dam (Appendix 5).

III. PERFORMANCE ASSESSMENT

A. Overall Assessment

28. The overall performance of the project is rated *successful* on the basis of the Independent Evaluation Department's four evaluation criteria of relevance, effectiveness, efficiency, and sustainability (Table 1). The project is *relevant*, having been included in the national government's 10th Five-Year Plan (2001–2005) as a key water supply project for urban Harbin and as least-cost alternative to the supply of polluted waters from the Songhua River. Nonetheless, the project design did not give enough attention to improving cost recovery and commercial management—the change in the institutional structure of the Harbin water sector made its financial viability less of a concern to the sector and the government (para. 13). The project is *effective* as it achieved the main objectives of greater quality and reliability of water supply to consumers in urban Harbin, and continued supply to the urban poor at the lifeline rate. The project is also *efficient*, as it was completed about 1 year ahead of schedule and began benefiting consumers earlier than expected. The economic benefits associated with the project also make its economic internal rate of return attractive. However, the project is *less likely* sustainable, as pricing and unaccounted-for water (UFW) management issues were not adequately dealt with so far.

Table 1: Overall Performance Assessment

Item	Weighting	Rating	Score
Relevance	20%	Relevant	2
Effectiveness	30%	Effective	2
Efficiency	30%	Efficient	2
Sustainability	20%	Less likely	1
Overall Rating^a		Successful	1.8

^a Highly successful ≥ 2.7 , Successful $2.7 > S \geq 1.6$, Partly Successful $1.6 > PS \geq 0.8$, Unsuccessful < 0.8 .
Source: Independent evaluation mission.

B. Relevance

29. The project is *relevant* for consistency of its impacts, outcomes, and outputs with the government's development strategy, ADB's strategic objectives, ADB's lending strategy, as well as formulation and design. Changes in the technical design of the project after appraisal (para. 11) did not affect the project's overall scope and objectives.

30. **Consistency with PRC priority and objectives.** By the beginning of the 10th five-year planning period (2001–2005), the government had recognized that major water resource problems in the PRC were interrelated, and that their resolution required a shift from a sector focus to a more integrated and comprehensive approach. Since then, the government has launched several programs to reduce water shortages and prevent or control water pollution that were successfully implemented during the 10th and 11th five-year planning periods.¹³ The project is consistent with these government objectives, particularly as it has helped since 2007 to (i) meet water demand in Harbin urban areas and reverse the trend of a declining groundwater table; and (ii) provide good-quality raw water—which when treated meets drinking water quality standards—several years before the Songhua River will be cleaned up sufficiently to provide similar quality of raw water. The project is also consistent with the national Water Law (2002),¹⁴ as it reinforces the government objectives of rationally developing, utilizing, conserving, and protecting water resources, preventing and controlling water disasters, among other things. However, the Water Law (2002) also requires water users to pay a water-supply tariff that ensures cost recovery and a reasonable profit to the water-supply entity—a feature not yet met.

31. **Consistency with ADB strategic objectives and country partnership strategy.** At appraisal, ADB's operational strategy in the water sector focused on (i) improving the efficiency of water supply and distribution systems through investment in physical infrastructure; (ii) promoting corporate governance and commercial management to enhance the potential for private sector involvement; (iii) improving cost recovery by strengthening tariff systems and structures for raw water and treated water; and (iv) ensuring water resource conservation and environmental protection through continuing support of legislative and regulatory provisions governing water pollution and natural resource management.¹⁵ By investing in physical

¹³ Some of the more important programs are (i) instituting water pollution control planning at regional level, in which a Songhua River clean-up is one of the focus areas; (ii) approving specific industrial and other projects based on the findings of area-wide and cumulative environmental impact assessments; and (iii) setting a target for reducing chemical-oxygen-demand concentrations by 10% by the end of 2010—with the intended side effect of reduced concentrations of other pollutants (Appendix 5).

¹⁴ People's Republic of China. 2002. *Water Law*. Beijing (August). The law was first adopted at the 24th Meeting of the Standing Committee of the Sixth National People's Congress on 21 January 1988; it was revised at the 29th Meeting of the Standing Committee of the Ninth National People's Congress on 29 August 2002; and promulgated by Order No. 74 of the President of the People's Republic of China on 29 August 2002.

¹⁵ As described in the PCR and outlined in para. 5 of this document; based on ADB. 2000. *Country Assistance Plan: People's Republic of China 2001–2003*. Manila (December).

infrastructure, the project has been consistent with aims (i) and (iv), but the project component relating to institutional strengthening (enhancing the skills of technical staff to operate and maintain the project facilities) did not give enough attention to corporate governance and other aspects that make the project more relevant to all its objectives. ADB's operational strategy at loan closing in 2009 remained essentially unchanged, and so did the consistency of project design and actual achievements with ADB's strategic objectives at the time.¹⁶

32. **Ownership.** The project had been included in the 10th Five-Year Plan (2001–2005) as a key water supply project and the technically viable least-cost alternative to continued reliance on the polluted Songhua River as the water source for Harbin. There was strong ownership from both the provincial and municipal governments. Along with HWSEC, they provided assurances at approval on, among others, (i) implementation of provisions of the RAP agreed with ADB; (ii) project construction and operation in accordance with environmental procedures and guidelines of the government and ADB; (iii) timely availability of counterpart financing; (iv) exemption of the urban poor from increases in water tariffs and water meter charges;¹⁷ and (v) continued improvement of wastewater management within Harbin urban areas and other necessary steps to control pollution of the Songhua River.

C. Effectiveness

33. The project is rated *effective* in achieving the objectives, outputs, and outcomes. It has achieved the major objectives of greater quality and reliability of residential water supply in Harbin urban areas. Group company management also recognizes the need to make HWSEC operate as an efficient commercial enterprise and improve corporate governance; these aspects are discussed in the context of sustainability (paras. 46–48).

34. **Project performance.** The project began to alleviate the severe shortage of good-quality water by the end of 2006, i.e., completion testing and commissioning took place 1 year earlier than envisaged at appraisal. Table 2 summarizes project performance since commissioning. The WTP began to supply about 100,000 m³ per day in December 2006; and its output increased to over 400,000 m³ per day in 2008 and 2009.

35. The phase-I WTP can be operated at full capacity to supply 450,000 m³ per day, if required. Since commissioning the phase-II WTP in January 2010, available WTP capacity has doubled to 900,000 m³ per day. In keeping with the demand of the Harbin urban consumers supplied by the project, total water requirement has averaged about 747,000 m³ per day since January 2010. Thus, both WTPs have operated at less than full capacity in 2010. As per design, WTP losses are less than 4% and RWP losses are negligible. However, UFW or the distribution network's system losses have risen each year since 2006 (Table 2). Along with water sales to tariff-exempted customers, UFW is discussed further in the context of sustainability.

¹⁶ ADB. 2008. *Country Partnership Strategy: People's Republic of China 2008–2010*. Manila (February).

¹⁷ Poor urban households defined in accordance with ADB's urban poverty line of CNY3,300 per capita per year.

Table 2: Project Performance

Item	Units	2006	2007	2008	2009	2010	2010
						(Phase I)	(Phase II)
WTP input ^a	m ³ /day	110,000	190,219	417,347	428,703	319,000	428,000
WTP output ^b	m ³ /day	106,150	183,562	402,740	413,699	307,835	413,020
UFW	%	19.4%	21.8%	22.6%	23.1%	26.6%	26.6%
Sales ^c	m ³ /day	85,525	143,619	311,801	318,010	226,043	303,281

m³ = cubic meter, UFW = unaccounted-for water, WTP = water treatment plant.

^a Received through the raw water pipeline; pipeline losses are negligible, and the entire amount of water fed into the pipeline from the Mopanshan reservoir is received at the WTP.

^b About 3%–4% losses occur in the WTP.

^c Includes sales to tariff-exempted customers.

Source: Independent evaluation mission.

36. **Capacity development.** Since phase I of the project was commissioned, it is noted that (i) the Mopanshan reservoir has met the requirements of environmental flows throughout the year (para. 58); (ii) the RWP has operated without leaks or accidents; and (iii) no chlorine leaks from the WTP have occurred. Although there have been no incidents so far, HWSEC has institutionalized standard operating procedures in the event of an accident. It is clear that HWSEC staff have adequate skills to operate and maintain all physical components of the projects (Appendix 6). It appears that the group company management's focus has been to improve the technical and engineering skills of HWSEC. However, it is noteworthy that even where performance benchmarks are available, not much effort appears to have been made to improve performance. A case in point is the rising trend of yearly water losses in the distribution network (UFW) since the project was appraised in 2002.

37. **Water quality.** Since 2006 and to an increasing extent, good-quality drinking water is being supplied to consumers in Harbin urban areas—much earlier than could have been achieved without the project. The Mopanshan reservoir's water quality has been kept within the acceptable range for municipal water supply (classes I and II),¹⁸ and strict limits have been placed on the use of the Mopanshan reservoir to ensure that the water continues to meet the quality objectives (Appendix 5). In addition, owing to continued and persistent efforts to clean up the Songhua River, it is noted that near the point of entry to Harbin City, the Songhua River quality now meets acceptable standards (class III) during the high-flow summer months, although toward the exit point from Harbin City, the water quality falls outside the acceptable quality range even during summer (class IV). During the low-flow winter season, water quality is generally worse (classes IV or V).

38. **Reliability.** Harbin consumers are supplied good-quality water with a high degree of reliability. The best evidence comes from the fact that even during industrial accidents, good, clean drinking water continues to be supplied in Harbin urban areas. For instance, when floods washed away several thousand barrels of toxic organic chemicals from two chemical plants in Jilin province, water supplies to residents in many cities along the Songhua River were impaired for several days.¹⁹ Urban residents of Harbin continued to receive clean Mopanshan water.

39. **Customer satisfaction.** Interviews conducted by the independent evaluation mission with a small number of urban Harbin residents revealed generally high customer satisfaction with the water supplied by the project. In general, once consumer begin to receive the clean

¹⁸ Government of the People's Republic of China. 2002. *PRC Surface Water Quality Standards (GB 3838–2002)*. Beijing.

¹⁹ Each barrel contained about 170 kilograms of toxic organic chemicals; some barrels exploded on contact with water. The incidence occurred on 28 July 2010.

Mopanshan water, their expenditure on water declines because their consumption of bottled water falls significantly. They also suffer fewer (or no) infections in the summer months, which leads to further savings. It is noted that by and large, customers have taken the water supply tariff increase of January 2010 in their stride. The lifeline rate for poor urban households has remained unchanged at CNY1.30 per m³, which implies that poor urban households have cleaner water at the same rate.²⁰ For other residential customers, the monthly water bill has remained miniscule compared with their overall monthly expenditures.

40. While the customers who are supplied with water from the project are generally satisfied, it is noted that not all are aware that the project enhanced the reliability of clean water supply. This is evident from the fact that during a few days in July 2010, after toxic organic chemicals were accidentally washed away in Jilin province, some residents of Harbin urban areas preferred to consume bottled water (rather than tap water sourced from Mopanshan reservoir and treated in the WTP). During those days, the demand for bottled water in Harbin increased significantly, as did the price of bottled water.²¹

D. Efficiency

41. The project is considered *efficient*. The reevaluated economic internal rate of return (EIRR) is estimated at 12.5%, making the project economically viable. It was commissioned about 1 year ahead of schedule and brought significant benefits to its customers. The willingness to pay estimated at appraisal forms the basis for the economic value of water used in the economic analysis; some economic benefits that were not included in this estimated willingness to pay are quantified on the basis of findings from interviews with a small sample of urban Harbin residents. Further inputs and assumptions are given in Appendix 7. Notable economic benefits that are not quantified relate to (i) avoided loss of life and economic output owing to a lower incidence of health problems caused by trace organic chemicals in the Songhua River;²² and (ii) environmental flows that have been maintained since the Mopanshan reservoir was built and phase I of the project commissioned (para. 57). The EIRR estimates at appraisal and completion are not directly comparable with the reevaluated EIRR, as the latter incorporates actual operating cost data and other factors (Appendix 7). Given that water has a finite non-zero economic value, reversing the trend of rising UFW levels should help improve the economic viability of the project, which the economic reevaluation exercise confirms.

42. **Capacity utilization.** The last major expansion of water supply to Harbin urban areas took place in 1993, when facilities to offtake and treat 250,000 m³ per day of Songhua River water were set up. As per forecasts made at appraisal, Harbin was projected to have a water supply shortage of at least 450,000 m³ per day by 2007, which was projected to increase to at least 950,000 m³ per day by 2020. At the same time, it was recognized that if the project could be set up earlier, the clean water it supplied over and above the shortfall volume would replace Songhua River water. As a result, capacity utilization for the project was projected to be high right from the start. Table 2 shows that phase I reached over 90% capacity utilization by 2008

²⁰ The threshold income for poor households has risen in the past 10 years, as the HMG grants subsidy to all urban residents who have no source of income or livelihood. The per-month, per-capita subsidy for such urban residents has risen from CNY200 in 2002 to CNY310 in 2010. China Northeast News. 2010. *Report on the Rise of Subsidies for Poverty in Harbin*. Harbin (<http://dongbei.nen.com.cn/dongbei/403/3419403.shtml>).

²¹ The independent evaluation mission was given to understand that for those few days, the price of bottled water rose significantly (e.g., a 250-milliliter bottle that normally sold for CNY1.50 was selling for up to twice as much).

²² The trace organic chemicals found in the Songhua River are known to cause cancers, birth defects, and/or premature births. However, reliable baseline data (before the project came on stream) and more recent data on the incidence of such health problems are not available to the independent evaluation mission.

(the second full year of operation), and the combined capacity of phases I and II is estimated at about 80% in 2010 (the first full year of operation for both phases).

43. **Implementation.** The project was implemented and commissioned about 1 year ahead of schedule. The implementing agency engaged domestic institutes for engineering design and procured indigenously manufactured equipment to the extent possible. HWSEC staff interfaced closely with both indigenous and international equipment suppliers, undertook joint installations and, in the process, received on-site training and upgraded their technical skills.

44. **Project optimization.** Although it was implemented in two phases, the project was planned and designed as a single project to feed 900,000 m³ per day of clean and high-quality water into the distribution network in Harbin urban areas. The project design was also optimized as follows: (i) of the five sites considered for the reservoir, the Mopanshan site was selected as one of two sites that provided class II quality water but was closer to the Harbin urban areas;²³ (ii) an analysis of reservoir volume and dam height during implementation showed that the benefit of greater flood protection downstream from the reservoir outweighed the incremental costs;²⁴ (iii) two RWPs, one for each phase and each with a design throughput of 477,000 m³ per day, were preferred to a single RWP of twice the design throughput on cost and reliability considerations;²⁵ (iv) the RWPs run along a highway that facilitated implementation and makes maintenance easier; (v) the WTP is in an economic development zone that provides reliable infrastructure for electricity supply, sewage and waste collection, and road links; (vi) the WTP deploys known and tested technologies for removal of contaminants such as suspended solids, minerals, synthetic chemical pollutants, as well as algae, bacteria, fungi, and viruses; and (vii) the distribution network expansion and refurbishment program was a good mix of connecting the separate networks of five different districts of urban Harbin and extending laterals to cover more consumers. The only drawback appears to be the absence of flow meters on large transmission pipes and smaller distribution pipes and laterals, which is one of the important reasons for rising annual UFW.

E. Sustainability

45. The project is rated *less likely* sustainable. Project sustainability is considered from the pricing, financial, market, management, and natural resource perspectives. The market-related aspects are discussed in the context of customer satisfaction and capacity utilization, and pose little risks to sustainability. Other aspects are discussed in paras. 46–51 and show that it is important to address pricing and UFW management to improve the project's sustainability.

