

**REPORT AND RECOMMENDATION
OF THE
PRESIDENT
TO THE
BOARD OF DIRECTORS
ON A
PROPOSED LOAN
TO THE
PEOPLE'S REPUBLIC OF CHINA
FOR THE
DALIAN WATER SUPPLY PROJECT**

August 1994

CURRENCY EQUIVALENTS

(as of 14 August 1994)

Currency Unit	-	Yuan (Y)
Y 1.00	=	\$0.116
\$1.00	=	Y 8.59

On 1 January 1994, the dual exchange rate system of the People's Republic of China was unified. The exchange rate of the yuan is now determined under a managed floating exchange rate system. For the purposes of this Report, an exchange rate of Y 8.7 to \$1.00 is used.

ABBREVIATIONS

AIC	-	Average Incremental Cost
AIEC	-	Average Incremental Economic Cost
AIFC	-	Average Incremental Financial Cost
BME	-	Benefit Monitoring and Evaluation
DETDZ	-	Dalian Economic and Technology Development Zone
DMG	-	Dalian Municipal Government
DWSC	-	Dalian Water Supply Company
EA	-	Executing Agency
FIRR	-	Financial Internal Rate of Return
HRD	-	Human Resource Development
ICB	-	International Competitive Bidding
IS	-	International Shopping
LCB	-	Local Competitive Bidding
NRW	-	Nonrevenue Water
NWSC	-	Dalian Yinbi Northern Water Supply Company
OECF	-	Overseas Economic Cooperation Fund (of Japan)
O&M	-	Operation and Maintenance
PIU	-	Project Implementation Unit
PRC	-	People's Republic of China
SCADA	-	Supervisory Control and Data Acquisition
TA	-	Technical Assistance
WBG	-	World Bank Group

WEIGHTS AND MEASURES

cum	-	cubic meter
cum/day	-	cubic meter per day
km	-	kilometer
lpcd	-	liter per capita per day
m cum/day	-	million cubic meter per day

NOTES

- (i) The fiscal year (FY) of the Government coincides with the calendar year.
- (ii) In this Report, "\$" refers to US dollars.

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(ii)

PEOPLE'S REPUBLIC OF CHINA
DALIAN WATER SUPPLY PROJECT

LOAN AND PROJECT SUMMARY

Borrower	:	The People's Republic of China (PRC)
Project Outline	:	<p>The Project will provide much-needed additional water supplies for more than three million people living in Dalian Municipality. If approved, this will be the Bank's first loan to the water supply sector in the PRC.</p>
Classification	:	Human Resource Development
Rationale	:	<p>Severe water supply shortages in Dalian are resulting in extensive interruptions of service, which endanger public health and lower the living standards of the urban residents. Cutbacks of water delivery from the municipal system to industries and development zones have slowed economic development. Excessive extraction of limited groundwater resources is endangering the environment.</p> <p>The Project will address current water shortages and the growing water demand, through the year 2000, by providing new infrastructure. The Project will help to ensure that the limited water resources are utilized in an environmentally sustainable manner. In addition, the Project will provide institutional strengthening and training that will enable the new water supply facilities to be operated in a financially sustainable manner. Policy dialogue with the Government and the responsible agencies in Dalian during the processing of the Project has resulted in a fourfold increase in average water tariffs and in the adoption of tariff reforms that will lead to full cost recovery and elimination of the remaining subsidies within one year of completion and commissioning of the Project facilities.</p>
Objectives and Scope	:	<p>The objectives of the Project are to (i) augment Dalian's water supply to enable residential usage on a 24 hour basis, (ii) provide additional water to meet high priority needs, and (iii) ensure that the new water supply facilities are financially self sustaining. By addressing these objectives, the Project will help to improve the public health, economic opportunity and living standards of Dalian residents. The Project will achieve these objectives by (i) constructing new water supply facilities; (ii) enabling more efficient and cost effective use of existing facilities through leakage detection, water conservancy and improved operation and maintenance programs; (iii) enhancing the Executing Agencies' (EAs') financing capacity and domestic resource mobilization through tariff reform policies that will ensure full cost recovery and elimination of subsidies; and (iv) assisting in the</p>

(iii)

development of human resources for the management and operation of the water supply facilities.

The Project scope comprises two parts:

Part A -- Supply and installation of equipment and civil works for the northern conveyor portion including about 68 kilometers (km) of gravity conduit.

Part B -- Supply and installation of equipment and civil works for the southern conveyor portion including (i) two new raw water pump stations; (ii) two pressurized pipelines of 79 km and 94 km; (iii) a new water treatment plant with capacity of 150,000 cubic meters per day (cum/day) and expansion of an existing water treatment plant with incremental capacity of 180,000 cum/day; and (iv) 140 km of new mains, and replacement of 36 km of old water lines and eight storage tanks with a total capacity of 40,000 cum.

The scope also includes provision of consultant services and training for the implementation of Parts A and B.

Cost Estimates : (\$ million equivalent)

Components	Foreign Currency Cost	Local Currency Cost	Total Cost
Base Cost:			
Parts A & B - Physical Investment, Consulting Services and Training	127.8 2.2	150.5 7.6	278.3 9.8
Total Base Cost	130.0	158.1	288.1
Physical and Price Contingencies	17.5	40.0	57.5
Interest During Construction and Other Charges	16.6	17.5	34.1
Total Project Cost	164.1	215.6	379.7

Financing Plan : (\$ million equivalent)

Financing Source	Foreign Currency Cost	Local Currency Cost	Total Cost
Bank Loan	160.0	-	160.0
Central Government Grant	-	11.5	11.5
Loan: Ministry of Water Resources	-	23.0	23.0
Loan: State Planning Commission	-	11.5	11.5
Loans: Commercial Banks	-	18.4	18.4
Dalian Municipal Government	4.1	151.2	155.3
Total Project Cost	164.1	215.6	379.7

(iv)

Loan Amount and Terms	:	\$160 million from the Bank's ordinary capital resources, with an interest rate to be determined in accordance with the Bank's pool-based variable lending rate system for US dollar loans, with an amortization period of 25 years, including a grace period of 5 years, and a commitment charge of 0.75 per cent per annum.
Allocation and Relending Terms	:	The entire loan amount of \$160 million will be re-lent to the two EAs, the Dalian Yinbi Northern Water Supply Company (NWSC) and the Dalian Water Supply Company (DWSC), under two separate subsidiary loan agreements for \$60 million and \$100 million, respectively, on substantially the same terms and conditions as the Bank loan to the Borrower.
Period of Utilization	:	Until 31 March 1999
Implementation Arrangements	:	The day-to-day responsibility for supervision and implementation will be carried out by Project Implementation Units established for the Project by DWSC and NWSC, to construct the southern conveyor, pumping, treatment and distribution facilities and the northern conveyor system, respectively. To ensure the coordination and overall implementation of the Project, a Project Steering Committee established by the Dalian Municipal Government will provide guidance to DWSC and NWSC through Project Management and Finance Units.
Executing Agencies	:	DWSC and NWSC
Procurement	:	Procurement of all goods and services financed under the Bank loan will be carried out in accordance with the Bank's <i>Guidelines for Procurement</i> , and tendering of materials and equipment will follow international competitive bidding and international shopping procedures. Advance procurement action was approved in April 1994 to expedite Project implementation. Smaller civil works contracts for the northern conveyor, partially funded by the Bank loan, will be tendered following local competitive bidding procedures acceptable to the Bank.
Consultant Services	:	A total of approximately 3000 person-months of consultant services is estimated to be required (66.5 person-months international, 2940 person-months domestic) for (i) detailed engineering design and construction supervision; and (ii) project management, institutional strengthening and training. Selection of international consultants, who will be financed under the loan, will be in accordance with the Bank's

(v)

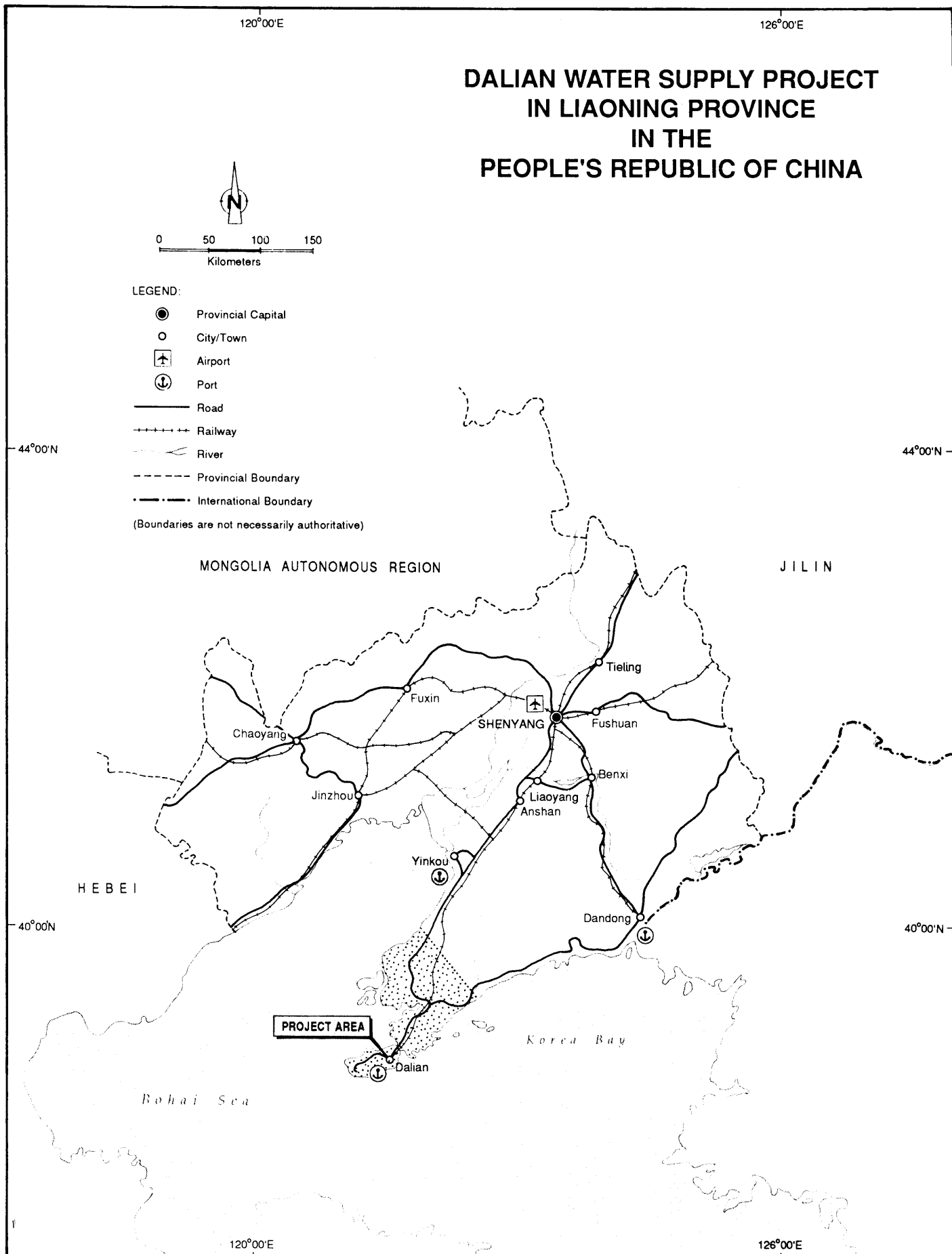
Guidelines on the Use of Consultants. Local consultants will be selected following Government guidelines and procedures acceptable to the Bank.

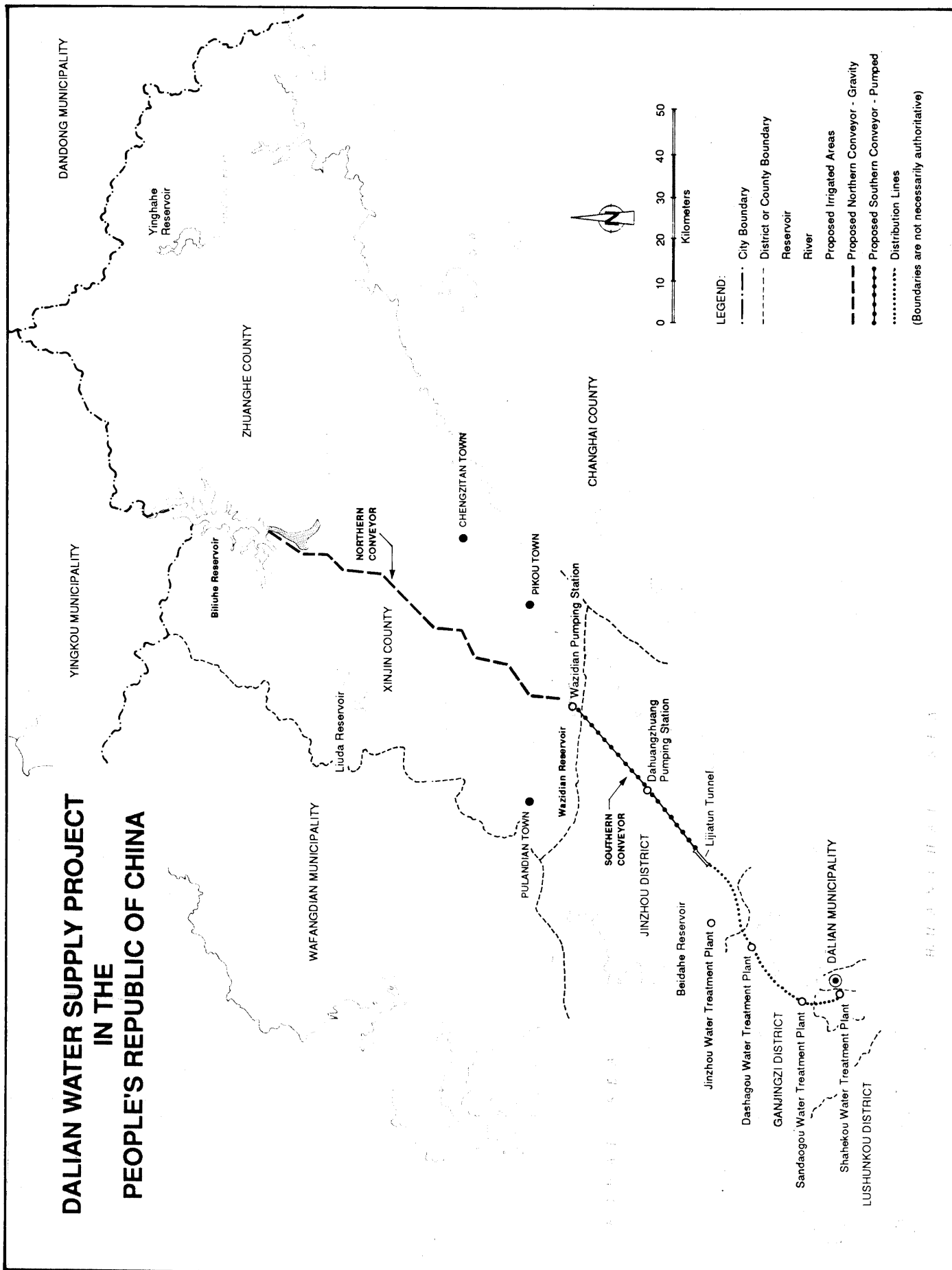
Estimated Completion Date : 30 September 1998

Project Benefits and Beneficiaries : The direct beneficiaries of the Project will include 2.2 million (1.8 million existing and 0.4 million new) residents in Dalian City, about 1 million residents in the rural towns and the farmers who will receive increased supplies of irrigation water.

The benefits of the Project include:

- (i) increasing the water available for residential consumption from the current 80 liters per capita per day (lpcd) to 100 lpcd;
- (ii) enhancing economic growth and employment opportunities through increased industrial and agricultural production;
- (iii) environmental improvements related to protection of scarce groundwater resources;
- (iv) improved production and energy savings due to the new water supply facilities;
- (v) financially sustainable water supply systems resulting from tariff reform (the financial internal rate of return for the Project is estimated at 9.6 per cent); and
- (vi) human resources development through technology transfer and training programs.





I. THE PROPOSAL

1. I submit for your approval the following Report and Recommendation on a proposed loan to the People's Republic of China (PRC) for the Dalian Water Supply Project.

II. INTRODUCTION

2. During the 1991 Country Programming Mission, the Government of the PRC requested the Bank to assist the Dalian Municipal Government (DMG) in evaluating local water resource use and to help develop a project to improve and expand the water supply system in Dalian City. The evaluation was conducted by the DMG with the assistance of international and local consultants financed under Bank technical assistance (TA).¹ This work concluded that the water shortage situation in Dalian City was critical and that a doubling of the raw water supply by the year 2000 was required. Detailed feasibility studies for the resulting Project were prepared by the Dalian Water Supply Company (DWSC) and the Dalian Yinbi Northern Water Supply Company (NWSC), the Executing Agencies (EAs) for the Project. The feasibility studies were reviewed and refined by Bank-financed consultants.² Fact-Finding for the proposed Project was conducted during June 1993, with a follow-up Fact-Finding Mission³ in December 1993 and further discussions in early March 1994. The Project was appraised by a Mission that visited the PRC from 16 to 27 May 1994.⁴ This Report is based on the findings of the TA studies; the findings of the Missions; discussions with officials of the Government, the DMG and the two EAs; and other project preparatory work. If approved, this loan will be the Bank's 33rd loan to the PRC and the first loan in the water supply sector.

III. BACKGROUND

A. Sector Description

3. The PRC is the world's most populous country, with an estimated population of over 1.2 billion. The economic reform policies initiated in 1978, including relaxation of controls over rural-urban migration, brought about rapid growth of the cities. Between 1983 and 1991, the population of the cities grew at the rate of 8 per cent per annum. The urban population has reached 335 million, and there are now more than 476 cities with populations over 200,000. This massive rural-urban migration has generated an enormous demand for urban services including water supply.

4. In most large PRC cities, over 90 per cent of all urban households have piped water supply; but a primary problem is the lack of fresh/raw water for the municipal systems. This water shortage is particularly acute in northern PRC, where low rainfall limits

¹ TA No. 1506-PRC: Dalian Multipurpose Water Resources Development Project, for \$600,000, approved on 15 April 1991.

² TA No. 1852-PRC: Dalian Water Supply, for \$100,000, approved on 10 March 1993.

³ The follow-up Fact-Finding Mission was required because of a major reduction in the Project scope caused by financial constraints that reduced available Project funding by \$100 million equivalent.

⁴ The Mission comprised A. K. Jorgensen (Project Engineer/Mission Chief), B. W. Park (Senior Financial Analyst), I. H. Keum (Project Engineer), R. S. Ondrik (Programs Officer) and C. C. Fong (Counsel).

naturally available water resources. Of the 476 larger cities in the PRC, the Government considers that 300 have some water shortage, 108 have a serious water shortage and 68 are critically short of water. The large cities in the northern region of the PRC are particularly susceptible to critical water shortages, including those in Liaoning Province and the Liaodong Peninsula, where Dalian Municipality is located (see Map 1). For example, the consumption of water for domestic, public and commercial uses combined¹ in the northern cities of Qingdao, Dalian and Tianjin in 1990 was 85 liters per capita per day (lpcd), 120 lpcd and 120 lpcd, respectively, as compared with the national standard of 170 lpcd for cities of all sizes. A generally accepted consumption level in large cities in Asia is about 300 lpcd. These figures indicate that, despite the large-scale investment in water supply initiated during the last decade in the PRC, continued investment is essential to improve the living conditions of urban residents and to sustain economic growth.

5. Because of the shortage of water in many large cities, water resource management (including the allocation of water among competing uses) is an important issue. The allocation of scarce water resources among competing uses is based on a complex set of considerations. In principle, water for human consumption receives the highest priority in the PRC, but industrial and agricultural water requirements must also be met. Over and above the quantity of water needed for essential domestic needs, factors to be considered are the real demand for the water, gross domestic product implications vis-a-vis industrial output, employment implications, and prior commitments given to traditional and new users (e.g., farmers, industries, fishermen and foreign investors). These factors are particularly difficult to consolidate in the PRC because of the tremendous demand for industrial growth to provide employment and the unparalleled growth pressures on existing cities and urban areas. As a result, water allocation and conservation receive detailed and careful consideration by both the Central Government and local governments, and regional water resources planning commissions are becoming more common. The Ministry of Water Resources manages a water-intake permit system, coordinates water resource utilization among different sectors, formulates interprovincial and inter-regional water allocation and distribution alternatives, and prepares long-term water demand projections and supply plans. The allocation of water among competing uses and related investment decisions involve provincial and municipal governments, their regional/basin water resource commissions, planning processes and financial bureaus. One of the major concerns in all of the coastal cities in the PRC is the overutilization by industries of increasingly scarce groundwater resources, leading to saline intrusion.

6. Another issue in the sector concerns cost recovery, financial resource mobilization, and budgetary resources for proper operation and maintenance of existing and new facilities. In the past, Government-owned water utility bureaus remained heavily dependent on Government subsidies because of inadequate cost recovery and tariff adjustment policies. As a result, the water utilities have not had the financial resources to expand properly or even to operate and maintain their existing systems on a financially sound basis. Because of these budget shortfalls, the water utilities in many cities have been unable to provide a dependable supply of good quality water. This has resulted in further difficulties in increasing user charges and sourcing funds for rehabilitation or

¹ In the PRC domestic water consumption refers to conventional residential household use; public water consumption refers to water usage by public buildings such as offices, schools, hospitals, government offices and premises and to watering of the public areas, i.e., basically institutional usage (this category is quite large in the PRC); and commercial consumption includes private enterprises such as restaurants, hotels, tourist facilities, etc. "Residential" consumption, which is part of domestic consumption, refers strictly to household use, estimated at 80 lpcd.

expansion. The introduction of new policy guidelines, as detailed in para. 9, for the water supply sector — announced in 1992 — has had a major impact on cost recovery. In addition to cost recovery, an increasingly large proportion of domestic financing will have to be mobilized from local rather than Central Government sources. As a result of these changes, local financial resource mobilization and cost recovery are now incorporated in the design of all future water supply projects.

7. Water conservation and the use of scarce water resources by industry is another issue. Some northern cities, such as Dalian, have been implementing strong water conservation measures. To further these efforts, the adoption of policies that link tariffs to the marginal cost of raw water supply, production and distribution is required to provide market incentives to discourage waste and to encourage more efficient use of water. This is planned to be linked to appropriate water pricing policies (para. 52) to help resolve water resource allocation issues and to encourage water conservation, especially by industries. The need for greater integration of water supply with sewerage collection and treatment, along with other environmental management programs, has also been recognized. The Government has put forth a series of measures, as detailed in para. 48, to implement pollution control policies, which will require increased investments in wastewater treatment by industries and local governments.

B. Government Policies and Plans

8. The PRC has developed specific medium-term objectives for urban water supply, and technically and institutionally well-defined policies for developing the water supply program. National level urban water supply objectives in the Eighth Five-Year Plan (1991-1995) are to:

- (i) raise the urban coverage of water supply from 89 per cent of the population in 1990 to 92 per cent in 1995 and to 95 per cent in 2000;
- (ii) increase the water supply for domestic, public and commercial uses from an average of 170 lpcd in 1990 to 185 lpcd in 1995 and to 200 lpcd in 2000; and
- (iii) recycle 50-55 per cent of industrial wastewater by 1995 and 65 per cent by 2000.

9. New guidelines for urban water supply, issued in 1992, emphasize (i) proper planning for, and the inclusion of, water supply projects in national, provincial, regional and local economic development plans; (ii) mobilization of financial resources from users and from various Government sources for the construction of new facilities; (iii) full cost recovery from industrial and commercial users and recovery of operation and maintenance (O&M) costs from residential users by 2000; (iv) prevention of excessive extraction of groundwater; (v) conservation of water resources; (vi) the use of loans and credits to finance urban water supply; and (vii) the application of new technology where appropriate.

C. External Assistance to the Sector

10. The urban water supply sector in the PRC has been supported by the World Bank Group (WBG)¹ and a number of bilateral agencies. All WBG assistance to the sector,

¹ International Bank for Reconstruction and Development, and International Development Agency.

which began in 1981, has been on concessional terms and has been in combination with general urban development and environmental improvement programs. Seven such projects, which include major water supply components with a total loan amount of \$628 million equivalent, have been approved: (i) Liaoning Urban Infrastructure Project, (ii) Changchun Water Supply and Environmental Project, (iii) Rural Water Supply and Sanitation Project, (iv) Zhejiang Multi-Cities Development Project, (v) Shanghai Environment Project, (vi) Liaoning Urban Infrastructure Project, and (vii) Liaoning Environment Improvement Project. The last-named project covers wastewater treatment in four cities in Liaoning Province including Dalian, water supply expansion in Jinzhou City and a water conservancy study including a small-scale pilot plant to evaluate the use of recycled wastewater.