46. **Pricing and financial viability.** Table 3 shows the weighted average cost of capital (WACC) and the reevaluated estimates for the project's financial internal rate of return (FIRR), along with WACC and FIRR estimates at appraisal and completion. The FIRRs in all three stages exceed WACC, which indicates the project's sustained financial viability. It is noted, however, that the financial reevaluation base case incorporates the tariff changes effective January 2010, and an assumption that the weighted average tariffs across all customer

²³ Water at the other three candidate sites conformed to class III quality standards. The RWP from Mopanshan reservoir is about 180 km long, whereas a 345 km RWP would have been required from the Taoshan site (the only other candidate that could have provided class II quality raw water).

²⁴ Largely because downstream on the Lalin River, the incidence of floods is estimated to fall from once in 10 years to once in 50–100 years.

²⁵ To ensure supply even during emergency conditions, the two RWPs have six interconnection joints along the 180 km route. The same level of reliability could have been obtained from a single RWP, but that would have entailed higher costs and construction of a standby reservoir about 100 km from the Mopanshan dam.

categories will increase by 10% every 3 years (Appendix 7). The future tariff increases are considered reasonable given that (i) in many cities, water tariff adjustments occur once every 3–5 years, with tariffs in Beijing increasing once every 2 years; and (ii) the national government issued a directive in 2009 that local governments should strictly follow procedures on water tariff adjustments, give due consideration to social affordability, and avoid sudden steep increases. In this context, the January 2010 tariff increase of over 30% (Appendix 8), the process for which started in 2005, may be considered as “removing the backlog.” Given that electricity and district heating tariffs have also increased 3–4 times over the past 10 years for Heilongjiang province and Harbin City, it is possible that consumers are accustomed to 10%–15% increases in tariffs at shorter intervals (Appendix 8).²⁶ However, as per guidelines from the national government, the final decision on tariff increases rests with the provincial government, and future tariff increases will be beyond the reasonable control of the group company.

47. **Nonrevenue water.** Nonrevenue water includes UFW and water sales to tariff-exempted water consumers. As per available data, the share of water sales to tariff-exempted customers has been negligible in Harbin and is likely to remain so.²⁷ Therefore, it is important to focus on reducing UFW. Although UFW has increased from 21% to 26% since 2007, it is still significantly below the typical level of 30%–40% seen in many PRC water utilities. The group company and HWSEC are aware of the deterioration of parts of the distribution network and have made some repairs. They also know that rising UFW levels make it more difficult to keep the water supply business financially sustainable and would like to reverse the trend. However, it appears they prefer to focus on expanding the areal coverage of the distribution network to 100% by 2013, before turning their attention to reducing UFW. Although they have no immediate plans to reduce UFW, they are aware that a first step would be to install flow meters on larger pipelines and main feeders, and use water accounting to determine priority actions.

48. **Governance.** The water supply business of the group company does not yield good returns. The revenue collected through the project is distributed to other companies and departments of the group. At least since project phase I came on stream, the group company has suffered annual financial loss from the water supply business. The water supply business thus imposes no corporate income tax liability. Nonetheless, HWSEC is able to raise funds from the PRC commercial banks to meet working capital and planned capital investment requirements, because it is backed by the financially strong group company, and the revenue receipts exceed the annual cash expenses for operation and maintenance.²⁸ The municipal government also extends a small subsidy to the group company, but not enough to cover all financial losses.²⁹ The government increased the subsidy in 2010, in recognition that water utilities should not suffer financially if government does not approve tariff increases often enough to keep pace with rising costs.

²⁶ The water tariff comprises three components: the water supply fee, the water resources fee, and the wastewater treatment fee; the latter two are pass-through for the water utility (see Appendix 8 for further details). The water tariff increase referred to in para. 46 pertains to the water supply fees alone.

²⁷ The share of water sales to tariff-exempted categories (such as public or civil sites) since project phase I was commissioned has ranged from 0.19% to 0.33%. It is expected to average about 0.25% in the foreseeable future.

²⁸ This includes all operation and maintenance costs other than depreciation.

²⁹ The total subsidy received from HMG was CNY40 million, comprising (i) a fixed amount of CNY27 million that is paid each year, (ii) CNY6.7 million to cover about 50% of costs to maintain back-up systems such as various Songhua River water treatment plants, and (iii) CNY6.3 million to compensate for subsidizing poor urban households on the lifeline tariff.

Table 3: Base Case Results of Financial Analyses

Item	At Appraisal	At Completion	At Independent Evaluation
WACC	4.4%	3.4%	3.4%
FIRR	6.0%	7.6%	7.0%

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Source: Report and recommendation of the President, project completion report, and independent evaluation mission.

49. **Skills.** During project implementation, the group company made sure that technical staff were properly trained to operate and maintain the sophisticated equipment deployed through the project, e.g., for quality monitoring, automation, water-flow, and pressure regulation. The project also institutionalized annual planning and scheduling of training for equipment operators and other technical staff (Appendix 6).

50. **Natural resource availability.** The HMG has adopted a comprehensive approach to protecting the Mopanshan reservoir and its watershed, and to reducing the risk of water contamination in the medium term. This includes (i) encouraging organic farming to reduce fertilizer and pesticide use upstream of the Mopanshan reservoir along the Lalin River, (ii) encouraging population migration from the Lalin River catchment areas upstream of Mopanshan, and (iii) limiting access of people to the reservoir area. Since project phase I began supplying clean water to Harbin urban areas, the reliance on groundwater has declined significantly. As a result, the previously depleting underground water aquifers have begun to fill up and the declining groundwater table has begun to rise (Appendix 5).

51. For the longer term, several national, provincial, and municipal programs are in place to improve the water quality in the Songhua River to minimum mandatory standards for drinking water as soon as possible. These programs include (i) implementing 24 water-pollution control projects in Harbin's major water-polluting enterprises, as specified by the national government; (ii) carrying out HMG initiatives such as audits to determine and implement pollution-reduction measures, inspections of key polluting sources, and levying a pollution charge; (iii) setting up centralized wastewater treatment plants, beginning with relatively large townships and progressively moving toward smaller ones; and (iv) screening all proposals for industrial enterprises (Appendix 5). It is noteworthy that as a first result of these programs, the quality of Songhua River water has begun to meet class III standards in the high-flow summer months at least in some parts of Harbin City.

IV. OTHER ASSESSMENTS

A. Impact

52. The project's institutional, environmental, and socioeconomic impacts are *modest*, and no significant negative impacts were found.

1. Institutional Impact

53. **Implementing agency.** HWSEC, which is now a wholly owned subsidiary of the group company, has sufficient managerial autonomy to manage day-to-day operations. However, it relies on the financial strength of the group company to secure financing for its capital investment programs and needs approval from the group company's board of directors. So far, HWSEC appears to have focused on improving its technical and engineering skills, as evident

from the technical training systems it instituted. To some extent, HWSEC has been constrained by the fact that water tariffs remained unchanged from December 2001 to December 2009,³⁰ even as operation and maintenance costs kept rising each year.

54. HWSEC could benefit from (i) putting in place comprehensive management systems with the objective of attenuating the risk of deterioration of the supply infrastructure, and (ii) establishing suitable performance benchmarks and monitoring performance against certain indicators. As HWSEC also organizes training for its managers and executives (Appendix 6), it should be possible to set suitable performance targets against agreed indicators and institute systems to achieve those targets. A case in point is the rising UFW, which needs to be reversed. It is also worthwhile to reduce water losses in the WTP.

55. Some institutional systems are in place to encourage HWSEC to provide technical guidance and advice to other subsidiaries and departments of the group company (for instance, the Harbin Drainage Company). The experience gained by HWSEC through its PMO, which it set up to help implement the water supply project, has been useful in providing management services for other projects undertaken within the group company, such as (i) refurbishing and extending the distribution network to cover all consumers in Harbin urban areas; and (ii) changing end-user meter locations to facilitate meter reading.

56. **Harbin municipal government.** The HMG launched a major effort to oversee and monitor progress in improving and sustaining water supply quality across Harbin City. As a first step, it prompted the Harbin Environmental Protection Bureau to establish the Water Resources Protection Division in 2009. It is noteworthy that the national Ministry of Environment Protection has not made a similar effort to date. Since its inception, and in coordination with the Harbin Water Resources Bureau, the division is overseeing the clean-up of the Songhua River and its tributaries, and management of the Mopanshan reservoir's watershed (Appendix 5).

57. The HMG plans to move the division to the Water Resources Bureau. The bureau oversees the functioning of HWSEC and the group company, and this move is intended to improve coordination of all programs and works relating to the management of water resources and water supply. After the move, the Environmental Protection Bureau would concentrate on its core competencies—monitoring all water quality and pollution-control aspects, including levy of a pollution charge, review of environmental impact assessments for new industries and economic development zones, and inspections of key polluters and of wastewater treatment plants.

2. Environmental Impact

58. Although, at appraisal, the project was expected to have major impacts on fisheries, water quality, and river hydrology, it is worth noting that (i) the actual impact on fisheries was minimal, as demand for fishing decreased with the reduction of the rural population; (ii) the surrounding forest cover helped maintain low sedimentation in the Mopanshan reservoir; (iii) environmental flows became possible—before the Mopanshan reservoir was built, the water flows in the Lalin River used to fall to 3–4 m³ per second in the winter months, which was below the required environmental flow of 5 m³ per second. Now, through proper water management at Mopanshan and the WTP underground water storage facility, the Mopanshan reservoir can release up to 13 m³ per second even in winter months. In addition, water monitoring data since

³⁰ After a public hearing on 8 December 2009, the Heilongjiang Price Bureau decided on 4 January 2010 to raise water tariffs effective from 1 January 2010.

project phase I came on stream shows that both Mopanshan raw water and that released by the WTP have consistently met national water quality standards.

3. Resettlement Impact

59. Planning for the resettlement process, initiated in 2001, provided the basis for HWSEC to prepare a RAP that was approved by ADB in 2002. The RAP included the following: (i) permanent land acquisition, mostly for the Mopanshan reservoir; and (ii) temporary land acquisition for the RWP and WTP. Given that 3,360 hectares of land (including 1,436 hectares of forest land) were inundated by the reservoir, a large number of households were permanently displaced. The actual number of affected households (2,108) and people (7,048) exceeded RAP estimates of 1,740 households and 6,022 people (Appendix 9).

60. The actual physical resettlement took place over 18 months in 2004–2005, and monitoring and grievance redress continued into 2010. During the physical resettlement period, the RMO set up by HWSEC worked closely with local government bodies in (i) interacting with the affected households to explain the objectives and mechanisms of resettlement, the basis for compensation rates and amounts, other subsidies and assistance, and convince them of the overall benefits of resettlement; and (ii) monitoring the physical resettlement process to ensure that the national, provincial, municipal, and local laws and regulations were being followed (as applicable) with respect to compensation for permanent or temporary acquisition of land or other assets, as well as provision of other government assistance.³¹ It is noteworthy that (i) the actual compensation for permanent acquisition of paddy and dry agricultural land was 30% higher than estimated in the RAP; (ii) compensation rates for temporary acquisition of dry and vegetable lands were 50% higher; (iii) compensation rates for other lands were equal to or exceeded the rates budgeted in the RAP; and (iv) the special needs of vulnerable groups were addressed in many cases. In general, where there were adverse impacts on women, minorities, children, the elderly, and the poor, the RAP provided for additional social assistance of CNY7,000 per household. In practice, the approach adopted was to help the vulnerable affected household (or person) solve specific problems if it would cost more than CNY7,000. There are many instances of such help, which in all likelihood proved more beneficial to the recipient than a one-off payment of CNY7,000.

61. Given the changes in the actual need for land acquisition and structure demolition from that in the final and detailed project design, as well as the relatively higher compensation rates for some land acquisitions and treatment of at least some vulnerable households, the total resettlement budget estimated at about CNY520 million in the RAP was exceeded. The actual disbursement of resettlement funds by the end of 2008 was about CNY562 million, or 7% higher than budgeted.

62. Most permanently resettled households from the inundated Mopanshan area are now closer to centers of Wuchang City and other townships. The income of an increasing share of these households now comes from transportation, small businesses, and processing industries—although farming and agriculture remain the mainstay. A detailed field survey conducted by HWSEC in 2008 also revealed that (i) compared with their original villages, the relocated people have larger pieces of farmland and more job opportunities in their new

³¹ Most importantly, compensation is for (i) permanent acquisition of agricultural land and forest land; (ii) temporary land occupation; (iii) housing demolition; (iv) temporary or permanent acquisition or demolition of publicly used infrastructure; (v) costs incurred during physical relocation (e.g., transportation, medical expenses, lost working time). Other government assistance includes exemption from payment of agricultural tax for 3 years for qualified resettled households and a 3-year exemption from payment of school fees (Appendix 9).

communities; and (ii) the average annual income per capita of resettled rural and forest workers increased by more than 50% from 2006 to 2007. Income growth of households resettled from the Mopanshan area thus appears to have outpaced average income growth rates in rural areas across the Heilongjiang province (Appendix 9).

63. The RMO, which was set up in 2002, has worked closely with government bodies to ensure that the entire resettlement process (physical resettlement, compensation, arrangements to provide for livelihood, etc.) takes place systematically and in a transparent manner. After completion of the physical resettlement process and after helping stabilize livelihood-related aspects, the RMO's 10-member crew has been engaged in redressing grievances of resettled households. At present, most grievances relate to the ban of fertilizers and pesticides for farming in the vicinity of the Mopanshan reservoir.

4. Socioeconomic Impact

64. Once urban Harbin households began to be supplied treated Mopanshan water, they became aware of benefits that eluded households that still received the polluted Songhua River water, while retail tariffs for water from both sources remained the same. This is borne from a small survey of urban Harbin households across a range of income categories.³² The households covered by the Mopanshan water supply reported a lower incidence of stomach infections and other minor ailments, less expenditure on medicine for such illnesses, fewer absences from work, and less expenditure on bottled water. Given that only a few households were interviewed, the information is at best indicative. Nonetheless, it does show the social and economic benefits perceived by the public at large.

65. No information from the survey would indicate a lower incidence of some of the more serious health problems since the switch from polluted Songhua River water to clean Mopanshan water. In fact, little information is available from official sources as well.³³ The only available data is the overall reduction in cancer-related deaths and infection-related deaths since the early 2000s, owing to a mix of HMG initiatives aimed at improving health infrastructure, general cleanliness, air quality, and water quality (Appendix 10).

66. The survey also showed that the non-poor urban Harbin households did not suffer from the water tariff increase in January 2010. It was pointed out that the incremental monthly water bill is a small fraction (less than 0.2%) of the monthly household budget, and even for those with high water consumption, the incremental monthly bill is less than the price of 1 liter of bottled water.

B. ADB Performance

67. ADB's overall performance is rated *satisfactory*. The policy dialogue under the project was particularly successful in supporting the HMG in the implementation of measures to (i) improve the quality of the Songhua River and its tributaries (including but not limited to

³² The survey comprised a focus group discussion with six consumers, and interviews with about 10 randomly selected residents of urban Harbin (e.g., shop owners, taxi drivers, and waiters). The respondents included (i) poor urban households that pay a lifeline tariff of CNY1.30 per m³, typically comprise three family members, consume 3–4 m³ of tap water per month, and do not consume bottled water; (ii) low-income households, typically with three family members that consume up to 8 m³ of tap water per month, and now use bottled water only when they have guests; (iii) middle-income households that consume up to 15 m³ of tap water per month and regularly use small volumes of bottled water even now.

³³ The national, provincial, and municipal governments consider health data to be sensitive.

wastewater treatment), (ii) prevent and control pollution upstream of the Mopanshan reservoir, and (iii) monitor the progress of environmental management programs. The policy dialogue also succeeded in encouraging private sector participation in wastewater treatment. However, when it comes to tariff-setting and corporate governance aspects, the policy dialogue was not effective enough to adopt the National Guidelines on Water Tariffs and make the water sector commercially oriented. During project implementation, ADB monitored progress through frequent consultations and briefings with the HMG, the PMO, the group company, and other stakeholders. ADB fielded six review missions, spent adequate time reviewing physical progress, and resolving issues with implementing agency staff. ADB also promptly approved changes in the technical design of the project components, the reallocation of loan proceeds, the equipment supply contracts it financed, and the necessary loan disbursements. The performance of the PPTA consultant was also rated “good” by the implementing agency.³⁴

C. Borrower, Executing Agency, and Implementing Agency Performance

68. The overall performance of the borrower (the Government of the PRC), the executing agency (HMG), and the implementing agency (HWSEC) is rated *satisfactory*. Each communicated regularly with ADB and ensured timely availability of counterpart funds. The HMG showed strong leadership and made prompt decisions during project implementation. Even though the PMO consultants came on board after loan effectiveness, the PMO set up by HWSEC had begun functioning much earlier and was already coordinating activities between ADB, HMG, HWSEC, the contractors, and other consultants. When necessary, the PMO also sought advice and inputs from the HMG for coordination with other stakeholders. The high level of commitment from the executing and implementing agencies made it possible to commission the project 1 year ahead of schedule and provide early benefits to the residents of urban Harbin. However, water tariffs were not adjusted to allow full cost recovery and were not increased as covenanted.³⁵ Nonetheless, it is recognized that water is a “public good” and a “merit good”,³⁶ and therefore, water tariffs should not reflect only the cost recovery and profit making objectives. Besides, it is recognized that water tariff adjustments are ultimately made by the provincial government on the advice of the HMG (the executing agency) and as per national guidelines, and are not within the reasonable control of the PMO and the implementing agency (HWSEC).

V. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS

A. Issues

69. **Water tariffs.** Water tariffs remained unchanged from December 2001 to December 2009 even though the average per-capita income in urban areas of Heilongjiang province (Harbin is the provincial capital and a major urban center) more than doubled during this period.³⁷ This meant that HWSEC had to rely on the financial strength of the group company and budgetary support from the HMG to meet its capital investment and working capital requirements. It is imperative for the long-term sustainability of the project to raise water tariffs.

³⁴ The PPTA consultant was Camp Dresser & McKee International.

³⁵ For instance, as per the Project Agreement (Schedule, para. 43), the provincial government and HMG are to ensure that from “commencement of the project facilities,” the treated water tariffs charged by HWSEC are set at a level that ensures full cost recovery of operation and maintenance, depreciation, and financial costs (i.e., debt service obligations), and a reasonable profit margin for HWSEC.

³⁶ Water is a “public good” in the sense that no one should be excluded from using it; and water is a “merit good” in the sense that it should be consumed as per need, rather than on the ability or willingness to pay for its use.

³⁷ Heilongjiang Provincial Government. 2003 to 2009. *Heilongjiang Statistical Yearbooks*. Harbin.

70. **Nonrevenue and unaccounted-for water.** HWSEC's capabilities to function as a vertically integrated water utility are evident. Nonetheless, it has allowed nonrevenue water—particularly UFW—to increase year on year at least since 2002. Reversing this trend should be a priority in the coming years. Because of its financial dependence on the group company, HWSEC has given top priority to increasing the areal coverage of the distribution network to 100% by 2013 to increase the revenue base. Measures to reduce UFW (and hence revenue loss) appear to have taken a backseat; it is therefore unlikely that UFW reduction measures will gather pace in the next few years.

71. **Changes in financial and organizational covenants.** As per the original project design and the project agreement covenants, the HMG was to ensure that the wholesale price for water transferred from HWSEC's WTP to the distribution network of the Harbin Municipal Tap Water Company would be adjusted each year to cover changes in operation and maintenance costs, inflation, and currency fluctuations.³⁸ After a reorganization of Harbin's water sector and the registration of the group company, HWSEC became a wholly owned subsidiary of the group and the Harbin Municipal Tap Water Company—renamed as HWSD—became an operating arm of the group. Consequently, the wholesale transfer of water from the WTP to the distribution network became an internal pricing issue for the group company, the water purchase agreement became superfluous, and the financial covenant more difficult to meet.

B. Lessons

72. **Commitment.** The commitment shown by ADB and the HMG was fundamental to the project's success. Careful assessment and project design during loan processing, detailed procurement and implementation planning, and timely availability of counterpart funding and decision making ensured smooth implementation and commissioning of the project about 1 year ahead of schedule.

73. **Integrated view of water resource management.** The government recognizes that water resource problems in the PRC are related to various economic, technical, regulatory, and other developmental issues, and that an integrated and comprehensive approach is required to ensure that adequate volumes of water of requisite quality are available on a sustained basis. Such an integrated approach includes protection of upstream water sources, watersheds, rivers and other water bodies, and includes but is not limited to (i) alleviating risk of pollutant contamination from point and non-point sources of pollution; (ii) treating wastewater before discharge into such water bodies; (iii) monitoring and analyzing water quality; (iv) developing alternative sources of water supply; (v) setting up an institutional framework and strengthening the institutions; and (vi) establishing a regulatory framework that provides the right incentives for implementation of such measures. The success achieved by the project and the progress made so far in improving the Songhua River's water quality (eventually, the project facilities and the Songhua could jointly supply urban Harbin with good-quality water) attests to the benefits of such a comprehensive approach.

74. **Water tariffs.** While price setting in a tightly regulated market is often an act of balancing a large number of concerns, it is important to give due consideration to the long-term sustainability of the water utility, including investment in its modernization and expansion. If tariff income falls short of requirements (assuming normative operational efficiencies), government support is required. However, as ADB may not be in a position to influence water tariff levels

³⁸ Project Agreement, Schedule, para. 41.

and structures, ADB should review the merits of including tariff setting-related covenants in the loan and project agreements, or seeking assurances on this matter.

75. **Amending financial covenants.** The project became effective on 7 January 2004, nearly 1 year after the group company was registered with the HMG's Commercial and Industrial Bureau on 24 January 2003. Close attention should have been given to revising certain project covenants to ensure that the HMG could continue to follow up on some aspects of water pricing.

C. Follow-Up Actions

76. On the basis of issues and lessons from the study, the proposed follow-up actions are:
- (i) **Water tariff revisions.** In future interventions, ADB should support water tariff-related policy research and thus help bring to the attention of responsible authorities, requisite information to facilitate decisions on water tariff revisions. Such policy research may focus on:
 - (a) the financial and other consequences of a non-remunerative tariff regime on the concerned municipal and provincial governments; and
 - (b) an assessment of willingness-to-pay for various customer categories.
 - (ii) **Reducing UFW.** Through dialogue with the group company and a suitable water utility in the PRC or elsewhere, initiate a twinning arrangement that gives group company officials the opportunity to learn modern practices in water accounting and UFW reduction.

PROJECT FRAMEWORK

Design Summary	Appraisal Performance Targets and/or Indicators	Project Achievement ^a
<p>Impact</p> <p>Better health and living conditions of the Harbin urban population by providing clean and safe drinking water</p>	<p>Note: No relevant performance targets or indicators specified at appraisal</p>	<p>A health improvement trend is evident from available data (from HMG sources) on account of clean and safe drinking water, as well as other HMG initiatives.</p>
<p>Outcomes</p>		
<p>Improvement of quality and reliability of water supply to residential Harbin City</p>	<p>Supply urban residents with safe water at affordable prices</p>	<p>More than 1.4 million people benefited from better water quality supplied by phase I of the project (supported by ADB).</p> <p>Nearly 2.8 million people (living in 87% of the Harbin urban area) benefited from better water quality after phase II of the project came on stream in January 2010.</p> <p>Water supply remains affordable, even after tariffs were increased in January 2010 (for the first time since December 2001).</p>
	<p>Reliably supply clean water to urban residents in the project area by 2007</p>	<p>Supply of clean water through the project increased from 106,100 m³ per day in December 2006 to 183,500 m³ per day in 2007, to 402,700 m³ per day in 2008, and to 413,700 m³ per day in 2009. In 2010, the combined supply from both phases has been over 720,000 m³ per day.^b</p> <p>No disruption in project supply since commissioning in December 2006; reliability associated with an alternative source of water supply (such as the project facilities) recognized during toxic chemical spill accident in July 2010.</p>
<p>Institutional strengthening</p>	<p>HWSEC operating as an efficient commercial enterprise</p>	<p>HWSEC is a wholly owned subsidiary of HWSDGC, with managerial autonomy for day-to-day operations.</p> <p>HWSEC's expansion and capital investment plans are reviewed by HWSDGC management and approved by its board of directors.</p>

Design Summary	Appraisal Performance Targets and/or Indicators	Project Achievement ^a
		For necessary investments and working capital requirements, HWSEC is able to borrow from the PRC banks with the backing of the HWSDGC.
	Recommend practical and viable options for private sector participation in HWSEC by 2010	<p>With prevailing water supply tariffs, the water utility cannot recover costs and earn a reasonable profit. Private sector's interest is limited.</p> <p>The private sector is interested only in wastewater treatment and management, where it can recover full costs and earn a reasonable profit.</p>
Project Outputs		
Mopanshan dam and reservoir	Total reservoir capacity of 356 million m ³ by 2007	<p>Dam and reservoir completed and commissioned by December 2006.</p> <p>Reservoir constructed with total storage volume of 523 million m³ and flood control capacity of 1-in-100-year peak flood flows, and including five subcomponents: (i) a dam with a maximum height of 49.9 m and crest length of 406 m, (ii) a spillway, (iii) a diversion irrigation tunnel, (iv) a water supply tunnel, and (v) a hydrological and water environmental monitoring system.</p>
Raw water transmission pipeline	2.2–2.4 meter pipeline, 175 km long, with nominal capacity of 491,000 m ³ per day by 2007	<p>Phase I pipeline with design flow capacity of 477,000 m³ per day, completed and commissioned by December 2006.</p> <p>Phase II pipeline of same design flow rate, six interconnection joints with phase I pipeline, commissioned by January 2010.</p>
Water treatment plant	450,000 m ³ per day water treatment plant	Completed as planned, and supplying good-quality water since 5 December 2006.
Expansion and rehabilitation of water distribution network	Install 73.8 km of large pipes and 18 km of smaller pipes by 2007	Installed 76.2 km of large pipes and 18 km of small pipes for phase I. The large pipes connected all separate subnetworks in five districts of urban Harbin.

Design Summary	Appraisal Performance Targets and/or Indicators	Project Achievement ^a
		Installed laterals in phase II to cover more consumers in the five districts of urban Harbin.
Resettlement	Relocate 5,175 persons (1,740 households) from Mopanshan reservoir area Relocate 847 persons (241 households) affected by construction of raw water pipeline and water treatment plant.	Relocated 6,334 persons (1,798 households) from Mopanshan reservoir area. Relocated 714 persons (310 households) affected by construction of raw water pipeline and water treatment plant. Completed physical resettlement and compensation by 2005.
Institutional strengthening and capacity building	395 employed by HWSEC by 2008 150 employed by HMTWC (now HWSD) by 2008	240 staff employed by HWSEC and HWSD by end of phase I Further recruitment by HWSEC by end of phase II (mostly for raw water pipeline and water treatment plant).
	100 staff employed in county resettlement bureaus	100 staff employed in county resettlement bureaus.
Poverty reduction	Connection of 325,000 poor people to tap water supply between 2007 and 2010 Access by 889,000 poor beneficiaries to clean and reliable water from 2007 Greater savings by the poorest households from waived future tariffs 2,200 new jobs created for the poor from project construction between 2003 and 2006	907,000 households connected to the water supply, of which 42,000 are the poorest households. About 4,000 jobs created during the project construction phase and about 300 in full-time employment in the operation phase.
	Reduced morbidity and mortality rates from waterborne diseases, especially for the poor, elderly, women, and children	Little data available; considered sensitive by the national, provincial, and municipal governments.

ADB = Asian Development Bank, HMG = Harbin municipal government, HMTWC = Harbin Municipal Tap Water Company, HWSD = Harbin Water Supply Department, HWSEC = Harbin Water Supply Engineering Company, HWSDGC = Harbin Water Supply and Drainage Group Company, km = kilometer, m = meter, m³ = cubic meter, PRC = People's Republic of China.

^a Although project phase II is not supported by ADB, the project's technical design incorporated phase II. The two phases share several facilities; the group company has few (if any) staff that are dedicated to only one phase, and the group company does not specify targets and achievements under phase I separately. For certain indicators, therefore, it is useful to present data that covers both phases.

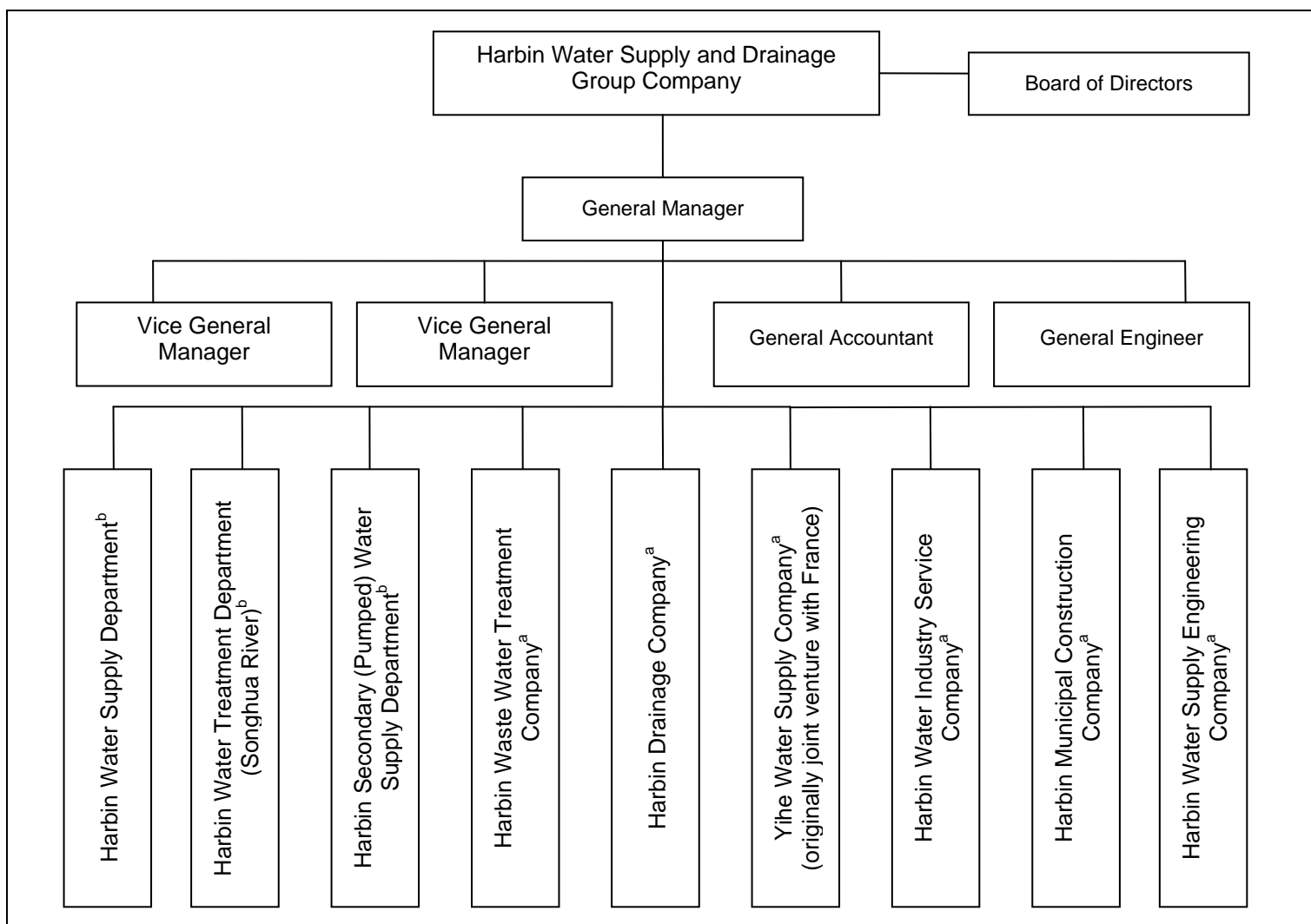
^b For and up to 2009, the data refers to average daily output of clean and safe water from the water treatment plant. For 2010, the data refers to the typical daily output from the water treatment plant in summer months.