11. Japan, through its Overseas Economic Cooperation Fund (OECF), is the largest source of bilateral assistance. Beginning in 1989, OECF has provided four loans on concessional terms for urban water supply totalling ¥ 47,329 million (about \$450 million equivalent) for the (i) Beijing Water Supply Project, (ii) Urban Water Supply Project (Nanjing, Chengde, Xuzhou and Zhengzhou), (iii) Three Cities Water Supply Project (Tianjin, Hefei and Anshan), and (iv) Urban Water Supply Project (Xiamin, Chongqing and Kunming).

12. A number of other bilateral donors are also active in the PRC water supply sector, albeit at a much smaller scale of \$5-10 million per project, for supply of technology and equipment to medium-sized city water supply facilities. Such bilateral support comes mainly from Australia, Canada, Germany, France, Italy and the Scandinavian countries through the provision of concessional financing to cities.

13. The Bank maintains both regular and project-specific consultations with the WBG and OECF, and with the major bilateral donor countries through their embassies in Beijing, to prevent duplication of effort and support. The Bank, in particular, collaborates with the WBG and OECF in the water supply sector, sharing project and economic information and exchanging views on appraisal methodology, policy reform and other operational areas of mutual concern.

D. Lessons Learned

14. The Project will be the Bank's first loan to the water supply sector in the PRC. However, the Bank has provided seven TA studies totalling \$6.19 million to address critical issues involving water resource management and water supply.¹ In addition, the

¹ (i) TA No. 1145-PRC: Beijing-Tianjin Water Resources Study, for \$550,000, approved on 17 April 1989; (ii) TA No. 1165-PRC: North Hainan Water Resources Development, for \$2.3 million, approved on 15 June 1989; (iii) TA No. 1506-PRC: Dalian Multipurpose Water Resources Development, for \$600,000, approved on 15 April 1991; (iv) TA No. 1518-PRC: Formulating Economic Reform Policies and Infrastructure Planning for Shanghai Pudong, for \$920,000, approved on 28 May 1991; (v) TA No. 1835-PRC: Haihe Basin Environmental Management and Planning Study, for \$1.24 million, approved on 31 December 1992; (vi) TA No. 1852-PRC: Dalian Water Supply, for \$100,000, approved on 10 March 1993; and (vii) TA No. 2015-PRC: Urban Environmental Improvement Planning, for \$480,000, approved on 14 December 1993.

Bank has provided two loans,¹ and corollary TAs, for integrated urban environmental improvement projects, which encompass wastewater treatment as well as air and soil pollution problems, primarily from industrial sources. The implementation of these loan projects is well under way and on schedule in terms of physical progress, loan disbursement and compliance with policy covenants.

15. The principal lesson learned from the Bank's experience in the PRC since 1987 covering 32 loans, of which 5 have been closed, 24 are in various stages of implementation and 3 await loan signing, is that the executing agencies responsible for these projects have shown strong preparation and implementation capabilities. PRC engineers possess adequate capability for design and construction supervision, and local contractors have proven generally competent. The various EAs are taking full advantage of both international and in-house training programs and technology transfer opportunities provided for under the projects. As a result, contract awards, loan disbursements, construction schedules and compliance with loan covenants have been satisfactory.

E. The Bank's Sectoral Strategy

16. The overall objective of the Bank's operations in the PRC is to help the country achieve an economy that will generate efficient, sustainable and equitable growth. Within this framework the Bank seeks to achieve three strategic objectives: (i) improving economic efficiency, (ii) reducing poverty, and (iii) protecting the environment and conserving natural resources. While improving economic efficiency is the most easily operationalized objective, the Bank's strategy provides for assistance in areas related to human resource development (HRD) and the social sectors through the provision of TA and follow-on loan projects to address the broad objectives of equity and sustainability. The issue of financial sustainability is a particular challenge in the PRC, where water supplies have been perceived as a social benefit with only a nominal user charge, often unchanged for more than 30 years, and heavily subsidized from general revenues. The issue of environmental sustainability in terms of design management of water resources is very important in the PRC because of the heavy demand on a comparatively scarce resource. The Bank has contributed extensively to improving water resource planning through several TAs specifically aimed at expanding the related data base and addressing the allocation and management of scarce water resources, including TA Nos. 1145-PRC, 1165-PRC and 1835-PRC. The Bank's involvement in the water supply and sanitation sector addresses these objectives through improvement of the health and living standards of the urban population while contributing to an improved environment and economic growth. As part of the Bank's strategy in the sector, emphasis is being placed on ensuring that incentive structures are adopted to reflect adequately the costs of the services in an equitable manner, and that there are provisions for improved or expanded sanitation facilities to treat the increased wastewater resulting from the new water supplies and for water resources planning. These issues are being addressed under TA No. 2015-PRC: Urban Environmental Improvement Planning. Cost recovery and financial sustainability are being emphasized so that public utilities have adequate resources to finance investments and O&M costs, and to encourage private sector participation. The Bank is assisting its developing member countries, including the PRC, in the accumulation and analysis of data to strengthen the water supply and environment sectors through the publication of related

¹ (i) Loan No. 1205-PRC: Qingdao Environmental Improvement, for \$103 million, approved on 10 December 1992; and ((ii) Loan No. 1270-PRC: Tangshan and Chengde Environmental Improvement, for \$140 million, approved on 25 November 1993.

materials such as the *Water Utilities Data Book* (November 1993) which includes data on water supply in Beijing.

F. Policy Dialogue

1. Ongoing Policy Dialogue

17. During Project formulation and processing, Bank staff undertook extensive policy dialogue with the Government, the DMG, DWSC and NWSC. The main issues addressed included:

(a) Cost Recovery/Tariff Reform

18. The Government's ongoing program of economic and enterprise reform will require water supply projects to become financially sustainable and capable of full cost recovery. Because of historical factors, which have led to water tariffs in some cities being "frozen" for 30-40 years, an immediate shift to full cost recovery is not feasible. Water tariffs are being increased in a phased manner to achieve full cost recovery after the new facilities have been completed. The tariff structures will be equitable and will allow for cross-subsidization from commercial and industrial to domestic users. In Dalian the first water tariff increase since 1956 was implemented in 1992, followed by further increases in 1993 resulting in total domestic, public and industrial tariff increases of 300, 800 and 550 per cent, respectively.¹ The 1992 water tariff recovered only 30 per cent of operation and maintenance (O&M) costs. With the tariff increases already implemented, O&M costs will be fully recovered by 1995, and the planned future tariff increases will enable full cost recovery at Project completion in 1998 (see para. 51). The domestic water tariff will be increased by a further 250 per cent in late 1994, with further increases planned in all categories as the level of service is improved. Since the foreign exchange risk will be borne by the EAs, the Mission also initiated discussion with them on the inclusion of foreign exchange risk safeguards in the tariff structure. These safeguards will be further explored during Project implementation.

(b) Environmental Considerations

19. The Government recognizes that provision of increased water supplies leads to increased wastewater. The Bank is supporting the Government's initiative through the various environmentally related loans and TAs, including TA No. 2015-PRC: Urban Environmental Improvement Planning, which will strengthen institutions responsible for environmental improvement in a number of cities, including Dalian, and identify future infrastructure required to meet the environmental goals of both the Government and local cities. The DMG's environmental regulations require that all existing and new industrial enterprises and factories must provide on-site treatment of wastewater, meeting national standards, prior to discharge into municipal sewers, drains or streams. These regulations are being implemented in the new development zones. In addition, central wastewater treatment facilities are under construction or are being planned (see para. 48) to provide treatment to all wastewater by 2005.

¹ Domestic, from Y 0.13 to Y 0.4 per cum; public/commercial, from Y 0.22 to Y 1.8 per cum; industrial, from Y 0.22 to Y 1.2 per cum.

2. New Policy Initiatives

20. In addition to the above, the Appraisal Mission initiated policy dialogue on new issues as follows:

(a) Economic Pricing and Allocation of Water Resources

21. The scarce water resources in the Dalian region, combined with the various competing uses for water and the extensive industrial development, require rational allocation. The use of economic pricing to encourage the rational allocation of water resources is increasingly being employed as an element of policy reform in the water supply sector in general. The Mission therefore stressed the concept of economic pricing of water, during discussions with the Government, as a desirable method of evaluating the true cost of water including the cost related to lost opportunities for alternative uses. The Mission noted that little or no information or data related to economic pricing of water were available in the DMG. The Government agreed to take the steps necessary to generate a better data base for calculating the average incremental cost of water as well as estimating economic benefits. The introduction of economic evaluation of projects as addressed in the ongoing TA No. 2015-PRC: Urban Environmental Improvement Planning will assist the Government, at all levels, to allocate scarce water resources for the most beneficial usages, and to encourage conservation and protection of water resources by all users. The DMG agreed to integrate this approach into the planning of future water supply projects (see para. 52).

(b) Water Conservancy

22. The issue of water conservancy has been introduced to the water supply sector in the PRC by the Bank through policy dialogue and TA studies. The goals of the water conservancy policies advanced by the Mission include (i) ensuring, through leakage detection and repair, that nonrevenue water (NRW), currently estimated at 17 per cent, does not increase as water pressures are raised to full service levels; (ii) reduced water use through economic pricing of water, and (iii) introduction of new or alternative industrial processes that utilize less water or replace fresh water with seawater or recycled wastewater. These goals complement the activities sponsored by the WBG and regular dialogue takes place with the WBG to ensure that these policies and activities remain complementary and incorporate lessons learned by each institution.

IV. THE PROJECT

A. **Outline**

23. Dalian is an important port city, situated at the southern tip of the Liaodong Peninsula (see Map 1). In 1984, Dalian was declared an "open" coastal city with a large degree of autonomy for its own economic planning, development of industry-led growth and promotion of international trade. In 1988, the Dalian Economic and Technology Development Zone (DETDZ) was created, and it is now one of the most successful such zones in the PRC. The DETDZ is playing an important role in the economic reforms and domestic growth in the northeast region of the PRC. A serious constraint to achieving further growth and economic development is the shortage of water, both in terms of regional water resources in the Liaodong Peninsula and the capacity of the Dalian water delivery system. The average consumption of water for domestic, public and commercial uses in Dalian in 1993 was 155 lpcd as compared with the PRC national standard of 170 lpcd, and 300 lpcd for large cities in Asia.

24. The population in Dalian Municipality¹ in 2000 is projected to be 5.2 million. The Project area includes Dalian City and the DETDZ, rural towns and a number of agricultural districts. The design population for the Project, based on a 3.1 per cent annual growth rate in Dalian City and the DETDZ, is projected to be 2.2 million in 2000, an increase of 400,000 persons from about 1.8 million in 1993. In addition, an estimated 1 million residents in the rural cities and towns and six agricultural districts, living within proximity of the Project's northern water conveyor,² will benefit from the Project.

25. The Project is necessary to meet both the current shortfall in water supply and the projected demand related to growth in population, industry and port capacity. Planning for Dalian's water supply requirements has been ongoing for the past decade. Available data were analyzed under Bank TAs.³ It was concluded that the surface water resources within Dalian City's urban area are fully exploited, and underground water resources in the area are overexploited, resulting in increasing saline intrusion. The only practical source of additional water is from the Biliuhe Reservoir, some 160 kilometers (km) north of the city (see Map 2). The Project will supply water from the Biliuhe Reservoir and will include the following major components: (i) civil works for the construction of 68 km of gravity water conveyor, 79 km of pressure pipelines, pumping stations, water treatment plants and distribution lines including all related components; (ii) procurement of mechanical equipment and materials for the various Project facilities; and (iii) consulting services for detailed design, construction supervision and training.

B. Rationale

26. Dalian's objective in the water supply sector is to provide a good quality water supply of sufficient volume and pressure to meet reasonable domestic requirements for 95 per cent of the urban population by 2000 in order to improve living conditions and to enable economic growth. In Dalian, the current water shortage is so severe that many areas of the city have water service only for a few hours per day, usually in the middle of the night, and the pressure in the system is sometimes insufficient to provide water to higher elevations of the city for periods of several days. In addition to the physical and economic inconvenience and cost, this frequent interruption of service has major implications on public health, since contamination from the surrounding drains and groundwater becomes possible under negative pressure conditions. Unless remedial measures are taken, this shortage is projected to increase from an average of about 40,000 cum/day in 1993 to about 670,000 cum/day in 2000. The Project will enable the DMG to construct the facilities required to address the shortfall and to meet demand increases. The Project will also make raw water available for agricultural uses and for smaller towns and cities in the DMG. The Project will lead to improved living conditions, improved public health, increased productivity and economic opportunities for the people of the municipality. The Project will also support institutional development and the financial strengthening of the EAs as well as HRD through skills and management training.

¹ A municipality, which is sometimes translated as prefecture, may embrace several cities, towns and rural areas.