Source: Independent evaluation mission.

ORGANIZATION OF THE HARBIN WATER SUPPLY SECTOR

1. The Harbin Water Supply and Drainage Group Company (the group company), a state-owned enterprise, has the overall responsibility for the entire water supply sector in Harbin urban areas.¹ Figure A2 shows the broad structure of the newly established group company. The general manager is responsible for day-to-day operations and reports to the board of directors, which is responsible for firming up investment and financing plans. The general manager is supported by two deputy general managers; a general accountant; and a general engineer on management, accounting/financial, and engineering/technical matters.

Figure A2: Structure of the Group Company



^a Wholly-owned subsidiary companies.

^b Departments of the group company.

Source: Harbin Water Supply and Drainage Group Company.

2. The group company comprises six wholly owned subsidiary companies and three departments. The six companies and their roles are as follows:

¹ The urban areas cover the five districts of Daoli, Daowai, Nangang, Pingfang, and Xiangfang.

- (i) The Harbin Water Supply Engineering Company (HWSEC)² was the project manager for the construction of phases I and II of the Harbin Water Supply Project and is now responsible for operating and maintaining the Mopanshan reservoir and dam, the raw water pipeline, and the water treatment plant (WTP). In theory, HWSEC is commercially oriented, but in practice, its commercial and financial viability is constrained by the existing tariff regime.
 - (ii) The Harbin Municipal Construction Company is a commercially oriented company that bids on a competitive basis for water supply and drainage system construction projects both within and outside the Heilongjiang province.
 - (iii) The Water Industry Service Company is also a commercially oriented company that bids for boiler installation, real estate, and landscaping projects.
 - (iv) The Yihe Water Supply Company, which was acquired by the group company, is responsible for maintaining one of the seven WTPs that were previously used to treat Songhua River water for supply to Harbin households and other consumers. At present, these WTPs are idling, but are maintained so as to be able to treat Songhua River water at short notice in the event of an emergency. Under normal circumstances, this company has no source of revenue. A part of the government subsidy of CNY 6.7 million received by the group company in 2010 to meet the costs of maintaining the back-up systems is used to meet the costs of this company.
 - (v) The Harbin Drainage Company, responsible for operation and maintenance of urban drainage and sewage pipes, meets its costs with funds transferred to it from the wastewater treatment company.
 - (vi) The Harbin Wastewater Treatment Company (HWWTC) is responsible for the construction, operation, and maintenance of wastewater treatment plants that enable the Harbin water supply sector to meet standards for water discharge into the Songhua River. The wastewater treatment fee is used to meet the expenses of HWWTC and the Harbin Drainage Company.
3. The three departments of the group company and their respective roles are as follows:
- (i) The Harbin Secondary Water Supply Department is responsible for ensuring the proper functioning of the internal water networks of households and other customers. The operation of secondary water supply fulfills the requirements of the People's Republic of China's criteria and standards.³
 - (ii) The Harbin Water Treatment Department maintains 6 of the 7 WTPs that were previously used to treat Songhua River water before supply to Harbin households and other consumers. At present, the WTPs are idle, but are maintained to remain in working condition so that they can spring into service at short notice in the event of an emergency.
 - (iii) The Harbin Water Supply Department (HWSD) is responsible for meter reading, billing, and revenue collection from all customers. The water resource fee, the water supply fee, and the wastewater treatment fee portions of the revenue are collected by HWSD on behalf of the group company and distributed to other companies and/or the designated government bodies.

² The independent evaluation mission was informed that in the project completion report, HWSEC has been incorrectly named the Harbin Municipal Water Supply Construction Company.

³ Secondary water supply refers to water supply from groundwater pumps as well as the pipeline network within customer premises. Consumers in Harbin can commission the department for secondary water supply design, installation, and maintenance in accordance with the Hygienic Code for Secondary Water Supply Facilities (GB 17051-1997) and the Hygienic Code for Secondary Water Supply for Drinking Purpose (a new GB standard under consultation).

4. The group company was registered on 24 January 2003 with the Harbin Commercial and Industrial Bureau. The six wholly-owned subsidiary companies are also registered with the bureau. The general managers of the six subsidiary companies are appointed by the general manager of the group company and perform their duties as per group company guidelines. Although they have managerial autonomy for day-to-day operations, their expansion and capital investment plans need to be reviewed by the group company management and approved by the board of directors. The group management directly oversees the day-to-day management of the three departments.

5. In the present structure, the water purchase agreement that was signed in June 2002 (between the erstwhile engineering company and the erstwhile tap water company) is redundant.

PROJECT CAPITAL COST AND FINANCING PLAN

Table A3.1: Project Capital Cost (\$ million)

Item	Appraisal			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Base Cost						
- Mopanshan Dam	(..)	81.2	81.2	(..)	132.2	132.2
- Raw Water Pipeline	62.8	79.7	142.5	76.9	102.6	179.5
- Water Treatment Plant	17.3	28.6	45.9	9.8	37.6	47.4
- Distribution Network	0.5	52.9	53.4	0.7	40.6	41.3
- Subtotal	80.5	242.4	323.0	87.4	313.0	400.4
Finance Charges ^a	11.2	20.1	31.3	11.2	50.1	61.3
Physical Contingency	4.2	23.4	27.6	(..)	(..)	(..)
Price Contingency	4.1	13.6	17.7	(..)	(..)	(..)
Total	100.0	299.5	399.5	98.6	363.1	461.7

(..) = zero.

^a Includes front-end fee and interest during construction.

Source: Harbin Water Supply and Drainage Group Company, Harbin Water Supply Engineering Company.

Table A3.2: Financing Plan (\$ million)

Financing Source	Appraisal			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Asian Development Bank	100.0	(..)	100.0	98.6	(..)	98.6
Government and Group Company Equity	(..)	119.9	119.9	(..)	69.0 ^a	69.0
Domestic Bank Loans	(..)	179.6	179.6	(..)	294.1 ^b	294.1
Total	100.0	299.5	399.5	98.6	363.1	461.7

(..) = zero

^a Includes loans from the national, provincial and municipal governments, and equity from the group company.

^b Includes loans from the China Development Bank and Industrial and Commercial Bank of China.

Source: Harbin Water Supply and Drainage Group Company, Harbin Water Supply Engineering Company.

PROJECT DESIGN AND CONFIGURATION

A. Introduction

1. The Harbin Water Supply Project is consistent with the strategies of the Government of the People's Republic of China (PRC) and the Heilongjiang provincial government for developing, protecting, and managing water resources. The project was to be implemented in two phases in quick succession to supply 900,000 cubic meters (m³) per day of good-quality water so as to (i) meet the projected water shortage of about 936,000 m³ per day in Harbin urban areas by 2010; (ii) provide high-quality water in Harbin urban areas long before the Songhua River clean-up program could achieve that quality; and (iii) reduce pressure on groundwater use and thus allow the water table to begin rising again. Although implemented in two phases, each phase with a capacity of 450,000 m³ per day, the project was planned and designed as a single project. Phase I was supported by the Asian Development Bank (ADB). It comprised four infrastructure components: the Mopanshan dam, the raw water pipeline (RWP); the water treatment plant (WTP), and expansion and refurbishment of the water distribution network in Harbin urban areas. The project's design and configuration aspects are discussed from the viewpoint of technical, social, environmental, economic, and financial issues.

B. Reservoir and Dam

2. **Location.** At least five reservoirs had been considered for the project (Table A4). Of the five, only the Taoshan reservoir was located in a designated preserved area and could provide the same quality of water as the Mopanshan. The Taoshan was rejected because it entailed transporting water through more than 300 kilometers (km) of pipeline, which would have increased project costs by more than 30% compared with the Mopanshan option. Besides, Taoshan is located in Qitai City, beyond the jurisdiction of the Harbin municipal government (HMG), making it harder to ensure construction and maintenance of the reservoir and the RWP.

Table A4: Overview of Reservoir Alternatives

Reservoirs	Administrative City/Counties	Distance to Harbin	Water Quality
Mopanshan	Wuchang city (county) of Harbin	180 km	Good ^a
Taoshan	Qitai city of Heilongjiang	345 km	Good
Xiquanyan	Acheng District of Harbin	84 km	Normal
Shirengou	Shuangcheng city (county) of Harbin	128 km	Normal
Nihe	Suihua city of Heilongjiang	150 km	Normal

km = kilometer.

^a As per national Environmental Quality Standards for Surface Water (GB 3838-2002), the Mopanshan water conforms to class II. The only parameter beyond the class I threshold is "total nitrogen" at 0.41 milligram (mg) per liter (the limit for class I is 0.2 mg per liter, for class II it is 0.5 mg per liter).

Source: Asian Development Bank. 2002. *Technical Assistance to the People's Republic of China for the Harbin Water Supply Project*. Manila (PPTA 3571, Draft Final Report).

3. The Xiquanyan reservoir, constructed in 1992, had been used as water supply source for the Acheng district (in Harbin City). As it offered scenic beauty, tourism and commercial activity grew in the reservoir area and water quality deteriorated. The Xiquanyan area is now included in the Songhua River clean-up action plan. The Shirengou and Nihe reservoirs were originally developed for irrigation and fishing; and the latter has impaired water quality.

4. **Reservoir volume and dam height.** At appraisal, the decision was to build a dam with a height of 45 meters (m), capable of supplying water at 900,000 m³ per day, with a 318 m

water level to hold an effective volume of 356 million m³. In reality, the Mopanshan dam was constructed 49.9 m high with a water level of 319.69 m and a capacity of 523 million m³. The increase in the reservoir water level (from 318 m to 319.69 m) was approved by the HMG's Flood Protection Division (of the Water Affairs Bureau), as it improved the flood protection of downstream Lalin River from a flood once in 10 years to once in 50–100 years, and the incremental benefits were considered to outweigh cost increases.

C. Raw Water Pipeline

5. The objective of the project's RWP (phase I and phase II) was to transport 900,000 m³ of raw water from Mopanshan to the WTP in Pingfang district. The RWP was designed by the North China Municipal Engineering Design and Research Institute. The pipeline elevation is 292.54 m at the Mopanshan end and 169.54 m at the Pingfang end, and the resultant gradient along with the Mopanshan reservoir pressure facilitates gravity flow. The pipeline is at least 1.5 m below ground, although the depth may increase according to geological conditions and at river-crossing or highway-crossing points.

6. Two parallel RWPs are designed to carry 900,000 m³ per day of raw water. Each has a 2,200 millimeter (mm) diameter and comprises sections of 15 mm thick (or thicker) prestressed concrete cylinder pipe and 18–22 mm steel pipes of 2,200 mm diameter. Steel pipe sections are normally laid under highways and rail lines, as well as in complicated geological terrain. The design flow of each pipeline is 477,000 m³ per day. The clearance between the two parallel pipelines is 11–22 m from the center of the pipes (which complies with relevant standards), the buffer land is 15 m either side of the pipelines, and the total right-of-way is about 60 m. Two depressurizing valves are installed—at 38.7 km and 101 km downstream from Mopanshan—and there are 32 pressure detectors along the pipelines.

7. **Pipeline alignment.** The RWPs run along the highway from Wuchang county to the Harbin urban areas, about 50–100 m from the highway. Such proximity helped construction and makes maintenance easier. The other important consideration was to minimize temporary resettlement and temporary land acquisition during pipeline construction.

8. **Pipeline reliability.** The choice was between laying two pipelines (each with a throughput of 450,000 m³ per day) or one large pipeline to carry 900,000 m³ per day. The two options were further defined: (i) two parallel pipelines, each 180 km long, with six interconnection joints between the two, so as to ensure that 70% of the design flow can be delivered even in emergency conditions; and (ii) a single 180 km pipeline with a standby reservoir about 100 km from Mopanshan dam to provide the same level of reliability as the two pipelines. Excluding the cost of the standby reservoir, the single-pipeline option entailed significantly lower capital costs; but the cost associated with improving reliability (i.e., the cost of the standby reservoir) made the two-pipeline option more attractive.

D. Water Treatment Plant

9. The WTP was designed by the China Northeast Municipal Engineering Design and Research Institute. The basic design philosophy was to set up a 450,000 m³ per day output facility for phase I of the project, and replicate it for phase II. As used worldwide, a combination of the following processes is deployed in the WTP for removal of contaminants such as suspended solids; minerals (such as iron, manganese, and sulfur); and synthetic chemical pollutants like fertilizers, as well as algae, bacteria, fungi, and viruses. The treatment process deployed in the WTP includes (i) *pre-chlorination* to control growth of algae and arrest any other

biological growth; (ii) *aeration*, which along with pre-chlorination removes dissolved iron and manganese; (iii) *coagulation*, where polyelectrolytes (that aid in coagulation) are used to improve coagulation and thicken floc formation;¹ (iv) *sedimentation*, where suspended solids trapped in the floc are separated out; (v) *filtration*, which removes particles from water; and (vi) *disinfection*, which removes bacteria. The above process was preferred to the reverse-osmosis process.

10. The WTP is on a 25.4 acre site in the Pingfang District Economic Development Zone in the southern part of the Harbin urban area. No other alternatives appear to have been considered for the WTP location, given that (i) the distribution network can rely on gravity flow because the southern portion has a higher elevation than the northern parts; and (ii) the economic development zone provides sufficiently reliable and high-quality electricity to run the WTP, as well as connections by road, a good sewer and waste collection system, and regular supply of fuel. In addition, there is no residential area in the vicinity of the WTP, and emissions from the coal-fired boiler (for indoor air heating in winter months), the noise from running equipment, and accidental release of chlorine gas can have only limited impacts.

E. Distribution Network

11. At appraisal, about 73.8 km of large pipes (800–1,600 mm diameter) and 18 km of small pipes (100–400 mm diameter) were to be set up or refurbished in phase I of the project. In reality, 76.2 km of large and 18 km of small pipes were laid or overhauled in phase I. Phase I connected all separate subnetworks in the five districts of urban Harbin. In phase II, only the laterals were extended to cover more consumers in the Harbin urban districts. Combined, the two phases serve about 87% of water users in the Harbin urban areas; the Harbin Water Supply Engineering Company plans to have 100% coverage by 2013.

12. No meters were installed on the large pipes; meters were installed only at the customer end. Pipes inside residential properties (e.g., high-rise apartment buildings) are owned by the consumers or operated by property management companies. Commercial and industrial units also have their own pump stations for water distribution within their properties.

F. Water Quality Monitoring

13. Water quality is monitored on each of the four physical infrastructure components. The monitoring systems are adequate and include the following: (i) *Mopanshan reservoir and dam*: automated pH and turbidity monitoring at outlet; real-time automated monitoring of 10 parameters (including temperature, pH, turbidity, chemical-oxygen-demand, hardness, conductivity, ammonia-nitrogen, chloride, total phosphorous) at inlet; manual monitoring (at 5 sampling points in the reservoir thrice a month) of 24 basic parameters plus 5 supplemental parameters, as per national surface water quality standards;² (ii) *WTP*: manually assisted turbidity, chloride, pH measurements at the WTP inlet point on an hourly basis; turbidity measurements of process water and outlet water; detailed monitoring four times a month at the WTP outlet, monitoring 15 parameters thrice a month and 42 parameters once a month, as per the national surface water quality standards; (iii) *distribution network*: measuring twice a month at each of the 123 monitoring points in the network, 7 parameters once and 12 parameters the

¹ Particles finer than 0.1 micron in water remain in motion due to their electrostatic charge (often negative), which causes them to repel each other. Once their electrostatic charge is neutralized by the coagulant material (the polyelectrolytes), the fine particles begin to collide and agglomerate into larger and heavier particles called flocs.

² Government of the People's Republic of China. 2002. *PRC Surface Water Quality Standards (GB3838-2002)*. Beijing.

other time, as per the national drinking water quality standards.³ The water quality data collected is sent to the group company's monitoring center in Harbin. The monitoring center is certified by the national quality supervision authorities.

14. Besides the self-monitoring at the project component level, the HMG's Water Resources Bureau and Environmental Protection Bureau monitor some aspects of water quality. At a supervisory level, the HMG's Health Bureau also monitors water quality at about 60 monitoring points twice a year. Relevant water quality data is published on a website that displays water quality data nationwide with monthly updates. Consumers also have access to the group company, as well as the mayor of Harbin, through a hotline facility.

³ Government of the People's Republic of China. 2002. *PRC Drinking Water Quality Standards (GB 5749-2006)*. Beijing.

POLICY AND REGULATORY SETTING FOR IMPROVING AND SUSTAINING DRINKING WATER QUALITY IN HARBIN URBAN AREAS

A. Introduction

1. Harbin had a water shortage of 143,000 cubic meters (m³) per day in 2000,¹ which was projected to increase to at least 450,000 m³ per day by 2007, and at least 950,000 m³ per day by 2020 in terms of treatment capacity.² The Songhua River, which passes through Harbin City, was the major raw water source for about 1 million m³ per day at the beginning of the 10th five-year planning period (2001–2005). The quality of water in the Songhua River had steadily deteriorated over the years and by the early 2000s, it did not always meet the class III standards required for treated, potable water supply, and fell to below class V standards during the low-flow winter season. The Songhua River water was supplemented by groundwater, which in turn had led to a lower water table. Against this backdrop, the Harbin Water Supply Project was designed to begin providing good-quality drinking water with a high degree of reliability to Harbin urban areas by 2007, while the longer-term Songhua River clean-up program continued to be implemented. Efforts to clean up the Songhua River are still under way. The project has also helped reduce groundwater use in Harbin urban areas.

2. As of August 2010, the project's raw water pipelines had a combined throughput of 747,000 m³ per day,³ and the output of the water treatment plant was about 720,000 m³ per day.⁴ Water supply from the Mopanshan reservoir is expected to increase in the coming years to 2013, and so is coverage of urban residential water supply (from 87% when phase II began operating in January 2010 to 100% by 2013). Rising urbanization and incomes are expected to further boost demand for good-quality water.

3. Following are broad overviews of the Songhua River clean-up program and efforts being made to maintain the quality of the Mopanshan water. Standards for water quality and effluent discharge are referred to as relevant. Issues surrounding groundwater use in Harbin urban areas are also discussed below.

B. Songhua River Clean-Up

1. Background

4. The main stream of the Songhua River is 1,434 kilometers long and flows from the Changbai mountains through Jilin and Heilongjiang provinces until it joins the Amur River.⁵ Major cities along the Songhua are Jilin and Songyuan (in Jilin province) and Harbin and Jiamusi (in Heilongjiang province). Songhua's main tributary, the Nen, flows from the Greater Khingan Mountains in Inner Mongolia Autonomous Region until it joins the Songhua near Songyuan City. Major cities along the Nen include Qiqihar and Daqing (both in Heilongjiang province).

¹ ADB. 2002. *Technical Assistance to the People's Republic of China for the Harbin Water Supply Project*. Manila (PPTA 3571, Draft Final Report by Camp Dresser & McKee International, April).

² ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan for the Harbin Water Supply Project in the People's Republic of China*. Manila (18 February).

³ Includes 319,000 m³ per day from the phase I pipeline, and 428,000 m³ per day from the phase II parallel pipeline.

⁴ Loss of less than 4%.

⁵ [Http://en.wikipedia.org/wiki/Songhua_River](http://en.wikipedia.org/wiki/Songhua_River).

5. The above-mentioned cities along the Songhua and Nen rivers host a variety of industries (chemical, petrochemical, fertilizer, steel, non-ferrous metals, and food processing) that have traditionally discharged into the rivers untreated or partly treated wastewater contaminated with various organic chemicals, heavy metals, and conventional pollutants. In the 10th five-year planning period (2001–2005), when a program to reverse the trend of Songhua’s deteriorating water quality was launched, Songhua’s water quality was classified as class IV during summer months, class V during the low-flow winter months, and considered unsuitable for municipal use in households. Water quality should conform to a minimum of class III to qualify as raw water source for municipal (and drinking) use.⁶

6. The program to clean up the Songhua River began in the early 2000s, and the Heilongjiang provincial government took concrete steps to reduce pollution in the Songhua River basin by setting up wastewater treatment plants in Harbin and cities upstream of Harbin. By 2008, six of 12 first-level tributaries of the Songhua had met (and retained in 2009) the class III water quality standards; and of the remaining six tributaries, one was upgraded from class IV to class V in 2009. The type of measures that helped achieve such improvements required government attention, formulation of scientific plans and programs for key polluting enterprises and wastewater treatment, and comprehensive measures for non-point sources. Systematic water quality monitoring programs were also initiated.

2. Specific Measures for Songhua River Clean-Up

7. **National pollution control projects.** The national government had identified 24 water-pollution control projects for implementation in Harbin’s major water-polluting enterprises during the 11th five-year planning period (2006–2010).⁷ Of these, 11 projects had been carried out and were completely operational by mid-2010; another six had been completed, but were awaiting acceptance; and the remaining seven were under implementation and on track to be completed by the end of 2010.

8. **Pollution control from key point sources.** In addition, after detailed production audits in key polluting enterprises, the provincial and municipal governments singled out about 570 projects for reduction of air, water, and solid-waste discharges. Many of these projects have been implemented in chemical and pharmaceutical plants. Automatic and real-time discharge–effluent monitoring equipment has been set up at key polluting sources, including industrial enterprises and urban sewage treatment plants.⁸ Inspections are conducted at regular intervals (including some surprise inspections when air, water, and solid-waste samples are taken for measurements and analysis). A water-pollution levy system is also in place; however, the expert opinion is that pollution levy and fines are too low to encourage investment to reduce effluent discharges. Although some industrial enterprise closures (for not meeting the specific pollution reduction targets during the specified time period, and after repeated guidance from the authorities) had been ordered during the 10th five-year planning period (2001–2005), such closures have become increasingly rare over the past few years.

9. **Centralized wastewater treatment.** The Harbin municipal government (HMG) planned for 22 wastewater plants to be set up in the 11th five-year planning period, with a combined

⁶ Government of the People’s Republic of China. 2002. *PRC Surface Water Quality Standards (GB 3838-2002)*. Beijing.

⁷ The national projects target metal-plating, chemical, pharmaceutical, and gasification plants, and breweries and liquor production enterprises.

⁸ As of 30 April 2010, 119 sets of automated, real-time wastewater effluent monitoring equipment and 135 sets of automated real-time air emission monitoring equipment were installed, covering about 97% of key pollution sources.

capacity of 1,508,000 m³ per day. Of these, 9 wastewater treatment plants with a combined capacity of 792,000 m³ per day became operational by mid-2010, and the remaining 13 are expected to be completed by the end of 2010. During the 11th planning period, the Harbin urban areas and county-level cities were equipped with wastewater treatment plants. Smaller towns are to be equipped during the 12th five-year planning period (2011–2015), some with plants as small as 20,000 m³ per day.

10. **Watershed rehabilitation.** The erosion control program managed by the HMG's Water Resources Bureau, which covered 468,000 million units (31,200 hectares), was completed in 2009. The grassland rehabilitation and reforestation program, managed by the HMG's Forest Bureau and covering 395,000 million units (26,333 hectares), is expected to be completed by the end of 2010.

11. **Pollution control for new industrial enterprises at point of entry.** Proposals for new industrial establishments are required to include an environmental impact assessment; and no discharges of toxic or hazardous waste are permitted. So far, 28 projects have been vetoed. For new economic development zones, area-wide development plans are formulated and strategic environment assessments are conducted. An environmental impact assessment is also required for any projects within the economic development zones.

3. Water Quality Monitoring Arrangements

12. The Songhua River flows for about 466 kilometers within the boundaries of Harbin City. Between its point of entry into Harbin City and the point of exit, 10 environmental monitoring stations have been set up. At each station, monitoring is done at three points (at the middle of the river, and at each of the banks); at each point, the monitoring is at three depths (0.5 meters [m] below water surface, 0.5 m above the river-bed, and the mid-point). Thus, 90 observations and/or readings comprise one set. In line with the requirements of the national surface water quality standards (GB 3838-2002), the 24 basic parameters are measured at all points. To the extent that Songhua water is used for drinking purposes (post-treatment), the five supplementary parameters and some of the 80 special parameters are also measured at or near the point where Songhua water is drawn.

13. Given that several highly polluting industrial enterprises are located along the Songhua in cities upstream of Harbin, it has been difficult to achieve year-round minimum quality standards required of a raw water source for drinking purposes. It is noted that near the point of entry into Harbin City, the Songhua River's water quality appears to have improved, exceeding class III standards at least during the high-flow summer months. Toward the exit from Harbin City, Songhua's water quality dips to class IV during summer months. During the low-flow winter months, water quality is generally worse.

C. Mopanshan Reservoir Watershed Management

14. Total population upstream of the Mopanshan reservoir and dam in about 10 villages and 6 forest farms is roughly 15,000 people. There are no industrial enterprises upstream of the Mopanshan.⁹ Nonetheless, there are two major environmental pressures on the reservoir: (i) *deforestation*: there are about 10,000 forest workers who have a logging quota of 80,000 m³

⁹ Upstream from Mopanshan, there are mostly mountains and hills where there is no industry.

of wood, or about 400,000 trees a year;¹⁰ and (ii) *non-point source pollution*: this comprises essentially fertilizer and pesticide run-off from farmlands,¹¹ domestic sewage from villages,¹² and run-off of oil used in forest farms.¹³

15. To reduce the risk of water supply disruptions in Harbin from the type of accidents that have happened in recent years on the Songhua and Nen rivers,¹⁴ the HMG has adopted a comprehensive approach to lower the risk of Mopanshan water contamination in the medium term. This includes (i) Agricultural restructuring: Moving toward a cropping system that uses fewer chemicals, or promoting organic farming. Because the HMG recognizes that such measures would in all likelihood result in reducing farmers' incomes by as much as 25%–33%, it is exploring the idea of providing ecological compensation to the farmers; (ii) Mopanshan Reservoir Water Source Protection Ordinance: The HMG plans to pass this ordinance and make it effective by 1 January 2011.¹⁵ The draft ordinance was put on the internet in September 2009 to invite comments from the public. The ordinance will limit access to the reservoir area for fishing, boating, sightseeing, etc., and even agriculture. A master plan for protection of the reservoir area will be an integral part of the ordinance; (iii) Population Migration Program: As distinct from resettlement, the HMG plans to induce and motivate people to move away from the catchment area (for incentive, by sending their children for education in urban centers) so that within a few decades, the population in the catchment area falls significantly.

D. Implications for Groundwater Pumping

16. To meet the growing demand for water in the 1980s and 1990s, about 1,380 wells had been set up to supply about 325,000 m³ per day of water. Only about 600 wells were functioning by 2006. Wells had run dry due to the falling groundwater table (by as much as 20 m in certain locations) and overextraction of groundwater in an area of about 380 square kilometers. In 2006, the provincial and municipal governments enforced the provisions of a regulation that had been promulgated in 1983 but not enforced until then.¹⁶

17. In 2006, permits began to be required to extract groundwater and the volume of extracted groundwater fell to about 120,000 m³ per day. It is reported that the overextracted areas have recovered somewhat since 2006—areas where the water table is below historically recorded levels have gradually decreased to about 200 square kilometers, and the water table has risen by 0.54 m (in the dry season) and 0.77 m in the wet season in 2006–2007. No further updates are available, but it is believed that the water table continues to rise and overextracted areas are further declining.

¹⁰ These forest farms have existed for a long time, well before the watershed was designated as a water supply source for Harbin.

¹¹ Approximately 70% of fertilizers and pesticides applied to the 60,000 mu (4,000 hectares) of farmland that includes 15,000 mu (1,000 hectares) of rice paddies is lost to groundwater and the river. The run-off to the river ultimately ends up in the Mopanshan reservoir.

¹² Essentially kitchen and toilet water; only a few houses have septic tanks.

¹³ Oil leaks and run-off from repair shops.

¹⁴ In November 2005, the benzene spill led to a shutdown of water supply in Harbin areas over several days, and even threats of a lawsuit by the Russian Federation against the PRC after the spill eventually reached the Amur River. In March 2007, a glue manufacturing company in Qiqihar City (upstream of Harbin City in Heilongjiang province) accidentally released several chemicals into the Nen River, although this did not result in any water supply shutdowns in Harbin. In July 2010, several thousand barrels, each containing 170 kilograms of poisonous substance, were washed away by floods from two chemical plants in Jilin province.

¹⁵ The HMG Council is to have a second reading of this ordinance in September 2010 and is to be reviewed by the HPG Congress in November 2010.

¹⁶ HPG and HMG. 1983. *The Water Intake Permit*. Harbin.

SKILLS DEVELOPMENT

A. During Project Implementation

1. During project implementation, the contractors and equipment suppliers provided necessary training. The training programs had three phases: (i) before equipment installation, the suppliers trained staff of the Harbin Water Supply Engineering Company (HWSEC) on the specifications and parameters of the equipment. For some sensitive and sophisticated equipment, training was provided up to three times; (ii) during installation, HWSEC staff participated in on-site installation works; and (iii) after installation, HWSEC staff were trained on operations and maintenance aspects as well. Training amounted to 500 person-times.

2. Critical and core equipment on which intensive training was provided includes (i) water quality monitoring equipment for the Mopanshan reservoir; (ii) water-flow regulators, pressure adjustment regulators, and air-flow valves for the raw-water pipelines; and (iii) electric motors, air blowers, filters, lab quality testing equipment, automation, certain regulators or valves, and other major electrical equipment in the water treatment plant.

B. After Project Implementation

3. The Harbin Water Supply and Drainage Group Company (the group company) has instituted a system of training as per national standards to previously licensed (certified) operators of laboratory or automation or other equipment. Management approves an annual training plan for different types of operators, and where necessary, the training is customized. The group company also has a professional training school; training is provided jointly by the Harbin municipal labor department and the group company's training school.

4. Training is also provided to senior executives on management, economics, and technical matters (e.g., technology for water drainage management). Management considers such training as being mandatory and treats it as an essential precondition for promotions.

FINANCIAL AND ECONOMIC REEVALUATION

A. Introduction

1. The objective of the financial and economic reevaluation is to determine the financial and economic viability of the Harbin Water Supply Project on the basis of updated information on water supply volumes, operating costs, and tariff rates, and to assess the financial and economic internal rates of return. The methodology broadly follows the approach adopted at completion, as given in the project completion report (PCR). The economic analysis is carried out in accordance with the *Guidelines for the Economic Analysis of Projects* of the Asian Development Bank (ADB) by comparing the with-project and without-project scenarios that weigh project benefits against initial investments, and periodic and routine maintenance requirements over a 20-year period. All expenditures and revenues are in constant 2009 prices.

2. Although ADB supported only phase I of the project, the financial and economic analysis is conducted for the combined phases I and II, largely because (i) the project was planned to be implemented in two phases, each phase to deliver 450,000 cubic meters (m³) per day of clean water to consumers in Harbin urban areas; (ii) the capital investments made before the commissioning of phase I incorporated infrastructure that would be used for both phases; and (iii) particularly since the beginning of phase II in January 2010, the Harbin Water Supply and Drainage Company (the group company) has not maintained operating cost data for phase I separately.

B. Financial Analysis

1. Inputs and Assumptions

3. The inputs and assumptions for the financial analysis are described in Table A7.1; and weighted average cost of capital (WACC) computations are shown in Table A7.2. The approach is essentially to rely on capital cost data (including interest during construction) of the PCR, and operating cost and revenue data since the beginning of 2007 to mid-2010 (by which time phase II had been operating commercially for about 6 months) on information provided by the group company.