² The term "conveyor" encompasses several different types of water carrying structures including pipeline, tunnel, siphon and closed concrete conduit.

³ TA No. 1506-PRC: Dalian Multipurpose Water Resources Development Project, for \$600,000, approved on 15 April 1991 and TA No. 1852-PRC: Dalian Water Supply, for \$100,000, approved on 10 March 1993.

C. Objectives

27. The major objectives of the Project are to (i) improve the health and living conditions of the growing urban population of Dalian City by increasing available water for residential consumption from about 80 lpcd at present to 100 lpcd¹ in 2000; (ii) improve the health and living conditions of the residents of small towns located in Dalian Municipality by providing water from the Project; (iii) support the industrial growth of Dalian Municipality including the DETDZ; (iv) improve urban environmental conditions by preventing the contamination of groundwater aquifers caused by saltwater intrusion due to excessive extraction of the groundwater by industries; and (v) facilitate increased agricultural production by supplying water for irrigation use. On the policy side, the Project will (i) promote rational pricing policies for water and strengthen the financial management of the water supply system; and (ii) strengthen sector institutions, policies and regulations. In terms of the Bank's strategic development objectives, the Project objectives relate to HRD while also facilitating economic growth and sound management of natural resources. Over half of the water to be supplied under the Project will be for human consumption.

D. Scope

28. The Project is designed to supply about 400 million cum/year of water to 2.2 million people in Dalian City for domestic, public and industrial use, and about 58 million cum/year for bulk water sale to the Dalian Water Conservancy Bureau.² About 55 per cent of the total water provided under the Project will be for human consumption. The Project will consist of two parts: a 1.3 million cum/day capacity northern conveyor system, from the Biliuhe Reservoir to the Wazidian Reservoir, for the production and transmission of raw water for urban and irrigation purposes; and a southern conveyor system, from the Wazidian Reservoir to Dalian City (see Map 2). The combined capacity of the southern conveyors will be increased from 530,000 cum/day at present to 1,200,000 cum/day upon Project completion. The Project will also increase the water treatment capacity in Dalian City. Furthermore, the distribution system will be extended and rehabilitated throughout the service area, including bulk and service connection metering to reduce unaccounted for water.

29. The design capacity for Dalian City — about 1.1 million cum/day — was based on year 2000 water demand projections for residential, public and industrial categories, (see Appendix 1). The 1993 figures are based on actual production and water sales. Growth in residential demand is expected to increase once more water and higher pressure become available from the Project facilities. However, this growth is expected to be modest because of the water conservancy program and substantially increased tariffs. The public demand will grow quickly because of the rapid expansion of Dalian City, especially in the development zones, where new infrastructure is being developed. Much of the increase in public demand will occur in the tertiary sector because of the construction of major office complexes, hotels, restaurants and related business. Industrial demand is forecast to double by the year 2000 as the planned new industries in the development zones come onstream. Part of the growth in industrial demand is related to the

¹ This demand represents household use without institutional, public and commercial consumption.

² The Dalian Water Conservancy Bureau will supply water for agricultural uses (26 million cum/year) and raw water to towns (32 million cum/year) along the conveyor route. This water is estimated to service about one million users.

replacement of current groundwater extraction with municipal water, as the Project facilities make more supplies available.

30. The Project will consist of two parts which will include the following components:

- | | |
|---------|---|
| Part A: | <ul style="list-style-type: none"> (i) construction of a northern conveyor with a total length of about 68 km, consisting of 1 intake, 19 sections of closed conduits, 9 tunnels, 8 inverted siphons, 1 pipe bridge and 6 offtakes; and (ii) preparation of detailed engineering design, construction supervision, technical support, institutional strengthening training and various studies. |
| Part B: | <ul style="list-style-type: none"> (i) new construction and rehabilitation of the southern conveyor system, comprising two new pumping stations as well as two new pipelines with total lengths of about 94 km and 79 km, respectively; (ii) construction of one new water treatment plant with a capacity of 150,000 cum/day and the expansion of existing water treatment facilities with an incremental capacity of about 180,000 cum/day; (iii) rehabilitation and expansion of the water distribution system through (a) installation of about 140 km of new water mains; (b) replacement of about 36 km of old water lines; (c) installation of eight storage tanks with a total capacity of 40,000 cum, and procurement of leakage detection equipment and the related technological training; and (iv) preparation of detailed engineering design, construction supervision, technical support, institutional strengthening training and various studies. |

E. Cost Estimates

31. The total cost of the Project is estimated at about \$380 million equivalent (Y 3.31 billion) comprising a foreign exchange component of about \$164 million equivalent (43 per cent) and a local currency component of about \$216 million equivalent (57 per cent). The foreign exchange cost includes adequate provisions for interest and other charges during construction, price escalation and physical contingencies. The local currency cost includes taxes and duties as well as price contingencies. A summary of major cost categories is shown in Table 1, and details are given in Appendix 2.

Table 1: Summary of Cost Estimates
(\$ million equivalent)

Major Components	Foreign Currency Cost	Local Currency Cost	Total Cost
I. Base Cost			
Civil Works	14.97	124.92	139.89
Equipment and Materials	112.84	8.84	121.68
Consulting Services and Training	2.21	7.59	9.80
Others (land, resettlement, and administration)	-	16.75	16.75
Subtotal	130.02	158.10	288.12
II. Physical and Price Contingencies	17.45	39.99	57.44
III. Interest During Construction	16.62	17.54	34.16
Total Project Cost	164.09	215.63	379.72

F. Financing Plan

32. It is proposed that the Bank provide a loan of \$160 million to finance a portion of the foreign exchange costs. The DMG will assist the EAs with financing the balance of the foreign exchange costs and the entire local currency costs, equivalent to about \$219.7 million, utilizing a grant from the Central Government, its own internal resources and loans at commercial rates from (i) the Ministry of Water Resources, (ii) the State Planning Commission, and (iii) commercial banks. The financing plan is summarized in Table 2. The proposed Bank loan, from ordinary capital resources, is proposed to have a maturity period of 25 years, including a grace period of 5 years, which is the expected implementation period. The interest rate for the Bank's loan will be based upon the Bank's pool-based variable rate lending system for US dollar-denominated loans. The Borrower will be the People's Republic of China. The Government will relend the entire loan amount to the two EAs, DWSC and NWSC, under two separate subsidiary loan agreements for \$100 million and \$60 million, respectively, on substantially the same terms and conditions as the Bank loan to the Borrower. The EAs will assume the interest rate variation and foreign exchange risks. The DMG will guarantee repayment to the Government of the subsidiary loans by DWSC and NWSC.

Table 2: Financing Arrangements
(\$ million equivalent)

Financing Source	Foreign Currency Cost	Local Currency Cost	Total Cost
Bank Loan	160.0	-	160.0
Central Government Grant	-	11.5	11.5
Loan: Ministry of Water Resources	-	23.0	23.0
Loan: State Planning Commission	-	11.5	11.5
Loans: Commercial Banks	-	18.4	18.4
Dalian Municipal Government	4.1	151.2	155.3
Total Project Cost	164.1	215.6	379.7

G. Implementation Arrangements

1. Execution and Coordination

33. Implementation of Part A, the northern conveyor, and Part B, the southern conveyor, treatment plants and distribution system of the Project will be carried out by NWSC and DWSC, respectively. The two EAs will receive guidance from the Leading Group, which has been established for the Project, headed by the Executive Vice Mayor of the DMG. The Leading Group, consisting of the heads of DMG's and Dalian City's bureaus and departments involved with the Project, will meet as required to guide the Project. The Leading Group will provide support to the EAs' Project Managers, who have been appointed through a Project Management Unit consisting of senior representatives from City bureaus and departments, which will provide systematic liaison between the EAs and the Leading Group; ensure that policy decisions of the Leading Group are carried out; and provide for senior level project management, coordination and quality control. In addition, the Leading Group will provide the DMG's funds to the Project through a special Finance Unit drawn from the Bureau of Finance of the DMG. The Finance Unit will ensure that necessary and sufficient funds drawn from various sources are available and disbursed in a timely manner.

2. Management and Organization

34. Day-to-day implementation will be undertaken through two separate Project Implementation Units (PIUs) under the direction of the Project Managers of each EA. The DMG, DWSC and NWSC will ensure that each PIU is staffed with an adequate number of suitably qualified and experienced staff throughout Project implementation. In addition, for Parts A and B, project offices will be established at appropriately located sites. The organizational arrangements are outlined in Appendix 3.

3. Implementation Schedule

35. The detailed design of portions of the southern conveyor has already been completed utilizing DWSC's own funds. One of the two pipelines included in this portion of the Project is also under construction financed by DWSC. The remaining portion of this pipeline is expected to be completed by the end of 1994 utilizing proceeds of the Bank loan in accordance with advance action and retroactive financing approved by the Bank.¹ The remainder of the northern and southern conveyor designs will be substantially completed by mid-1995, and the designs of the water treatment and distribution facilities will be completed by early 1996. Other preconstruction activities, such as prequalification of contractors, and tendering and awarding of equipment and materials contracts will be undertaken through the end of 1996 and early 1997. The physical implementation of the Project is expected to be completed by the end of September 1998. An implementation schedule showing the major activities of the Project is provided in Appendix 4.

¹ Approved 25 April 1994; included in *ADB Business Opportunities* in September 1994.

4. Procurement

(a) Advance Action and Retroactive Financing

36. The Bank has approved advance action and retroactive financing, for up to \$8 million, for recruitment of consultants and procurement of steel plates for the southern conveyor pipeline in order to help alleviate Dalian's severe water shortage crisis as soon as possible. The advance action will include mainly (i) recruitment of consultants for preparation of detailed designs, specifications and tender documents; and (ii) procurement of steel plate for the southern conveyor pipeline under international competitive bidding (ICB) procedures. It is expected that this advance action will enable one of the southern conveyor pipelines to be completed by December 1994. The Government has been advised that the approval of advance action and retroactive financing does not commit the Bank to finance the Project.

(b) Consulting Services

37. Consulting services will be needed for (i) engineering design and construction supervision; (ii) project management; and (iii) associated studies on institutional development, O&M support, leakage detection, network analysis and optimization, water resources allocation, economic pricing of water, water conservancy programs, benefit monitoring, water quality, wastewater treatment and policy-related legislation. Approximately 60 person-months of international consulting services for project management, preparation and review of bid and tender documents, bid evaluation, quality control and associated studies will be financed under the loan. The Bank has approved the Government's request that the team of international and local consulting firms¹ that undertook the Bank-financed project preparatory TAs and other preparatory studies be retained for Project implementation. These consultants were selected in accordance with the Bank's *Guidelines on the Use of Consultants*. The local consulting input is estimated at 3000 person-months. Broad terms of reference for the consultants are provided in Appendix 5.

(c) Equipment and Materials

38. Equipment and materials financed under the Bank loan will be procured in accordance with the Bank's *Guidelines for Procurement*. ICB procedures will be followed for the procurement of the main construction materials, machinery and equipment. International shopping (IS) will be used to procure electrical equipment, office equipment and Project-related testing equipment. The indicative procurement packages are given in Appendix 6. ICB, IS and local competitive bidding (LCB) procurement — including prequalification, tendering and bid evaluation — will be undertaken by registered tendering agencies² employed by the EAs as per normal practice in the PRC. These agencies have extensive experience with both ICB and LCB procurement.

¹ C. Lotti & S.p.A. (Italy), Institute of Design and Investigation of Water and Hydroelectricity of Liaoning Province (PRC), Dalian Institute of Design of Hydraulic Building (PRC), and China Northeast Municipal Engineering Design Institute (PRC).

² For ICB and IS the EAs have retained the China International Machinery Import and Export Corporation. For LCB, the China Shenyang Machinery and Electric Equipment Tendering Corporation has been appointed.

(d) Civil Works

39. Two large civil works contracts for the installation of two pipelines of the southern conveyor, to be undertaken by DWSC and to be financed by the Bank (40 per cent), will be tendered under ICB following the Bank's *Guidelines for Procurement*. In addition, 22 smaller civil works contracts, to be undertaken by NWSC, of which the Bank will finance 15 per cent, will be tendered following LCB procedures, under Government guidelines and regulations acceptable to the Bank. These smaller contracts are for installation of tunnels, inverted siphons and closed conduit sections of the northern conveyor. Because of their small values, small foreign components, remote locations within Dalian Municipality and limited access they are not considered to be of interest to international bidders. Since the related equipment and materials will be procured under ICB procedures, these LCB contracts are basically for labor and have a value of less than \$5 million per contract (of which the Bank would finance 15 per cent). Indicative civil works packages to be financed under the loan are listed in Appendix 6. The remainder of the civil works will not involve Bank financing and will be awarded following Government guidelines.