Table A7.1: Parameters for Financial Analysis of HWSP

Capital Cost	<ul style="list-style-type: none"> • Based on the total capital cost as provided in the PCR. • The total includes capital cost of phase I plus phase II. • The total includes the CNY equivalent of expenditures incurred in foreign exchange plus local currency expenditures. • ADB supported foreign exchange-denominated expenditures only for phase I, although imported equipment (paid for in foreign exchange) was also deployed in phase II. • For the purposes of financial analysis that is carried out in local currency (CNY), the lack of data on foreign exchange expenditures for phase II poses a little problem.
Operating Cost of Mopanshan Dam and Reservoir	<ul style="list-style-type: none"> • The group company has maintained the complete set of operating cost data separately for 2009 (full year) and 2010 (first half of the year). • Although the reservoir became operational by the end of 2006, some capital expenditure continued to be incurred in 2007 and 2008. • Depreciation and salaries and wages data are available for 2007 and 2008 and provided by the group company. • Data on other components of operating costs (power and utilities, administrative expenses, repair and maintenance expenses) are not maintained separately by the group company, but combined with the capital expenditure stream.

	<ul style="list-style-type: none"> For analytical purposes, reasonable estimates of these operating cost components (for 2007 and 2008) are arrived at on the basis of water output from the dam, the consumer price index, and the manufacturing unit value index.
Operating Cost of Raw Water Pipeline	<ul style="list-style-type: none"> The group company has maintained complete operating cost data separately only for 2010 (first half of the year). Although the phase I raw water pipeline became operational by the end of 2006, the capital expenditure incurred for the phase II raw water pipeline up to 2009 included expenditures on the common right-of-way of pipelines for both phases. Depreciation and salaries and wages data are available for 2007–2009 from the group company. Data on other components of operating costs (power and utilities, administrative expenses, repair and maintenance expenses) are not maintained separately by the group company, but combined with the capital expenditure stream. For analytical purposes, reasonable estimates of these operating cost components (for 2007–2009) are arrived at on the basis of water throughput of the pipeline, the consumer price index, and the manufacturing unit value index.
Operating Cost of Water Treatment Plant	<ul style="list-style-type: none"> The group company has maintained complete operating cost data separately for 2008 (full year), 2009 (full year), and 2010 (first half of the year). Although the phase I water treatment plant became operational by the end of 2006, the capital expenditure incurred for the phase II treatment plant up to 2009 included expenditures on certain shared facilities for both phases. Depreciation and salaries and wages data are available for 2007 from the group company. Data on other components of operating costs (power and utilities, chemicals, administrative expenses, repair and maintenance expenses) are not maintained separately by the group company, but combined with the capital expenditure stream. For analytical purposes, reasonable estimates of these operating cost components (for 2007) are arrived at on the basis of water input to the treatment plant, the consumer price index, and the manufacturing unit value index.
Operating Cost of Distribution Network	<ul style="list-style-type: none"> The group company has provided complete operating cost data for 2007, 2008, and 2009 for the entire network; however, no data for 2010 (first half of the year) was provided. For 2007–2009, as in addition to water treated under the project, the network also delivers water from the Songhua River, the various cost components were scaled down in the ratio of project water provided. The 2010 costs are estimated by component, by scaling up the 2009 costs in line with in line with total water output from the water treatment plant.
Revenue ^a	<ul style="list-style-type: none"> The group company has provided data on volume of water sales and revenue from water sales by customer category for September 2007 and September 2009; along with data on total volume of project water supplied during the year 2007–2009, system losses (unaccounted-for water) in 2007–2009, and prevailing tariff rates in 2007–2009. Unaccounted-for water, as a percent of water fed into the distribution network, increased from 21.76% in 2007 to 22.58% in 2008, and 23.13% in 2009. It increased further to over 30% in some months of 2010 (as construction works on the network proceeded) but is estimated to average about 26.57% in 2010. The above data provides a basis for estimating water sales volume and revenue by customer category in 2008. The 3-year time series of water sales volume is used to extrapolate the share of water sales to various customer categories in 2010 (when phase II of the project also began commercial operations) and, with revised tariff rates, provides estimates of sales revenue in 2010.

ADB = Asian Development Bank, PCR = project completion report.

^a Revenue based on the water supply tariff, which does not include (i) water resource fee of CNY0.05 per cubic meter from 1 January to 31 August 2010, and CNY0.10 since 31 August 2010; (ii) prime charge that has been gathered along with the water supply tariff since the project came on stream, which is transferred to a fund that provides assistance to key consumers to conserve water; and (iii) a 6% tax imposed on gross revenue receipts, which are a pass-through to the Finance Bureau.

Source: Independent evaluation mission.

Table A7.2: Estimation of Weighted Average Cost of Capital

Item	Nominal Rate	Real Rate ^a	Funding	Weight	WACC
ADB Loan	2.7%	0.10%	826.2	15.3%	0.01%
Equity	8.0%	5.26%	1,240.7	23.0%	1.21%
Local Bank Loans	6.2%	3.51%	3,330.0	61.7%	2.16%
Total			5,396.9	100.0%	3.39%

ADB = Asian Development Bank, WACC = weighted average cost of capital.

^a Inflation rate of 2.6% from 2003 to 2007.

Sources: Project completion report and Harbin Water Supply and Drainage Group Company.

2. Results of Financial Analysis

4. The inputs and assumptions explained in Table A7.1 form the basis for projecting water sales and water revenues over a 20-year period. Other salient assumptions in making base-case projections are (i) the capacity utilization of the water treatment plant rises from 80% in 2010 to 100% by 2013 and remains at 100% thereafter; (ii) the unaccounted-for water (UFW) or system losses in the distribution network, which have been rising since project phase I came on stream rises further to exceed 28% in 2011, stays at that level for a few more years, and then begins to decline each year to fall to about 20% by 2030; and (iii) tariff revisions occur once every 3 years after 2010, with average overall tariff increases being about 10% each time.¹

5. With these inputs and assumptions, the financial internal rate of return (FIRR) is estimated at 7.0%. This makes the project financially attractive, given the WACC of 1.97%. The base-case FIRR at completion was 7.6%. The difference between the two base cases is essentially on account of the following: (i) an actual tariff increase of January 2010 is considered in the reevaluated FIRR, while in the PCR, a tariff rise is assumed to take place in 2009; (ii) updated operating cost data is used in the reevaluated FIRR. The FIRR at appraisal was 6.0%. In addition to the differences in inputs and assumptions regarding sales revenue and operating costs, the difference in FIRR value at appraisal versus the reevaluated FIRR also reflects the differences between appraised versus actual capital investment and cost of capital.

6. Sensitivity analysis (Table A7.3) also shows that if tariffs are raised once again after a 10-year gap, it would be important to have a tariff rise of over 60% for the FIRR to equal the base-case value of 7%; and that attention to accelerating the reduction of UFW to the 20% level can raise the FIRR significantly.

¹ Over the useful life of the project, some equipment is likely to be replaced, and capital cost may also be incurred on incremental improvements in performance efficiency (e.g., to reduce water losses in the water treatment plant). Such expenditures are not considered in the financial analysis.

Table A7.3: Results of Financial Analysis

Unaccounted-for Water Reduction Trajectory	Time Interval Between Tariff Increases (Years)	Weighted Average Tariff Increase (%)	Financial Internal Rate of Return (%)	Net Present Value (CNY million)
Peaks at over 28% by 2011, declines to 20% over 20 years	3	10	7.0	5,177
Peaks at over 28% by 2011, declines to 20% over 20 years	3	5	5.5	3,150
Peaks at over 28% by 2011, declines to 20% over 20 years	5	5	4.7	2,308
Declines to 20% by 2013	10	65	7.0	5,486
Declines to 20% by 2013	3	10	7.5	5,825

Source: Independent evaluation mission.

C. Economic Analysis

1. Inputs and Assumptions

7. Capital and operating costs used for financial analysis are adjusted with shadow pricing factors that reflect the tradable or non-tradable nature of products, commodities, utilities, and other services used in project set-up and operations, as well as the use of skilled and unskilled labor.² For purposes of estimating the economic internal rate of return (EIRR), the consumer willingness to pay estimated at appraisal provides the basis for assessing the value of clean Mopanshan water. As per these estimates, the households were willing to pay an additional 43% for clean water, while value addition by water to industrial output was estimated at CNY6.32 per m³.³ The additional 43% reflects the benefits that the survey respondents were aware of—such as convenience of 24-hour water availability, and the avoidance of diarrhea and hepatitis (i.e., cost of medicines to treat such ailments).

8. The economic analysis also incorporates additional benefits from clean water that the independent evaluation mission could discern from a focus group discussion and a small sample survey of Harbin residents. These discussions revealed that in addition to avoiding expenditure on medicines to cure infections,⁴ the benefits are (i) less income lost owing to absence from work due to such ailments, and (ii) less expenditure on bottled water. The underlying data for estimating such benefits is presented in Table A7.4. In recognition of the fact that the independent evaluation mission could conduct only a small number of interviews, the findings can at best be considered indicative. Therefore, conservative assumptions are used to assess the benefits from these findings.

² The shadow price factors for project capital cost are 0.5 for land acquisition, 1.0 for civil works and construction equipment, 1.05 for electrical and mechanical works, 1.1 for project management and resettlement works, 1.28 for consulting and training, 1.52 for survey and design, and 0 (zero) for taxes and duties. The shadow price factors for operation and maintenance are 0.93 for power, chemicals, administrative, finance, routine repair, and maintenance and depreciation; 2.0 for skilled labor; and 0.7 for unskilled labor. All shadow price factors are same as used for economic analysis at completion.

³ ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan for the Harbin Water Supply Project in the People's Republic of China*. Manila (18 February).

⁴ As per these discussions, the avoided cost of medicine is estimated on the basis of (i) a person gets some infection about 2–3 times each year during the summer months; and (ii) expenditure on medicines is CNY30–50 for each such illness. This information is not used in the economic analysis as the avoided medicine cost was included in the willingness-to-pay price of water.

Table A7.4: Assumptions for Estimating Economic Benefits

Economic output lost from infections and other minor ailments	<ul style="list-style-type: none"> Assumed that the per-capita GDP of Harbin urban areas is in the \$5,000–5,600 range since 2007. This is a very conservative number, given that the GDP per capita for the entire Harbin City (which includes rural areas as well) was \$4,168 in 2008. Assumed further that 30% of people living in Harbin urban areas have jobs and contribute to economic output. A person does not go to work for 2–3 days each time he/she has such an infection/ailment. For base-case analysis, assumed 2.5 days absence per ailment.
Avoided use of bottled water	<ul style="list-style-type: none"> Before the project came on stream, bottled water consumption was as follows: 3 liters per month in middle-income households, 0.5 liters per month in low-income households, and no (zero) consumption in poor households. Assumed that 50% of non-poor urban households are middle-income and the remaining are low-income households. Bottled water prices ranged from CNY1.5 for a 250-milliliter bottle to CNY10 for a 5-gallon (approximately 20 liter) barrel.

GDP = gross domestic product.

Source: Independent evaluation mission.

9. The EIRR estimates do not include any benefits that accrue from (i) avoided loss of life and economic output owing to reduced incidence of health problems caused by trace organic chemicals in the Songhua River;⁵ and (ii) environmental flows that have been maintained since the Mopanshan reservoir was constructed and phase I of the project was commissioned.⁶

2. Results of Economic Analysis

10. With the above-mentioned inputs and assumptions, the EIRR is estimated at 12.5%, which makes the project economically viable. The economic viability is enhanced further if UFW is assumed to decrease rapidly to 20% by 2013, when the EIRR is estimated at 12.9%. These EIRR estimates however, are underestimated, as the values of certain economic benefits (para. 9) are difficult to estimate from available information.

⁵ The trace organic chemicals found in the Songhua River are known to cause cancers, birth defects, and/or premature births. However, reliable baseline data (before the project came on stream) and more recent data on the level of incidence of such health problems are not available to the independent evaluation mission.

⁶ Before the Mopanshan reservoir was built, the water flows in the Lalin River fell to 3 m³–4 m³ per second in the winter months, which was below the required environmental flow of 5 m³ per second. However, through proper water management at Mopanshan and the water treatment plant underground storage facility, the reservoir can release up to 13 m³ per second even in winter months, and meet water requirements of Harbin urban areas and environmental flows.

WATER TARIFFS

A. Water Tariff Policies

1. The Asian Development Bank (ADB) actively encouraged enterprise reform and water tariff rationalization through two advisory technical assistance (TA) projects for tariff studies in the late 1990s. The first tariff study assisted in the development of guidelines for appropriate national tariff mechanisms at the national level and was a major step in improving governance in the water and wastewater sectors.¹ The tariff study supported the formulation of the National Guidelines on Water Tariffs (NGWT), which were promulgated by the Government of the People's Republic of China (PRC) in September 1998, and became fully operational a few years later. The NGWT was the first national regulation on water tariffs, and also the first national tariff regulation within the urban public utilities sector. The NGWT stipulated tariff definitions, tariff setting, application and approval procedures, supervision, and monitoring. Wastewater treatment fees were to be included as an addition to the tariff and collected with the water bill. Tariffs were stipulated to recover costs, fees, taxes, and allow for reasonable profits. The NGWT provided a reference level for profit; and tariff levels were to be set on the principles of cost recovery, a reasonable profit, water conservation, and fairness to users. The tariff application and approval procedures also included mandatory public hearings, and the authority to approve new water tariffs was vested with the provincial government.

2. The second ADB-supported tariff study focused on implementation of the NGWT within the provincial government and the Harbin municipal government (HMG).² In particular, it provided assistance in (i) the drafting of local implementing regulations under the NGWT and making it fully operational; (ii) recommending cost-control measures for water supply companies; (iii) assessing affordability and related urban poverty issues; (iv) assessing implications for water conservation and sustainable environment management; (v) assessing capacity-building requirements in the water sector; and (vi) developing a national program for implementing the NGWT.

3. The water bills that supply companies tender to their customers include three major components:

- (i) *the water resource fee (WRF)*, which is channeled to meet the costs incurred for protection of water resources in upstream areas including the headwaters. As per the administrative guideline that became effective in January 2009,³ 10% of the collected WRF is remitted to the national government (Ministry of Finance), and the remaining 90% is shared by the provincial, municipal, and local governments;⁴
- (ii) *the water supply fee (WSF)*, which under the NGWT is intended to cover all costs incurred by the supply companies, including a reasonable profit margin. In the case of Harbin urban areas, the WSF should cover the costs of and a reasonable profit margin for the Harbin Water Supply Engineering Company (HWSEC) and the Harbin Water Supply Department (HWSD); and

¹ ADB. 1997. *Technical Assistance to the People's Republic of China for the Water Supply Tariff Study*. Manila (TA 2773, for \$600,000, approved on 24 March).

² ADB. 1999. *Technical Assistance to the People's Republic of China for the Water Tariff Study II*. Manila (TA 3250, for \$950,000, approved on 3 September).

³ National Development and Reform Commission and Ministry of Finance. 2008. *Administrative Guideline on Collection and Use of Water Resource Fees*. Beijing, 10 November (effective 1 January 2009).

⁴ In the specific case of Harbin, the HWSD began WRF in 2010; from 1 January to 1 August 2010, the WRF was CNY0.50 per m³, and since 1 August 2010 it is CNY1.0 per m³.

- (iii) *the wastewater treatment fee (WWTF)*, which covers the costs of setting up and operating wastewater treatment plants, and a reasonable profit margin. In the case of Harbin urban areas, the WWTF is passed on to the Harbin Wastewater Treatment Company and the Harbin Drainage Company—both of which are under the fold of the group company.