5. Training

40. Training requirements have been identified under each Project component. The staff to be trained will be the employees of the Dalian Water Conservancy Bureau, NWSC, DWSC and other involved organizations. The training will cover both Project implementation and quality control as well as various aspects of management, administration, O&M of the new facilities. The proposed training program and list of candidates to receive the training will be provided to the Bank for review and approval prior to the undertaking of the training programs. The training costs to be financed by the loan relate to 96 person-months of training for the EAs' staff at an international institution or facility including study visits, 6.5 person-months of instruction/hands-on training by international consultants and 100 person-months of training in the PRC.

6. Land Acquisition

41. The acquisition of land for the pipeline right-of-ways, pump stations, water treatment plants and related facilities has been completed. In addition, land will also be acquired for resettlement of some of the 450 households that will be affected by the Project (see para. 49).

7. Reports, Accounts and Audit

42. The Government has agreed that arrangements satisfactory to the Bank will be made for reporting the progress of Project implementation. The two EAs will provide to the Bank detailed quarterly and annual reports summarizing the physical progress and disbursements related to the Project within one month of the close of each quarter. To facilitate post-evaluation of the Project, the EAs will furnish the Bank, within one year of Project completion, completion reports providing details regarding implementation, costs, benefits and other details requested by the Bank.

43. The Government has agreed to have each EA furnish the Bank annually with audited Project accounts and related financial statements, including income statements, balance sheets and cash flow statements. Such statements will be audited by auditors acceptable to the Bank. The audited accounts and financial statements will be submitted within six months of the end of each related fiscal year for the first ten years of the Project.

44. In addition to the above Project implementation reporting, the Government has agreed that the two EAs and the DMG will provide the Bank with annual reporting summarizing the progress made in addressing several policy issues, including (i) tariff reviews, (ii) water quality surveys, (iii) status report on investment planning for wastewater treatment, (iv) status report on the Water Conservancy Program, and (v) BME. Further to these annual reports, the Government, the EAs and the DMG have agreed to provide a summary report of the tariff reform seminar to be held in 1996 with specific emphasis on the introduction of progressive tariffs in Dalian and in the sector in general. The DMG will also provide an independent post-evaluation report on resettlement in late 1999, one year after Project completion.

8. Benefit Monitoring and Evaluation

45. In order to ensure that the works and facilities provided under the Project are managed efficiently and that Project benefits are maximized, BME will be undertaken by the EAs. The BME system will be developed by the PIUs in the two EAs with the assistance of the engineering design and supervision consultants following the Bank's *Guidelines for Benefit Monitoring and Evaluation*. The BME will include five general types of indicators that measure (i) service levels, (ii) efficiency, (iii) public health, (iv) financial performance, and (v) environmental impacts. The specific indicators in each of the five areas were selected because of their availability and ability to measure Project benefits and potential areas of concern. All of the indicators selected are within the current data collection capabilities of NWSC and DWSC. The BME system is subject to the approval of the Bank, and the EAs will evaluate the benefits of the Project in accordance with a schedule and the terms of reference to be mutually agreed upon with the Bank. It is envisaged that data will be collected and prepared after the first year of implementation, and updated annually thereafter with the first report being prepared after 1996 and DMG will furnish the Bank annual reports thereafter for ten years.

H. **Executing Agencies**

46. NWSC and DWSC will be the EAs responsible for planning, organizing and implementing the Project. NWSC was created by the DMG in 1993 to convey and sell raw water from Biliuhe Reservoir to the agricultural and small town takeoffs along the northern conveyor and to Dalian City at Wazidian Reservoir. NWSC is independent from Dalian City and is responsible for the water resource management and water allocation for all of Dalian Municipality, which includes rural areas and numerous villages, towns and smaller cities as well as Dalian City. NWSC is fully operational. DWSC has been the water supply company for Dalian City for more than 80 years and is responsible for the treatment, distribution and sale of water in the city's urban area. DWSC will purchase the raw water from NWSC at Wazidian Reservoir, and convey it through the southern conveyors to the DETDZ, Jinzhou district, Lushen district and to its own water treatment plants in Dalian City for distribution and sale to urban consumers. Both NWSC and DWSC are legal entities and registered as State Enterprises under the country's State Industrial Enterprise Law with full legal person status.

I. **Environmental and Social Measures**

1. Environment

47. The proposed Project does not present any specific environmental problems, nor does it impact upon any sensitive environmental variables or parameters. An Environmental Impact Assessment for the Project was prepared and approved by Dalian

City and the National Environmental Protection Agency. It found that there are no known protected plants or animals or cultural relics along the conveyor routes. No endangered aquatic species are known to exist along or within any of the water bodies being utilized by the Project. A Summary Environmental Impact Assessment report was circulated to the Bank's Board in July 1993.¹

48. Because the Project will more than double the supply of water to Dalian City, it will substantially increase the wastewater generated. The DMG is aware of this increase and of the need to improve disposal facilities. The impact of the increased wastewater is being planned for through installation of new municipal wastewater collection and treatment facilities in a manner consistent with the DMG's financial constraints. The DMG's environmental regulations require that all existing and new industrial enterprises and factories must provide on-site treatment of wastewater prior to discharge. A new wastewater treatment plant with a capacity of 100,000 cum/day is being constructed in the DETDZ, financed by local funds. In addition, a portion of the WBG's Liaoning Environment Improvement Project² loan will help finance expansion of an existing wastewater treatment plant and construction of a new plant in Dalian, providing further incremental treatment capacity of 165,000 cum/day. The DMG is planning a further 400,000 cum/day increase in wastewater treatment capacity by 2005, which, combined with industrial water conservancy programs and on-site treatment, would treat all the wastewater produced. The DMG will provide the Bank with an annual report detailing the progress made with respect to increasing its wastewater collection and treatment capacity.

2. Resettlement

49. To ensure that none of the households impacted by the Project are adversely affected, a resettlement plan was prepared by the EAs and DMG. The plan was reviewed and found to be satisfactory by the Bank. The plan requires resettlement of 450 households (1800 persons) following the Government's Resettlement Law (1991). Of the 450 households, 250 are in rural areas; these families will be resettled into newly constructed houses and provided with an equivalent land area of equal quality and production capacity. About 50 of these households will return to their own land after construction is completed, with the added benefit of a new house. The other 200 households are in urban areas and have chosen to be resettled in apartments in existing developments. The new housing will be of superior quality, with modern conveniences (e.g., heating, water, modern bathrooms). Also, the resettled families will be compensated for loss of income or productivity of their land due to the Project. All 450 households will be resettled within their existing communities, with no loss of employment or family and social relationships. The total allocation for resettlement-related activities is about \$13.5 million; the major resettlement cost is land and house replacement, which is included under the overall land acquisition for the Project. Some of the residents along the southern conveyor route have already been successfully resettled. The status of the resettled population will be monitored as part of the BME program agreed upon with the Government (see para. 45), and an independent post-evaluation will be prepared after Project implementation and submitted to the Bank.

¹ The report was completed by the DMG and its agencies, supported by local design institutes, and found acceptable by the Bank's Office of the Environment.

² Approved by WBG's Board on 7 July 1994.

J. Policy Issues

50. The agenda for policy dialogue for the Project covered three major issues: (i) enterprise reform, subsidy elimination and commercial operation; (ii) economic pricing and allocation of water resources; and (iii) water conservancy. Agreements were reached with the DMG and the EAs in each of these areas as discussed in the following sections.

1. Enterprise Reform, Subsidy Elimination and Commercial Operation

51. In the PRC water has been traditionally viewed as a basic human need, provided on highly subsidized terms. During Project processing the Mission drew on Bank experience in other countries to indicate to the Government the benefits that can be gained in terms of efficiency, accountability and service quality if commercial practices are introduced in the water supply sector. In keeping with this advice and the Government's ongoing program of economic and enterprise reforms, the Project is designed to separate the operations of the two water supply companies from dependence upon DMG budgetary support and transform them into autonomous commercial enterprises. The creation of NWSC as an independent legal entity and state enterprise under the State Industrial Enterprise Law was a major step in this process. Because of the natural monopoly held by the two companies, the DMG will continue to regulate pricing and allocative decisions for consumer protection. The Mission stressed the benefits of pricing water at sufficient levels to both to provide market-based incentives to encourage water conservation and rational use, and to provide the necessary financing for O&M and capital expansion. Because of historical factors and the existing low water prices, an immediate shift to full market pricing is not feasible. The DMG has been taking steps to increase water tariffs in a phased manner to ensure that there will be an adequate revenue base to support the commercial operation of NWSC and DWSC, including all debt-service requirements and O&M of the Project facilities (see para. 18). In 1993, the tariff for industrial consumers was doubled from Y 0.6/cum to Y 1.2/cum and that for commercial users increased from Y 0.8/cum to Y 1.8/cum. In the latter half of 1994, residential rates are to be raised by 250 per cent from Y 0.4/cum to Y 1.0/cum. Further tariff increases are planned in all three user categories over the next two years. In conjunction with the water tariff increases, the DMG plans to phase out the existing fiscal subsidies provided to DWSC and NWSC¹ from general Government revenues for O&M costs. The DMG has agreed that these subsidies will be eliminated within one year of completion and commissioning of the Project facilities. It has also agreed to maintain water tariffs at levels sufficient to recover fully all debt-service and O&M costs for the Project facilities directly from consumers based on commercially sound operating principles to comply with the financial covenants agreed upon with the Bank. The DMG agreed to continue the ongoing review of O&M efficiency in order to control costs. This includes more efficient operation to minimize energy consumption, chemical usage, consumables and duplication of manpower. The DMG has further agreed to conduct an annual review of water tariff levels and the revenue base of each EA to ensure timely adjustment of water tariff levels, and to furnish the Bank with annual summary reports.

2. Economic Pricing and Allocation of Water Resources

52. As indicated in para. 21, water resources are scarce in Dalian City, which has to import water from a source more than 160 km away, as provided for by the Project. Future raw water supplies for Dalian must come from 60-70 km farther away, with additional pumping and infrastructure. This will make the economic cost of future water supply for

¹ About Y 95 million and Y 20 million for DWSC and NWSC, respectively, in 1994.

Dalian substantially higher than that estimated for the Project. This high cost will potentially make alternate water sources more attractive and affordable and may even cause relocation of high water consumption industries to areas with more available water. Since 45 per cent of the water demand in Dalian is for industrial use, basic changes to the type of industry and industrial processes along with traditional water conservancy programs will be necessary. The DMG, the EAs and industrial users will investigate these alternatives and estimate the economic pricing of water. In 1996, the DMG and other concerned agencies will invite experts and conduct a workshop designed specifically to address issues related to the economic pricing of water resources, allocation between competing uses, price level calculations, progressive (incremental) tariffs and so forth with appropriate attention to financial returns and cost recovery, regulation of public utilities, fairness and basic human needs considerations. The DMG will provide a report to the Bank summarizing the findings of this investigation and workshop.

3. Water Conservancy

53. Because of the scarce water resources, water conservancy is an issue of critical importance in Dalian. The Mission held extensive discussions with the DMG and the EAs on water conservancy, and agreement was reached to have the Project's international consultant, in conjunction with the local design institutes and the DMG's own agencies, carry out a number of water conservancy studies leading to remedial measures. These include (i) improved operation of Biliuhe Reservoir to maintain yield, (ii) improved hydraulic operation of the water delivery and distribution piping to minimize pressure and leakage losses through installation of a computerized Supervisory Control and Data Acquisition (SCADA) system, (iii) conventional leakage detection program throughout the delivery system, and (iv) evaluation of industrial related water conservancy measures and alternatives to reduce water consumption. The Mission stressed that these water conservancy measures would yield substantial savings, with corollary decreases in wastewater production. In general, such water conservancy measures would include (i) industrial recycling of water, especially cooling water through installation of cooling towers; (ii) reuse of water within industry in a cascading manner, whereby slightly used lower quality water is reused for processes that do not necessarily require clean or municipal potable water; (iii) reuse of treated wastewater/effluent for nonsensitive uses such as cooling; (iv) use of seawater for nonsensitive processes involving biologically degradable wastes (seawater can be treated by biological processes) and cooling; (v) relocation of high water-consuming industries to areas where there are adequate water resources, freeing up not only valuable land but also reducing pressure on water demand and the environment; and (vi) changing the industrial processes to ones with less water consumption.

54. The Mission also advised the DMG and the EAs that the Bank's TA No. 2015-PRC: Urban Environment Improvement Planning Study, which includes Dalian, will stress environmental improvements through water conservancy, pollution control facilities, the related institutional strengthening and cost recovery measures. The DMG and the EAs agreed to coordinate the above Project water conservancy measures with TA 2015-PRC and the WBG-financed water conservation pilot project.¹ The DMG will provide annual progress reports on the implementation of the water conservancy measures during the Project implementation period.