B. Water Tariffs in Harbin Municipal Area

4. After a policy dialogue during project formulation, the provincial and municipal governments implemented the NGWT in Harbin City. Accordingly, the water supply tariffs were raised twice in relatively quick succession: by 34% in June 2000 and a further 26% in December 2001; the cumulative increase was about 68%. The end-user tariff rates effective December 2001 are as shown in Table A8.1. The supply tariff levels remained unchanged until 1 January 2010, when they were revised after approval from the provincial government. The key features of the tariff revision are (i) the tariff rate for poor urban households was not raised in keeping with the minimum living guarantee regulation; (ii) the number of tariff categories was reduced from 5 to 3 through a directive from the National Development and Reforms Commission, with some tariff benefit accruing to certain service providers such as hotels and restaurants; and (iii) special businesses were subject to the highest tariff rate increase. There are no progressive tariff rates for any customer category. Besides, there are certain categories that are not covered by the tariff regime, such as organizations and institutes that are exempted from paying for water they consume, public construction, or other civil construction sites.⁵

Table A8.1: End-User Water Supply Tariffs

Tariff Category	Tariff Rates Effective December 2001 (CNY/m ³)	Tariff Rates Effective January 2010 (CNY/m ³)
Households ^a	1.80	2.40
Industry	2.40	
Commercial and business	2.50	4.30
Services (hotels, restaurants, etc.)	4.00	
Special businesses (spas, car washing, etc.)	7.00–10.00 ^b	16.40

^a The lifeline rate for poor households, as per the minimum living guarantee regulation, remained unchanged at CNY1.30/m³.

^b Tariff rate of CNY7/m³ for car-washing and bath-houses with a cover charge of up to CNY10; tariff rate of CNY10/m³ for bath-houses with a cover charge higher than CNY10.

Source: Harbin Water Supply Company.

5. The HWSD bills customers each month. The water bills include the following: (i) the WRF of CNY0.10/m³ (since 1 August 2010); (ii) the WSF as shown in Table A8.1; and (iii) the WWTF, which is CNY0.80/m³ for households and CNY1.20/m³ for other customer categories. The WRF is a pass-through to the government. The WWTF that is collected by HWSD is passed on to the Harbin Wastewater Treatment Company (HWWTC) and the Harbin Drainage Company. The WSF, which essentially helps meet the costs of the HWSD and HWSEC, also includes (i) from all customers, a fee contribution of CNY0.10/m³ to the water meter upgrade fund. HWSD is at present using this contribution to move water meters from inside individual homes in apartment buildings to common passage areas that are more accessible to meter readers; and (ii) from key and large non-household customers, a water prime charge that is

⁵ Although only 2%–3% of consumers may fall under these categories, they may still account for as much as 30% of water consumption and about 20% of revenue (as per data from the HWSD for September 2007 and September 2009).

about 10% of the total WSF, with the objective of encouraging them to conserve water.⁶ The WSF also includes the cost of maintaining seven back-up systems to provide water from the Songhua River.⁷

C. Sustainability Issues

6. Sustainability issues in the Harbin water supply sector arise from inadequacies of the WSF and WWTF. The WRF is a pass-through, and the water supply company simply acts as a WRF-collecting and channeling agent.

7. The WWTF is considered adequate for the HWWTC and the Harbin Drainage Company to recover their costs and generate a small profit. It is important to recognize, however, that their cost recovery is contingent upon the facts that (i) the national and provincial governments and the PRC commercial banks continue to provide capital for investment and expansion purposes, and that interest payment and loan repayment liabilities arise only from bank borrowings; and (ii) capital and operating costs for sludge treatment are not considered, even though the HWWTC is implementing a 1,000 tons per day sludge treatment plant that is expected to be commissioned by early 2011. The HWWTC is also implementing four new class 1a wastewater treatment plants.

8. The average WSF collected in 2009 was CNY2.24/m³ versus a total cost of CNY3.75/m³.⁸ The estimated financial shortfall in 2009 was over CNY200 million. The tariff increase of January 2010 is estimated to increase the average revenue realization by no more than 30%–40%, which would reduce the financial shortfall somewhat but not eliminate it. In fact, even the CNY40 million subsidy extended by the HMG will not be enough for the HWSD and HWSEC to fully recover their costs.⁹ However, it is important to recognize that both successfully continue to raise finances for both working capital and capital investment requirements from the PRC commercial banks—albeit on the financial strength of the group company. Thus far, the financial shortfall does not appear to have led to deferment of projects or project implementation delays. And even though the January 2010 tariff increase and the HMG subsidy are good signs for HWSEC and HWSD, it is not quite clear whether or not the subsidy will continue to come each year, and whether or not efforts will be made to improve the operational efficiency of the distribution network, and rationalize tariffs each year over the next few years.

9. Nonetheless, if the Harbin gross domestic product continues to grow as in recent years (about 10% per annum), it is very likely that the average water tariff would rise in nominal terms at least from 2013, when the share of sales to non-household categories would begin increasing year on year after 100% area coverage is achieved.¹⁰

⁶ A new regulation expected to become effective by the end of 2010 is expected to remove the water prime charge.

⁷ One back-up system is maintained by the Yihe Wastewater Supply Company; the other six are maintained by the HWWTC. Both are within the fold of the group company.

⁸ As per the group company, HWSEC, and HWSD, the average total cost incurred to source and supply water during the 3-year period 2007–2009 is CNY3.75/m³, which covers (i) inclusive of WRF, the cost of raw water supply to the water treatment plant of CNY1.93/m³; and (ii) other costs of raw water processing, and clean water distribution and supply of CNY1.82/m³.

⁹ The CNY40 million subsidy is for both phase I and phase II of the project and comprises (i) a fixed amount of CNY27 million paid each year to the group company; (ii) a subsidy of CNY6.3 million to make up the shortfall from the tariff subsidy to poor households covered by the minimum living guarantee regulation; and (iii) CNY6.7 million to partly cover the cost of maintaining back-up systems for supply of Songhua River water.

¹⁰ Owing to gradual population growth in Harbin urban areas coupled with rapid increase in economic and commercial activity.

D. Water Tariff Revision Process (the Harbin Experience)

10. In line with the national policy and regulations, water tariffs are revised with the approval of the provincial government's price bureau, after consultations with the HMG's price bureau, and involving various stakeholders, including the consumers, the group company, and its various subsidiaries and departments. The process for changing the WSF or the WWTF is the same. Below is the process that led to the increases in WSF from January 2010:

- (i) Along with the group company, HWSD and HWSEC began the process by submitting a tariff revision proposal to HMG's price bureau. The proposal contained details of cost of supply, balance sheet, and income statement data that provided the financial and accounting justification for revising tariffs.
- (ii) Upon receipt of this proposal, the price bureau conducted an audit of the financial and accounting information provided by the petitioners.
- (iii) The price bureau prepared an audit report for submission to the HMG and requested a discussion of the tariff proposal at the next HMG executive meeting.
- (iv) After the HMG executive's decision to go ahead and process the tariff petition further, steps to hold a public hearing were initiated. In particular, the key elements of the tariff proposal were published 30 days prior to the public hearing to invite feedback and comments. The feedback was channeled through a consumer association, which also published the names of persons who had expressed interest in submitting their views at the public hearing. There was only one public hearing.¹¹
- (v) A synthesis report that included key aspects of the original tariff petition, the audit findings, opinions of the executive meeting, etc. was prepared by the Harbin Price Bureau.
- (vi) At the public hearing, the price bureau presented the justification for tariff increase, and the consumers provided their feedback and comments to which the price bureau responded. Officials of the group company and its subsidiaries and divisions were also present at the public hearing, but provided additional inputs (in response to consumers) only when asked to do so by the price bureau.
- (vii) Given the successful outcome of the public hearing on 8 December 2009 (in that tariffs could be increased) and in keeping with the tariff increases considered acceptable, the price bureau updated the proposals for submission to the Heilongjiang provincial price bureau.
- (viii) After approval from the Heilongjiang provincial price bureau on 4 January 2010, tariffs were revised with effect from 1 January 2010.

11. The entire process took about 5 years since the tariff revision proposal was first submitted in 2005, while the project was still being implemented. However, the need for further tariff increase still remains, and it is hoped that tariff rationalization mechanisms are put in place.

E. Outlook for Water Tariff Revisions

12. The frequency of tariff adjustment varies from city to city. Beijing has adjusted its water tariff once every 2 years on average, whereas Harbin once in the past 10 years. On average, the frequency is about 3–5 years. In Beijing, the composite water tariff for residential consumers increased from CNY0.70 per m³ in 1997 to CNY2.90 per m³ in 2003, to CNY3.70 per m³ in 2004–2008, and CNY4.00 per m³ since 2008.

¹¹ As per norm, only one public hearing is required to be held for each petition.

13. The last wave of water tariff adjustments swept the country in 2009, with many cities planning to increase water tariffs in 2009 and 2010. In response, the national government issued a directive on water tariffs,¹² which requires the provincial, municipal, and local governments to comply strictly with the water tariff adjustment procedures, take full consideration of the social affordability, and prevent steep increases. The directive also requires local governments to expedite the implementation of appropriate “progressive water tariffs” for residential consumers to minimize the impact of water tariff adjustment on low-income families and to encourage water conservation, and to streamline the tariff structure by reducing the consumer categories to three: residential, non-residential (industrial and commercial), and special sector.

14. Historically, public utility (including water) tariffs in the PRC have been kept low. The prices do not reflect the true market value or even the cost of production. While the government is determined to implement market-based price reforms for public utilities and to make them financially sustainable, it is also concerned with the risks associated with sudden tariff increases. The likely approach is to adjust the tariffs gradually to a self-sustaining level, while maintaining affordability to the low-income families. Progressive block tariffs are likely to be adopted, in combination with preferential tariffs and subsidies for low-income households.

F. Tariff Increases for Other Utility Services

1. Electricity

15. Harbin is served by the Harbin Power Supply Company, and the electricity tariffs are determined at the provincial level by the Heilongjiang provincial price bureau. Electricity tariffs may differ marginally from city to city. Table A8.2 shows that electricity tariffs in Harbin have been increased at least three times for all customer categories (including households) since 2000. During 2000–2010, tariffs have increased by about 24% for households and nearly 60% for industrial customers; tariff rates for commercial consumers, which were already high in 2000, have increased marginally. It appears, therefore, that an attempt is being made to gradually reduce the cross-subsidy between customer categories.

Table A8.2: Electricity Tariffs in Heilongjiang Province (CNY per kilowatt-hour)

Item	2000	2002	2004	2006	2007	2008	2010
Residential	0.412	0.412	0.470	0.510	0.510	0.510	0.510
Industrial	0.500	0.500	0.500	0.526	0.773	0.773	0.798
Commercial	0.852	0.852	0.852	0.868	0.883	0.883	0.908

Sources: (i) <http://news.qq.com/a/20091126/000790.htm>

(ii) http://www.sdpc.gov.cn/jggl/jggs/t20071010_175905.htm

(iii) <http://news.sina.com.cn/c/2006-07-25/01159554405s.shtml>

(iv) http://news.163.com/2004w04/12522/2004w04_1081923039059.html#rightnow#rightnow

(v) <http://wenku.baidu.com/view/11390469a45177232f60a217.html>

2. Heating

16. The concessionaire for heat supplies to residential and other customers in urban Harbin is required to charge its customers as per tariffs set by the HMG's Price Bureau. Table A8.3 shows that heating tariffs have also increased at least twice during the past 5 years.

¹² National Development and Reform Commission, and Ministry of Housing and Urban and Rural Development. 2009. *Directive on Improving Management of Urban Water Tariffs*. Beijing. (6 July).

Table A8.3: Heating Tariffs in Harbin City
(CNY per square meter per season)^a

Item	1996	2006	2008	2010
Residential	31.15	34.55	40.35	40.35
Non-residential	31.15	37.35	44.49	44.49

^a Refers to square meter of net floor area in a household; and to the entire 5–6 month heating period in the winter season.

Sources: (i) <http://news.qq.com/a/20081023/002716.htm>

(ii) <http://heilongjiang.dbw.cn/system/2006/01/12/050235086.shtml>

RESETTLEMENT, COMPENSATION, AND LIVELIHOOD ASPECTS

A. Background

1. The resettlement action plan (RAP) prepared by the Harbin Water Supply Engineering Company (HWSEC) in 2002 was approved by the Asian Development Bank (ADB) in the same year. As per the RAP, 6,022 persons or 1,740 households from 10 townships, 24 villages, and 1 forest bureau with 3 forest stations were to be partly or fully affected by land acquisition and resettlement. The affected persons included 5,175 persons or 1,499 households in the Mopanshan reservoir inundation area (3,314 persons or 859 households in Wuchang City, and 1,861 persons or 640 households in Shanhetun Forest Bureau); 505 persons or 101 households along the water transmission pipeline; and 342 people or 140 households within the site of the water treatment plant. During implementation, the number of affected persons increased to 7,048—2,108 households in 12 townships, 59 villages, and 1 forest bureau (Table A9.1).

Table A9.1: People Affected by Land Acquisition and Resettlement

Item	Affected Households		Affected Population	
	Appraisal	Actual	Appraisal	Actual
Reservoir (Wuchang City) ^a	859	1,146	3,314	4,444
Reservoir (Shanhetun Forest Bureau) ^a	640	652	1,861	1,890
Raw water pipeline ^b	101	170	505	372
Water treatment plant ^b	140	140	342	342
Distribution network	-	-	-	-
Total	1,740	2,108	6,022	7,048

^a Permanent land acquisition only.

^b Includes permanent and temporary land acquisition.

Source: Harbin Water Supply Engineering Company.

2. Table A9.2 also shows the area of land acquired for permanent use of the project facilities (mostly Mopanshan reservoir and dam). It is noteworthy that HWSEC had obtained approval from the Harbin municipal government (HMG) for acquiring, both permanently and for temporary use, more land than was necessary, which avoided implementation delays.

Table A9.2: Permanent and Temporary Land Acquisition (mu)

Item	Permanent Land Acquisition			Temporary Land Acquisition		
	Appraisal	Actual	Government Approval	Appraisal	Actual	Government Approval
Reservoir (Wuchang City)	22,544	21,823	43,963	970	3,473	3,473
Reservoir (Shanhetun Forest Bureau)	22,526	20,032				
Raw water pipeline	1,469	154	154	8,107	6,852	8,138
Water treatment plant	381	448	448	-	300	300
Distribution network	-	-	-	315	-	616
Total	46,919	42,457	44,565	9,392	10,625	12,572

mu = Chinese acre (666.67 square meters).

Source: Harbin Water Supply Engineering Company.

3. The progress of the resettlement effort was monitored by HWSEC's resettlement management office (RMO). The actual resettlement effort, however, required the efforts from a large number of officials from the local governments at the source and destination locations. Among other factors, the resettlement process entailed a process of interaction with the affected

households to explain the terms of the resettlement (essentially compensation rates and amounts, resettlement schedule, and dates). The contracts did not include any clauses on subsidies or other assistance to the affected households, but simply followed the provisions of the national, provincial, municipal, and local governments (Box A9.1). The normal process is for the concerned government officials (and perhaps RMO officials) to provide a detailed explanation to the affected households on the objectives and mechanisms of resettlement, basis for compensation rates and amounts, other subsidies and assistance, etc., and convince them of the overall benefits of resettlement. As a case in point, two households in Shanhezi township were not willing to give up their original home and resettle even nearby. Senior RMO and local government officials visited their homes several times to explain the benefits of the project as well as the benefits of moving elsewhere. Eventually, the two households were reported to have understood that their living conditions would improve if they were relocated to another township, that the compensation would help them to buy new land or house, and that they would be able to sustain a livelihood.

Box A9.1: Government Assistance to Affected Households^a

- Households resettled from Mopanshan reservoir area to Wuchang City are exempted from agricultural tax for 3 years.
- Students affected by resettlement from the Mopanshan reservoir area are admitted to schools near the places they have resettled and have a 3-year exemption for tuition fees.
- Businessmen who are resettled from the Mopanshan reservoir area are considered to be on 6-month probation for temporary business operation in the place they have resettled (if so approved by the Commercial and Industrial Administration). They are exempt from paying administrative charges during the 6-months temporary business operation.
- Affected people who are resettled from the Mopanshan reservoir area and intend to engage in production and business development in Wuchang are provided with low-interest (at the lowest permissible interest rate) short-term and medium-term credit.
- Farm vehicles that are owned by Mopanshan reservoir area resettlers and have to be relocated are not intercepted on highways and detained by the Traffic Management Bureau if there is no criminal violation and are registered free of charge in the new place within 3 years of relocation.^b
- Affected people from the Mopanshan reservoir area are allowed to sell their agricultural products in Wuchang and are exempt from administrative charges that are normally levied on the sellers.
- Affected people from the Mopanshan reservoir area who buy or construct houses in the relocated areas are exempt from all administrative and construction charges.

^a Assistance from national, provincial, municipal, and local governments to affected households, over and above the compensation they receive.

^b In the People's Republic of China, farming tractors are not allowed on highways or civil roads and were especially allowed to do so during the physical relocation process.

Source: Harbin Water Supply Engineering Company.

4. The relocation destinations of the affected households were decided through a consultative and participatory approach, and compensation payments were made. During the consultative process, some affected households expressed their desire not to move far away from their hometown, and proposed to stay in the area where they grew up. The RMO thus revised the relocation plan several times to accommodate such requests. As a result, nearly 90% of the families displaced from the Wuchang City were resettled in Wuchang City itself (Table A9.3); most continued agriculture or agriculture-related livelihoods. Most affected persons from the Shanhetun Forest Bureau moved to centralized resettlement sites, as they preferred to continue to engage in forestry-related livelihoods.

Table A9.3: Relocation Destinations and Housing Arrangements

Relocation From	Relocation To	Affected Population	No. of Affected Households	Resettlement Houses Purchased	Resettlement Houses Self-Built
Wuchang City	Within Wuchang City	3,982	1,034	491	543
	Within Heilongjiang	89	20	9	11
	Outside Heilongjiang	373	92	44	48
	All	4,444	1,146	544	602
Three inundated substations of Shanhetun Forest Bureau	Harbin station	2	1	1	-
	Other substations within Shanhetun Township	143	52	52	-
Forest Bureau	Daqing station	3	1	1	-
	Qifengshan station	421	139	-	139 ^a
	Shuguang station	118	51	-	51 ^a
	Fendou station	1,203	408	-	408 ^a
	All	1,890	652	54	598 ^a

^a Including houses in the newly built resettlement site of the designated forest stations.

Source: Harbin Water Supply Engineering Company.

B. Compensation

1. Compensation for Permanent Agricultural Land Acquisition

5. The RAP provided for land compensation and resettlement subsidy as part of the compensation for the permanent acquisition of agricultural land. The land compensation level was set at six times the average annual agricultural output value (AAOV) for dry land, paddy land, and orchards, and the resettlement allowance to four times the AAOV (Table A9.4). Table A9.4 also gives the compensation rates for other lands, as set in the RAP. During actual project implementation, however, the compensation rates were 13 times the AAOV for dry land and paddy land. It needs no reiteration that the new multipliers were applied in the interest of the affected persons. AAOVs were also set at a higher level for certain agricultural land uses (e.g., vegetable garden, greenhouses) not considered in the RAP.

Table A9.4: Compensation Rates for Acquisition of Agricultural Land

Type of Land	As per RAP			Actual		
	AAOV (CNY/mu)	LCAR Multiple	Compensation Rate (CNY/mu)	AAOV (CNY/mu)	LCAR Multiple	Compensation Rate (CNY/mu)
Dry land	520	6 + 4	5,200	520	7 + 6	6,760
Paddy land	787	6 + 4	7,870	787	7 + 6	10,231
Orchard	1,600	6 + 3	14,400	1,600	6 + 3	14,400
Fish pond	2,333	3 + 3	14,000	2,333	6 + 0	14,000
Unused land	520	2 + 0	1,040	520	2 + 0	1,040
Homestead	520	4 + 0	2,080	520	4 + 0	2,080
Vegetable land	-	-	-	2,533	7 + 6	32,929
Plastic greenhouse	-	-	-	8,333	7 + 6	108,329
Heated greenhouse	-	-	-	11,332	7 + 6	147,316
Energy-efficient greenhouse	-	-	-	13,332	7 + 6	173,316
Natural pasture land	-	-	-	100	6 + 0	600
Planted pasture land	-	-	-	133	6 + 0	798

AAOV = annual agricultural output value, CNY = yuan, LCAR = land compensation and resettlement subsidy, mu = Chinese acre (666.67 square meters), RAP = resettlement action plan.

Source: Harbin Water Supply Engineering Company. 2009. *Resettlement Completion and External Evaluation Report*. Harbin (March).

2. Compensation for Permanent Acquisition of Forest Land

6. Forest land is the primary resource for people living and working in the Shanhetun Forest Bureau. As per national and local laws and regulations, a forest area destroyed in one location should be replaced by an equivalent forest area in another location, and compensation should be provided to affected people so that they can maintain their livelihoods. As shown in Table A9.5, compensation for permanently acquired forest land actually included (i) value of the acquired forest land; (ii) value of trees lost; (iii) cost of reforestation; and (iv) resettlement subsidy. This was different (and not directly comparable to) the forest land categories that had been included in the RAP; in particular, the four forest land categories in the RAP were reduced to two (“general woodland” and “forest for timber land”) during the implementation stage, as it was not easy to classify all forest lands into the four categories as per RAP. In general, however, the actual compensation rates for forest lands were higher than those stipulated in the RAP. In addition, the actual compensation also included compensation for cost incurred on reforestation as well as a resettlement subsidy for those whose forest lands had been permanently acquired for purposes of the project.

Table A9.5: Forest Land Compensation Rates

As per RAP		Actual	
Type of Forest Land	CNY/mu	Type of Forest Land	CNY/mu
Timber forest	500	General woodland	534.57
Protection forest land	650	Forest for timber land	698.59
Economic forest	900	Reforestation	350
Other forest land	250	Resettlement subsidy	3,000

mu = Chinese acre (666.67 square meters), RAP = resettlement action plan.

Source: Harbin Water Supply Engineering Company. 2009. *Resettlement Completion and External Evaluation Report*. Harbin (March).

7. For actual trees lost to land acquisition throughout the project area, the compensation rates are as presented in Table A9.6. The actual compensation rates for all types and sizes of trees were as specified in the RAP.

Table A9.6: Compensation for Individual Trees Lost to the Project (CNY per tree)

Type of Trees	Diameter (cm)	Compensation Rate (CNY/tree)
Coniferous trees	< 4.9	6.0
	5–9.9	10.0
	10–14.9	17.0
	> 15	32.0
	Young	1.4
Broad-leaf trees	< 4.9	4.5
	5–9.9	7.0
	10–14.9	12.0
	> 15	20.0
	Young	0.42

cm = centimeter, CNY = yuan.

Source: Harbin Water Supply Engineering Company. 2009. *Resettlement Completion and External Evaluation Report*. Harbin (March).

3. Compensation for Temporary Land Occupation

8. Land required temporarily during a construction period is normally for a period of 2 years. The compensation levels recommended in the RAP were twice the AAOV (the AAOV being the same as that used for compensation for permanent land acquisition). During actual implementation, however, the cost of restoring the land to its original state was also compensated for—normally at the rate equal to the AAOV. Table A9.7 shows that the overall compensation rates for temporary occupation of various types of land were higher than approved through the RAP.

Table A9.7: Compensation Rates for Temporary Land Occupation (Wuchang)

Type of Land	As per RAP			Actual		
	AAOV (CNY/mu)	CTLO Multiple	Compensation Rate (CNY/mu)	AAOV (CNY/mu)	CTLO Multiple	Compensation Rate (CNY/mu)
Dry land	520	2	1,040	520	3	1,560
Paddy land	787	2	1,574	787	-	-
Vegetable land	2,533	2	5,066	2,533	3	7,600
Plastic greenhouse	8,333	2	16,666	8,333	-	-
Orchard	1,600	2	3,200	1,600	2.5	4,000
Unused land	520	2	1,040	520	3	1,560
Other agricultural land	520	2	1,040	520	3	1,560

AAOV = annual agricultural output value, CNY = yuan, CTLO = compensation for temporary land occupation, mu = Chinese acre (666.67 square meters), RAP = resettlement action plan.

Source: Harbin Water Supply Engineering Company. 2009. *Resettlement Completion and External Evaluation Report*. Harbin (March).

4. Compensation Rates for Housing

9. An affected household is compensated for residential land through allocation of a plot of suitably sized land within a selected resettlement area. Houses are compensated so that similar or better houses than the demolished ones can be built or purchased by an affected household. Compensation rates for houses are determined as per the (estimated) full replacement cost. Table A9.8 shows that the actual compensation for house demolition was in line with that stated in the RAP; either the actual rates or the median rates were the same, and where a range of compensation rates was considered, it reflected the finer differences in the construction.¹ As per the RMO, follow-up meetings with the affected households revealed that they were indeed able to purchase or construct houses that were generally similar or better in size, quality, and functionality than their original (now demolished) houses. In fact, before the relocation, the original houses were primarily brick, mud-straw and mud-brick structures, while the new brick and concrete houses are relatively larger.²

¹ For instance, brick-concrete houses may involve houses with concrete walls of different heights and some walls with bricks alone. The differences in the quantity of construction materials would affect the reconstruction costs.

² The average house area (on a per-capita basis) has increased for rural households from 13 square meters (m²) to 21 m², and for forest households from 13.3 m² to 17.6 m². More specifically, a 36 m² wood and stone house of a certain rural family was replaced by a 40 m² brick structure. Likewise, a 45 m² wood and stone house of another rural family was replaced by an 82 m² concrete structure.

Table A9.8: Compensation Rates for Demolished Houses

Structure of Houses	RAP Compensation (CNY/m²)	Actual Compensation (CNY/m²)
Public office building	504	504
Club/theater houses	-	800
Private brick-concrete	410	370–538 with median: 410
Brick	410	252–470 with median: 410
Mud and brick	304	165–385 with median: 304
Mud and straw	265	135–381 with median: 265
Brick barns	100	100
Mud barns	60	60

CNY = yuan, m² = square meter, RAP = resettlement action plan.

Source: Harbin Water Supply Engineering Company. 2009. *Resettlement Completion and External Evaluation Report*. Harbin (March).

5. Other Compensation Benefits

10. Compensation benefits were also extended to permanent or temporary acquisition (and possibly demolition) of auxiliary structures, and public utilities and publicly used infrastructure.³ Besides, the affected people were compensated for costs incurred during the physical relocation, such as conveyance and transportation, medical expenses, lost working time, temporary housing, and vehicle rental (if any).

11. The special needs of vulnerable groups were also considered. In general, where there were adverse impacts on women, minorities, children, the elderly and the poor, the RAP provided for additional social assistance of CNY7,000 per household. In actual practice, the approach adopted was to help the vulnerable affected household (or person) solve specific problems if it would cost more than CNY7,000. There are many instances of such help,⁴ which in all likelihood proved more beneficial than a one-off payment of CNY7,000.

C. Resettlement Costs

12. As stated in the project completion report (PCR), the resettlement budget provided in the RAP at appraisal was CNY520.06 million. The actual disbursement of resettlement funds by the end of 2008 was CNY561.98 million, or 7% higher than the original budget, due to (i) changes in actual needs of land acquisition and structure demolition based on the final design and construction; and (ii) relatively higher compensation rates (especially for permanent acquisition of agricultural land) than assumed in the RAP.

D. Livelihood

13. Resettled households received resources (including land, housing, and public infrastructure) and support needed to help them restore their livelihoods and well-being and to achieve a standard of living comparable to residents of their host communities. The strategy

³ Auxiliary structures include wells and sheds. Public utilities and infrastructure include bridges, roads, public pavilions, and water supply towers.

⁴ For instance, a single mother and her two school-going children, who constituted an extremely poor family before relocation were placed in a nursing home. The children were enrolled in school free of charge. The local government resettlement office (of Shanhezi township) also bought them fuel wood, rice, and other goods for everyday existence. In another instance, an orphan who suffered appendicitis and needed to be operated upon, was assisted with hospitalization and other related costs that exceeded CNY15,000.

involved more than simply restoring previous incomes. A comprehensive survey conducted by the RMO in 2008, which covered 20% of the households affected by permanent land acquisition in Wuchang City and Shanhetan Forest Bureau, revealed a significant change in the occupation pattern of the displaced population. Most significantly, given that most resettlers have now moved closer to centers of Wuchang City and other townships, incomes of an increasing share of households now come from transportation, small businesses, and processing industries (although farming and agriculture remain the mainstay).

14. The 2008 survey also revealed that (i) compared with their original villages, the relocated people have larger pieces of farmland and more job opportunities in their new communities; (ii) the average annual income per capita for rural resettlers in 2007 was about CNY5,950, and for forest workers about CNY5,000—50% and 60% more than the per-capita incomes for the two categories in 2006. The RMO informed the independent evaluation mission that before relocation, the average annual per-capita income of the rural inhabitants of the Mopanshan area was below the average of CNY2,509 for the Heilongjiang province. However, available data for 2007 suggests that the average annual per-capita income of the affected rural population of the Mopanshan area probably exceeds the province-wide average (Table A9.9). This indicates that the project contributed to improving the socioeconomic conditions of the affected persons.

Table A9.9: Annual Per-Capita Income in Rural Heilongjiang Areas

Year	CNY/ Capita/Year	% Increase
2003	2,509	
2004	3,005	20
2005	3,221	7
2006	3,552	10
2007	4,132	16
2008	4,856	18

Sources: Heilongjiang Provincial Government. 2003 to 2009. Heilongjiang Statistical Yearbooks. Harbin.

E. Grievance Redress

15. The RMO has been inspecting the resettled areas and filing data and records each year since 2007, when the majority of resettlement and livelihood-generating works was completed. It ended its last full inspection in 2009, after the completion of the resettlement process in 2008.⁵ No more inspection reports are planned by the RMO, as the resettlement, compensation, and livelihood-related processes have been completed. Nonetheless, HWSEC has retained the RMO, which continues to have 10 full-time staff to offer a hotline service to the resettlers, redress their grievances, and maintain necessary records.⁶ The RMO has been managing its services and handling grievances in a transparent and fair manner, in keeping with the tradition developed during the physical resettlement phase.⁷

⁵ Reports on the progress of the resettlement program were prepared each year from 2002 to 2009.

⁶ The independent evaluation mission is given to understand that the grievances are increasingly related to regulations that prohibit the use of fertilizers and pesticides in agricultural land near the Mopanshan reservoir, so as to protect the water source by promoting organic farming.

⁷ During the physical resettlement, most grievances related to some aspect of compensation. Most complaints were received and resolved at the village and township levels; the city/forest resettlement bureaus received much fewer complaints. On the whole, for the entire resettlement process, few cases had to be resolved with the help of the RMO. At any level, the aggrieved party was kept informed of the progress of its case, relevant policies, options, etc.

HEALTH DATA

1. Table A10 shows the only health-related data available for Harbin. The declining trend in cancer deaths indicates better health conditions in Harbin that reduce the incidence of cancers, as well as better facilities and outreach to cure cancers. The infectious diseases include all air-borne, water-borne, and food-intake-related infectious diseases; more granular data is not available.
2. Better health conditions reflect a combination of (i) more hospitals, wards, and qualified doctors; (ii) more types of medical facilities; and (iii) greater coverage of poor households.
3. No large-scale water-borne epidemics in Harbin are reported in the Harbin Statistical Yearbooks.

Table A10: Cancer- and Infectious Disease-Related Deaths in Harbin

Item	2002	2007	2008
Deaths related to cancer	4,398 persons	1,817 persons	1,727 persons
Deaths related to infectious diseases	277 persons		

Source: Harbin Municipal Government. 2003 to 2009. *Harbin Statistical Yearbooks*. Harbin.