¹ Part of the WBG's Liaoning Environment Improvement Project.

V. PROJECT JUSTIFICATION

A. General

55. The future development of Dalian will be led by export-oriented growth in line with the Government policy on transition to an open market economy. Within the context of the Government's economic reform policy, the main target of economic growth in Dalian is to double the gross regional product in real terms by the year 2000. During the Eighth Five-Year Plan (1991-1995), the target is for the gross regional product to grow at 6.5 per cent per year, with the industry sector growing at 7.5 per cent per year and agriculture at 4.8 per cent per year. The plan focuses on the establishment of a firm platform for export-led growth based primarily on the DETDZ and the heavy industries of Dalian. This strategy will be vigorously pursued in the Ninth Five-Year Plan (1996-2000) with the aim of establishing Dalian as a major international trading center in the PRC. As such, in addition to ameliorating the critical water deficiencies for human consumption, which will represent at least 55 per cent of the design capacity, the increased supply of water provided under the Project for commercial and industrial activities will be important for the economic development of Dalian.

56. Because of the rapid growth in population and industry resulting from the Government's strategy for Dalian, the water demand has outstripped supply capacity. This was further exacerbated in the past due to water supply being considered a social service, which was subsidized without periodic review and increase of charges (tariffs) and resulted in DWSC having insufficient funds to maintain and expand the system properly, especially in the older residential areas of Dalian. As a result, severe water shortages have resulted, causing (i) inability to meet normal residential demand; (ii) water service outages in higher elevation areas of the city for extended periods when only a small trickle of water is available during low demand hours between midnight and four in the morning, forcing residents to stay up to fill containers for use the next day; (iii) low pressure in some areas of the city, resulting in failure of the district heating system in cold winter months, thereby causing a substantial percentage of the residential population, institutions and office buildings to be without heat or hot water for days at a time; (iv) increased use of polluted surface water from the Dalian River, which overloads the water treatment plants, resulting in potential contamination of the treated water and danger to public health; (v) overextraction of the groundwater, resulting in intrusion of polluted surface water and seawater; (vi) increased operating costs of the water system caused by increased treatment requirements and nonpumping; and (vii) loss of economic growth related to a restriction on industrial, commercial and tourism growth due to the lack of 24-hour per day good quality water supply and to the costs associated with developing their own systems.

57. The Project will help to improve water supply for both the current population and for an estimated additional 400,000 residents in Dalian by 2000, and will allow for further growth in the industry, commercial and tourism sectors. A total of 2.2 million residents in Dalian will receive a 24-hour supply of good quality water, thereby eliminating the problems described in para. 56. In addition, industries will be able to expand production, decrease their use of scarce groundwater and reduce their production costs. The threat to public health caused by the current severe water shortages will be eliminated by the new water supply provided by the Project. Further, an estimated one million users in rural towns will benefit from the provision of increased raw water supplies. Agricultural production will be enhanced by a doubling of irrigation water supply. The living conditions of residents of many areas of Dalian will be greatly improved through the Project facilities. Among the beneficiaries will be women, children and older residents, who would normally bear the brunt of the inconvenience of obtaining and storing household water supplies. The

economic development of the Dalian area, in particular of the DETDZ, will be accelerated with the ensuing benefit of improved employment opportunities and improved standard of living for existing and new residents of Dalian.

58. In addition to the public health, economic and environmental benefits, the Project will improve the overall water resources management of the region, provide a more energy-efficient gravity flow water supply scheme, reduce leakage and wastage, introduce further water conservancy measures, and result in full recovery of both O&M costs and financing of replacement costs. It is expected that the Project, which is the Bank's first water supply sector project in the PRC, will demonstrate the benefits of full cost recovery and the need to develop water demand management, allocation and conservancy measures.

B. Financial and Economic Analyses

59. DWSC's financial performance in the past was not acceptable. DWSC incurred operational losses primarily because of low tariffs that did not cover O&M costs. Water tariffs remained unchanged from 1956 through 1992. Recent and planned tariff increases for all of the consumer categories (see paras. 18, 51 and 53) will result in full cost recovery and will significantly improve financial performance. Despite the tariff increases averaging 400 per cent, billing and collection efficiencies are excellent. DWSC operates 564,000 connections (530,000 domestic, 17,000 industrial, 17,000 commercial and public connections). The vast majority of consumers pay diligently, and the collection efficiency is higher than 99 per cent.

60. The financial and accounting systems of DWSC are considered adequate. DWSC maintains accounts and books based on a double entry accounting system in accordance with the accounting rules and regulations issued by the Government. NWSC will set up a similar organizational structure before Project implementation begins. The DMG has established a separate Finance Unit to take charge of all financial and accounting matters concerning financing of the Project for DWSC and NWSC.

61. The financial performance of the two EAs, DWSC and NWSC, has been projected based on reasonable assumptions regarding water tariff levels and O&M costs of water supply operations as detailed in Appendix 7. These assumptions are based on the streamlining of the water system operations to minimize energy consumption, chemical usage, consumable usage and labor requirements throughout the operations, administration and management division of the EAs. The financial projections indicate that as the DMG implements the proposed water tariff increases, the financial situation of the two EAs will remain satisfactory for the next ten years. The two EAs will be able maintain their debt-service coverage ratios higher than 1.2 times their annual debt-service requirements and the subsidies to the water supply companies will be phased out. The financial analysis of the Project does include an assumed annual investment of Y 200 million (\$23 million) to upgrade, replace and expand the existing system. Detailed financial analysis was carried out to assess the adequacy of the financial internal rate of return (FIRR) of NWSC and of DWSC along with sensitivity tests to ascertain the variability of the results as described below and detailed in Appendix 8.

1. Financial Internal Rate of Return

62. The Project is financially viable, with an estimated FIRR of 8.6 per cent for NWSC and 9.9 per cent for DWSC. The FIRR of the Project as a whole is estimated at 9.6 per cent. Each of these FIRRs exceeds the weighted average financial cost of capital,

estimated at 4.3 per cent. A sensitivity analysis of the FIRR was also carried out assuming various adverse situations. The FIRR is most sensitive to revenue fluctuations, which highlight the importance of the policy dialogue related to tariff increases that was undertaken during Project processing. The Project will remain viable as long as water tariffs are increased on a regular basis to offset water production cost increases, local inflation and currency fluctuations.

2. Affordability

63. The affordability of the proposed tariff levels has been evaluated. Based on the water sales projections, the average per capita consumption is forecast to increase moderately from 80 lpcd in 1994 to 100 lpcd in 2000. The increase is expected to be moderate despite the present latent demand because of low system pressure, increasing awareness of conservation and the much higher water tariffs. The average household consists of 3.1 persons. Water expenditure of a household is projected to be about 1.0 per cent of household income in 1995 and 1.9 per cent in 2000. These percentages are well below the 3 per cent level usually considered as affordable in the water supply sector. The residential water tariffs will be cross-subsidized from the large commercial and industrial users through the block tariff systems that the Mission was instrumental in introducing to the EAs and DMG.

3. Pricing

64. The average incremental financial cost (AIFC) of water was calculated based on the assumptions described in Appendix 9. The price analysis shows that the current average tariff of water in Dalian City recovers about 50 per cent of the AIFC. With the planned tariff increases, however, the average price of water will recover 90 per cent of the AIFC by Project completion in 1998. Preliminary estimates are also provided for the average incremental economic cost (AIEC) of water. The AIEC is higher than the AIFC to the extent that the economic cost of the incremental wastewater treatment has been included as a proxy for the economic cost of incremental wastewater pollution.¹ The DMG will review its current fixed rate pollution charge policies as new wastewater treatment plants are brought on stream, and will consider revising these to reflect a user charge basis, which may be included as a specified surcharge on future water billings.

C. **Policy Impact**

65. The Project will generally help NWSC and DWSC to expand and rehabilitate the existing water supply system to meet the demand projections for 2000 at the Government's recommended levels of service for residential/household consumers. Extensive policy dialogue during Project preparation has supported a number of policy issues and led to specific action to implement the related improvements, including (i) tariff structure reform that will result in full cost recovery; (ii) introduction of the economic pricing of water, allocation of water resources, water demand management and water conservancy measures; (iii) improved operating efficiency; and (iv) acceleration of provision of environmental sanitation services through linkage of water supply expansion to corollary increased requirements for wastewater collection and drainage.

¹ The Bank's OENV is currently implementing RETA No. 5515: Economic Assessment of Environmental Impacts, for \$600,000, approved on 10 December 1992, which will lead to the development of a handbook to guide future analysis of environmental costs and benefits of 12 project categories including water supply.

D. Project Risks

66. The major potential Project-related risks are: (i) delays in construction of the Project, which would lead to a worsening of the present water supply shortages, causing reduced income, reluctance of consumers to pay higher tariffs and reduced economic growth; (ii) delays in the tariff increases; (iii) shortage of raw water supply from Biliuhe Reservoir; and (iv) delays in the implementation of the parallel environmental protection and wastewater treatment program. The Project was designed to mitigate these potential risks. The Bank's approval of advance action will help reduce the potential risk of delayed implementation. Agreement was reached with the DMG, NWSC and DWSC on matters related to implementation of water resources protection and management plans, wastewater treatment programs, improved water system operation and efficiency, tariff increases, institutional strengthening and training to address the related risks. As proposed, the Project does not face any unusual risks.

VI. ASSURANCES

67. The Borrower, the DMG and the EAs have given the following specific assurances, in addition to the standard assurances, which have been incorporated in the legal documents:

- (i) The DMG has established a Leading Group to be responsible for implementing policy and overall supervision of the Project.
- (ii) The DMG has established a properly staffed Project Management Unit, and the EAs have established properly staffed PIUs.
- (iii) Prior to undertaking overseas training, the DMG, NWSC and DWSC will, in consultation with the international consultants, prepare a training program, select candidates for training and develop the format of the report that will be submitted by the candidates upon completion of training. The EAs will submit the training program, the list of candidates, the report format and the training reports to the Bank for review.
- (iv) DWSC and NWSC have agreed to limit new debt to ensure that the debt-service ratio is maintained at a minimum of 1.2.
- (v) NWSC and DWSC have agreed not to endanger their financial positions or prospects by early repayment of their loans.
- (vi) The DMG and the EAs will carry out annual reviews of the water tariffs to maintain them at a level to generate sufficient revenue for NWSC and DWSC to (a) cover O&M costs and debt-service requirements or depreciation, whichever is greater; and (b) maintain a debt-service ratio not less than 1.2 times starting from 1999.
- (vii) The DMG subsidy currently covering a portion of O&M costs of DWSC and NWSC will be phased out within one year of completion and commissioning of the Project facilities, and full cost recovery will come directly from the water users.

- (viii) The DMG has agreed to provide the Bank with annual reports on various Project-related activities, including (a) water quality; (b) wastewater treatment capacity (including industrial pretreatment) for the areas served by the Project; and (c) Water Conservancy Program, including recycling, water saving measures, seawater utilization, relocation of major water-consuming industrial enterprises, and other measures having a significant impact on water conservancy and wastewater reduction.
- (ix) The DMG has agreed to conduct an independent post-evaluation of the resettlement program, including a socioeconomic survey of the resettlers within one year of completion and commissioning of the Project facilities, and to report the findings to the Bank.

VII. RECOMMENDATION

68. I am satisfied that the proposed loan would comply with the Articles of Agreement of the Bank and recommend that the Board approve the loan of \$160 million to the People's Republic of China for the Dalian Water Supply Project from the Bank's ordinary capital resources, with interest to be determined in accordance with the Bank's pool-based variable lending rate system for US dollar loans and with an amortization of 25 years, including a grace period of 5 years and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan and Project Agreements presented to the Board.

MITSUO SATO
President

26 August 1994

APPENDIXES

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WATER DEMAND PROJECTION IN DALIAN CITY

Categories	1993 ^a	1995	2000	2010
AVERAGE DAY DEMAND				
Domestic Demand (1,000 cum/day) ^b	288.36	321.60	458.00	721.90
Population (thousand)	1,823.54	1,911.90	2,167.00	2,465.10
Per capita consumption (lpcd)	158.13	168.20	211.35	292.85
Industrial Demand (1,000 cum/day)	203.04	332.00	452.00	640.00
Industrial water demand rate (cum/Y 1,000 of industrial output) ^c	10.06	9.84	9.56	9.28
TOTAL AVERAGE DAY SALEABLE WATER DEMAND (1,000 cum/day)	491.40	653.60	910.00	1,361.90
Nonrevenue water	78.62	104.58	145.60	217.90
Percentage	16.00	16.00	16.00	16.00
TOTAL AVERAGE DAY TREATED WATER DEMAND (1,000 cum/day)	570.02	758.18	1,055.60	1,579.80
Water Treatment Plant in-plant demand (4%)	22.80	30.33	42.22	63.19
TOTAL AVERAGE DAY RAW WATER DEMAND (1,000 cum/day)	592.82	788.50	1,097.82	1,643.00
TOTAL MAXIMUM DAY RAW WATER DEMAND (1,000 cum/day)	693.61	914.66	1,273.48	1,856.59
Ratio of maximum day to average day demand	1.17	1.16	1.16	1.13

^a Actual consumption reported.

^b Includes residential, commercial and institutional demands.

^c DMG water conservancy policies are projected to lower water consumption per Y 1,000 of industrial output.

COST ESTIMATES BY COMPONENTS AND BY EXECUTING AGENCIES *
(\$ million)

Categories	NWSC			DWSC						TOTAL		
	NORTHERN CONVEYOR			SOUTHERN CONVEYOR			WATER TREATMENT PLANTS AND DISTRIBUTION					
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
I BASE COST												
1. Land Acquisition	0.00	3.80	3.80	0.00	5.27	5.27	0.00	2.92	2.92	0.00	11.99	11.99
2. Resettlement	0.00	1.17	1.17	0.00	0.49	0.49	0.00	0.06	0.06	0.00	1.72	1.72
3. Civil Works	7.85	51.54	59.39	7.12	49.54	56.66	0.00	23.84	23.84	14.97	124.92	139.89
4. Construction Materials ^b	36.53	0.00	36.53	29.14	7.86	37.00	20.97	0.00	20.97	86.64	7.86	94.50
5. Equipment	3.35	0.11	3.46	4.16	0.87	5.03	18.26	0.00	18.26	25.77	0.98	26.75
6. Consultant Services	1.10	3.36	4.46	0.41	1.96	2.37	0.70	2.27	2.97	2.21	7.59	9.80
and Training												
7. Administration	0.15	1.34	1.49	0.14	0.72	0.86	0.14	0.98	1.12	0.44	3.04	3.47
Subtotal	48.98	61.32	110.30	40.98	66.71	107.69	40.07	30.07	70.14	130.03	158.10	288.13
II CONTINGENCIES												
1. Physical ^c	3.02	6.06	9.08	2.39	5.37	7.76	2.03	3.00	5.03	7.44	14.43	21.87
2. Price ^d	3.81	13.95	17.76	3.09	6.48	9.57	3.11	5.14	8.25	10.01	25.57	35.58
Subtotal	6.83	20.01	26.84	5.48	11.85	17.33	5.14	8.14	13.28	17.45	40.00	57.45
TOTAL	55.81	81.33	137.14	46.46	78.56	125.02	45.21	38.21	83.42	147.48	198.10	345.58
III IDC AND OTHER CHARGES												
	5.92	5.47	11.39	5.53	8.63	14.16	5.17	3.43	8.60	16.62	17.54	34.15
GRAND TOTAL	61.73	86.80	148.53	51.99	87.19	139.18	50.38	41.64	92.02	164.10	215.63	379.73

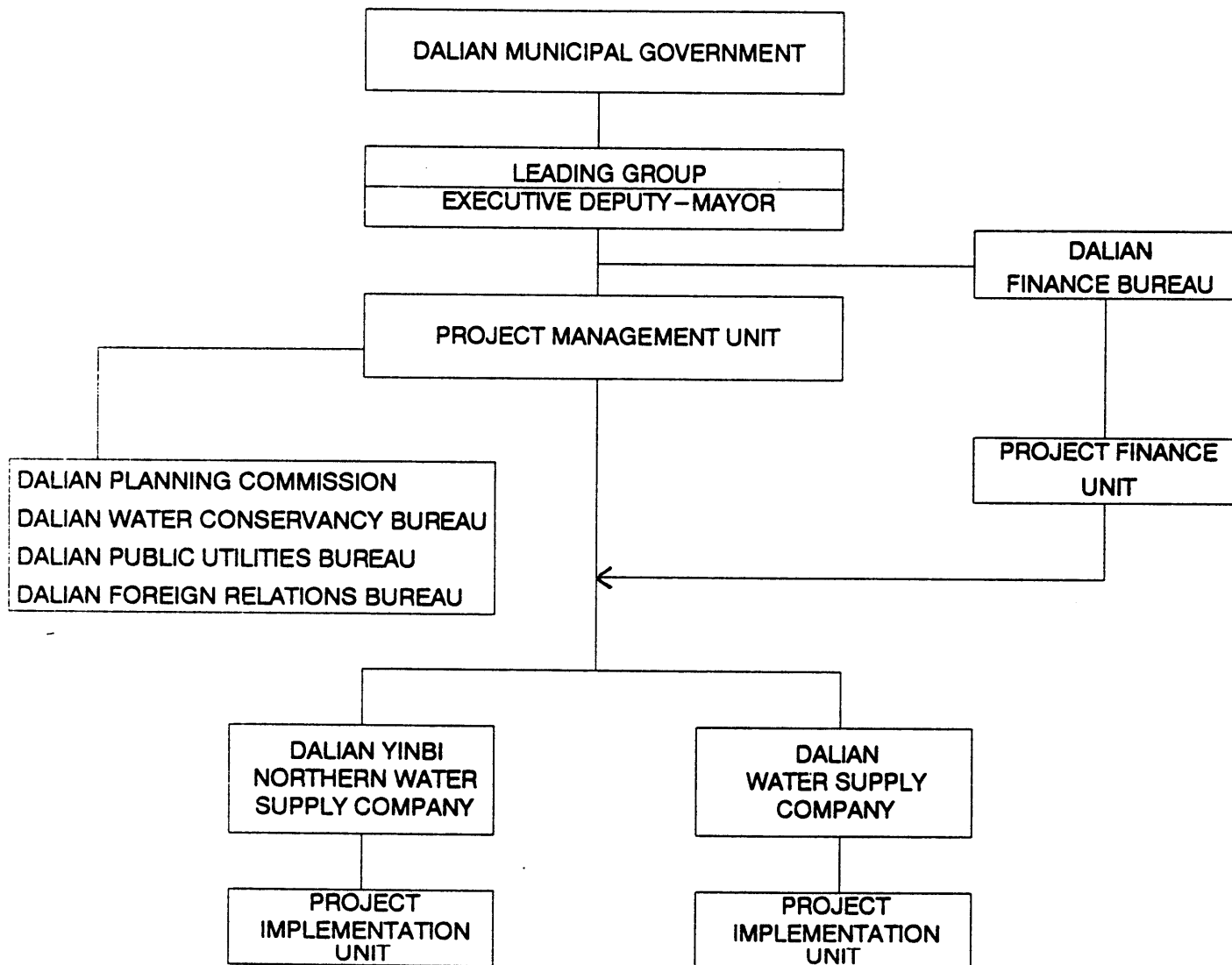
* 1994 May prices including 3.38 per cent of business tax for all costs excluding equipment.

^b Major construction materials. Minor construction materials are included in the civil works.

^c 10 per cent for civil works, and 5 per cent for materials and equipment

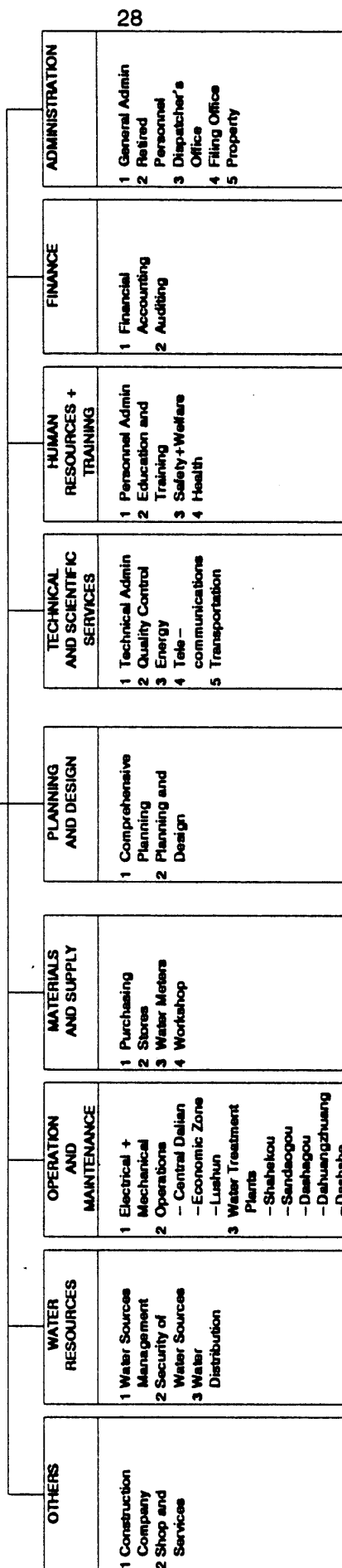
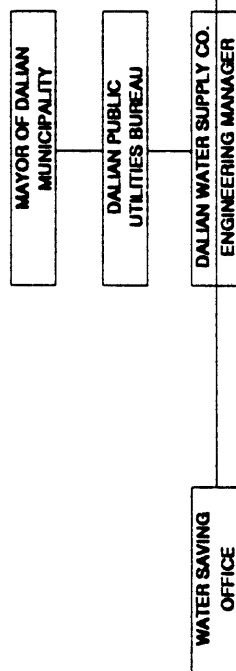
^d The following price escalation factors have been used:

	1994	1995-1997
Foreign exchange	3.1 per cent	3.1 per cent
Local currency	10 per cent	7 per cent

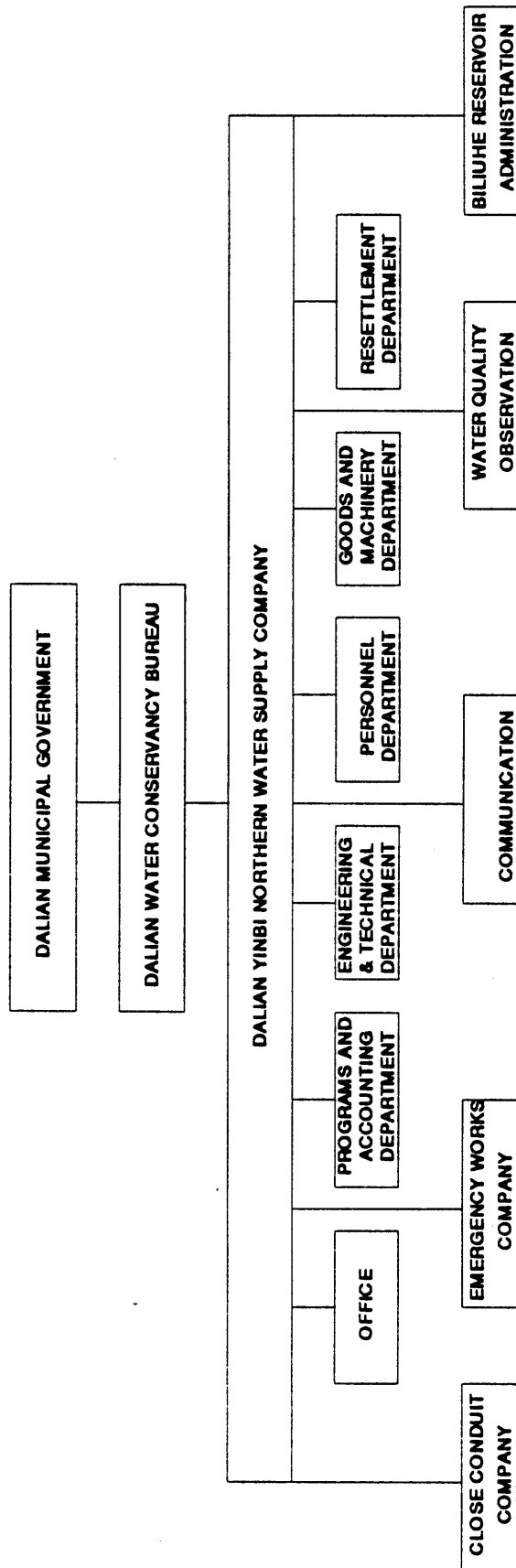
ORGANIZATIONAL ARRANGEMENTS FOR PROJECT IMPLEMENTATION**OVERALL ORGANIZATIONAL CHART**

(Reference in text: page 12, para. 34)

**ORGANIZATIONAL CHART OF
DALIAN WATER SUPPLY COMPANY**



ORGANIZATIONAL CHART OF
DALIAN YINBI NORTHERN WATER SUPPLY COMPANY



IMPLEMENTATION SCHEDULE

PHASE	ITEM	1992	1993	1994	1995	1996	1997	1998	1999
I. NORTHERN CONVEYOR	1. LAND ACQUISITION AND RESETTLEMENT								
	2. SURVEYS, DETAILED DESIGN, TENDER DOCUMENTS, SUPERVISION								
	3. INTAKES								
	4. CLOSED CONDUITS								
	5. TUNNELS								
	6. STEEL PIPE BRIDGE								
	7. INVERTED Siphons								
	8. SITE PROTECTION								
	9. DORMITORY & ETC.								
II. SOUTHERN CONVEYOR	1. SURVEYS, DETAILED DESIGN, TENDER DOCUMENTS, SUPERVISION								
	2. PIPE LINE D1400 & ETC (PROCUREMENT AND INSTALLATION)								
	3. WAZIRKHAH LIFT STATION								
III. WATER TREATMENT PLANT (WTP) & DISTRIBUTION NETWORK	1. SURVEYS, DETAILED DESIGN, TENDER DOCUMENTS, SUPERVISION								
	2. PIPE LINE D2000 (PROCUREMENT AND INSTALLATION)								
	3. WAZIRKHAH DELIVERY PUMPING STATION								
IV. WATER TREATMENT PLANT (WTP) & DISTRIBUTION NETWORK	1. NARSHAH WTP (180000 CUM/DAY)								
	a. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								
	b. IMPLEMENTATION								
	2. URBAN DISTRIBUTION NETWORK								
	a. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								
	b. IMPLEMENTATION								
	3. DASHAGOU WTP (180000 CUM/DAY)								
	a. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								
	b. IMPLEMENTATION								
V. URBAN DISTRIBUTION NETWORK	1. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								
	2. URBAN DISTRIBUTION NETWORK								
	a. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								
VI. EXISTING WTP'S REHABILITATION	1. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								
	2. EXISTING WTP'S REHABILITATION								
	a. SURVEY, DESIGN, TENDER DOCUMENTS, SUPERVISION								

DENOTES FULL - TIME ACTIVITY

DENOTES ONGOING CONSTRUCTION SUPERVISION

OUTLINE TERMS OF REFERENCE FOR CONSULTING SERVICES**I. Detailed Design**

- (i) Plan, direct and supervise detailed topographic surveys and soil/geological and geotechnical investigations along the alternative alignments of the proposed water conveyors and proposed sites for water pumping stations, water reservoirs and water treatment plants.
- (ii) Prepare (a) detailed engineering design and construction drawings of the Project facilities, (b) bills of quantities, (c) contract packages, (d) scope and cost estimates for each contract package, and (d) tender documents for each contract package.
- (iii) Prepare a detailed construction management plan including schedules for construction; bidding; financing, including disbursement of the proceeds of the loans and budget appropriation by Dalian City; and test run and start-up of Project facilities, including environmental management plan.

II. Construction Supervision

- (i) Review and evaluate the validity of proposed subcontracts, and assist in preparing letters of invitation for bidding, prequalification of civil works bidders and shortlists of suppliers, evaluating the submitted bids and bid evaluation reports, price and technical negotiations with the bidders, and related correspondence.
- (ii) Update or revise, if necessary, the construction management plan and the cost estimates based on the results of the bidding, and modify the design and construction drawings as necessary after the bidding and during construction.
- (iii) Supervise the mobilization of contractors and delivery of materials and equipment, review shop drawings, monitor contractors' topographic surveys to ensure correct alignments and elevations of the Project facilities, and perform soil/geological and geotechnical tests to ensure adequate data for foundation and structures.
- (iv) Inspect materials and equipment and supervise, inspect, measure and control the quality of the construction of works and installation of equipment.
- (v) Compare actual with scheduled progress and advise the Executing Agencies (EAs) of any developments that could delay completion. Recommend any necessary actions to be taken by the EAs to facilitate timely completion of construction.
- (vi) Supervise pressure tests of the major pipelines, and equipment start-up and commissioning; prepare Operation and Maintenance Manuals for equipment and the water treatment plant; and provide training assistance as required to operators of new facilities.

III. Project Management and Administration

- (i) Advise the EAs on the technical aspects, engineering design, construction supervision and Bank procurement procedures and guidelines for the procurement of goods.
- (ii) Help the EAs coordinate Project implementation activities, maintain records and minutes of all construction related activities, and certify and recommend payment of claims by the contractors and suppliers.
- (iii) Coordinate the activities of local and international consultants.
- (iv) Advise on environmental issues and resettlement of families displaced by construction activities.
- (v) Inspect completed works and make recommendations to the EAs on the issuance of the certification of completion.
- (vi) Prepare reports for the EAs and for the Bank, including progress reports, project completion report, and project benefit monitoring reports; and facilitate the Bank's loan review missions.

IV. Project-related Studies/Operations

- (i) Optimize the management and operation of the northern conveyor, emphasizing management, legal aspects and financial operation. The managers of the new company should be trained to optimize the use of water resources, negotiate changes in reservoir intake level that could cause abrupt changes in water quality, account for all water entering and leaving the conveyor, and avoid water losses and wasted energy. The managers should understand the use of the water management model and be trained to utilize the new telemetric control system. On the legal side, the managers should be aware of current provincial and municipal regulations governing sanitary protection and the allocation of raw water resources to different users. On the financial side, the managers should establish an accounting system, budget mechanism, a financial management information system and internal audit procedures. This task will include establishment of a raw water price level based on an average incremental cost concept.
- (ii) Install and initiate telemetric control systems in the northern conveyor, the southern conveyor, the water treatment plants and the distribution system.
- (iii) Calibrate and operate the existing water management model.
- (iv) Study the hydraulic behavior of the conveyors under unsteady flow conditions.
- (v) Optimize the operations of the reservoir and downstream works.
- (vi) Study the conditions of the Biliuhe Reservoir and Spillway, and make recommendations for improvements.

- (vii) Determine the detailed rehabilitation needs of old plants at Sunjiagou, Donkamen, Taishan and Yanjialou as well as the older parts of the plants at Sandagou and Shahekou, including repairs, replacement of worn-out equipment, and installation of new measuring and control instruments.
- (viii) Optimize the operation of the water treatment plants, including routine jar tests, monitoring of the coagulation process and improvements in bacteriological quality assurance.
- (ix) Initiate an effective nonrevenue water control program, including use of up-to-date leakage control equipment; and provide on-the-job training to Dalian Water Supply Company (DSWC) technicians responsible for nonrevenue water control.
- (x) Carry out hydraulic analysis of the water distribution system.
- (xi) Prepare an outline master plan and a medium-term development plan.
- (xii) Prepare water resource allocation/economic water pricing studies with the goal of attaining full Project cost recovery. This will include the development of rational water pricing policies such as progressive water tariffs, relating tariffs to the average incremental cost (AIC) of producing water and plans for controlling/allocating water resources in Dalian. The consultants will assist the EAs and the Dalian Municipal Government (DMG) with the determination of the economic cost of water and the most cost-effective use of the limited water resources while providing protection for smaller water users and guaranteeing riparian water rights. The consultants will assist the Leading Group with coordination of a workshop, which will provide a forum for discussion on various issues related to economic pricing of water resources, tariff reform/progressive tariffs and AIC of water.
- (xiii) Assist in the water conservancy program relating to recycling, re-use, process improvements/modernization, use of seawater for cooling, leakage detection and mitigation, metering improvements (repair, calibration, replacement), industrial relocation to industrial zones where greater integrated use of water is possible, as well as consumer education programs in responsible water use and protection of water resources.
- (xiv) Perform policy-related monitoring, covering resettlement; environmental conditions/water quality in streams, rivers and seashores in and near Dalian City; wastewater treatment capacity building; benefits monitoring evaluation (BME) reports; water conservancy progress; and related reports.

V. Specific Tasks of the International Consultants

- (i) In addition to the general Project responsibilities described above, review basic design criteria and detailed designs; prepare specifications for tender packages containing foreign exchange costs; prepare international competitive bidding (ICB) tender documents; review of local competitive bidding (LCB) tender documents; evaluate bid packages containing foreign exchange; prepare bid summaries; prepare quarterly and annual Project summary reports; update the Project Administration Manual and any related documents concurrently with the Project reports; and support the various training programs of the EAs.

- (ii) **Assist the EAs and the local consultants with quality control programs, including pressure/leakage testing of pipelines; compaction testing; concrete mix design; concrete compression and slump testing; testing and analysis of sand, gravel and backfill materials; and safety aspects for both construction workers and the general public.**

INDICATIVE LIST OF CONTRACT PACKAGES**Table 1: Materials & Equipment**

Description	Approximate Quantity	Unit	Approximate Amount (\$ million)	No. of Sub- packages	Mode of Procurement
<u>Northern Conveyor</u>					
A. Materials					
Pkg 1 Steel Bar	47,120	ton	19.57	three	ICB
Pkg 2 Cement	310,000	ton	15.49	three	ICB
Pkg 3 Steel Plate	3,940	ton	1.47	one	ICB
Subtotal			36.53		
B. Equipment					
Pkg 4 Excavators, Trucks and others	1	set	2.34	one	ICB
Pkg 5 Communication and SCADA System	1	set	1.01	two	IS
Pkg 6 Other Equipment	1	set	0.15	one	IS
Subtotal			3.50		
Total			40.03		
<u>Southern Conveyor</u>					
A. Materials					
Pkg 1 Prestressed Concrete Cylinder Pipe	43.60	km	16.13	one	ICB
Pkg 2 Steel Plate	35,000	ton	12.17	one	ICB
Pkg 3 Steel Bar	954	ton	0.37	two	IS
Pkg 4 Cement	7,300	ton	0.33	one	ICB
Pkg 5 Timber	800	cum	0.14	one	IS
Subtotal			29.14		
B. Equipment					
Pkg 6 Pump Station	1	set	2.66	one	ICB
Pkg 7 Energy Supply	1	set	1.50	one	ICB
Subtotal			4.16		
<u>Water Treatment Plants and Network</u>					
A. Materials					
Pkg 8 Steel Plate	27,200	ton	9.53	one	ICB
Pkg 9 Cast Iron Pipe	19,700	ton	6.78	one	ICB
Pkg10 Shape Steel	7,200	ton	2.82	one	ICB
Pkg11 Cement	27,700	ton	1.25	one	ICB
Pkg12 Timber	3,400	cum	0.59	one	ICB
Subtotal			20.97		
B. Equipment					
Pkg13 Water Treatment Equipment	7	set	14.36	seven	ICB
Pkg14 Excavators, Trucks and others	1	set	2.34	one	ICB
Pkg15 SCADA System	2	set	1.56	two	IS
Pkg16 Other Equipment	2	set	0.28	one	IS
Subtotal			18.54		
Total			72.81		
GRAND TOTAL			112.84		

ICB = international competitive bidding, IS = international shopping.

Table 2: Civil Works

Description	Approximate Quantity	Unit	Estimated	Bank	Mode of Procurement
			Total Cost ^a (\$ million)	Financing (\$ million)	
<u>Northern Conveyor</u>					
A. Tunnels					
Package C1	Biliuhe, Shanxi	2.1 km	1.45	0.22	LCB
Package C2	Hetaofang	1.8 km	1.48	0.22	LCB
Package C3	Yuhuangmiao	3.0 km	1.21	0.18	LCB
Package C4	Xiaojiang, Xiaolitun	1.5 km	1.63	0.24	LCB
Package C5	Suntun, Jigou	2.7 km	2.67	0.40	LCB
Package C6	Qiudian	4.6 km	2.89	0.43	LCB
Subtotal			11.33	1.70	
B. Inverted Siphon and Pipe Bridge					
Package C7	Liangtun, Dongtun	1.9 km	1.59	0.24	LCB
Package C8	Lintun, Houliu	1.6 km	1.36	0.20	LCB
Package C9	Daxin, Tangtun	1.4 km	1.35	0.20	LCB
Package C10	Bajiazi, Xioluan	2.5 km	2.31	0.35	LCB
Package C11	Dasha	1.6 km	3.38	0.51	LCB
Subtotal			9.99	1.50	
C. Closed Conduit					
Package C12	Sections 1 and 2	1.1 km	0.77	0.12	LCB
Package C13	Section 3	1.0 km	0.72	0.11	LCB
Package C14	Section 4	4.4 km	3.19	0.48	LCB
Package C15	Section 5	6.0 km	4.95	0.74	LCB
Package C16	Sections 6 and 7	4.5 km	2.97	0.45	LCB
Package C17	Sections 8, 9 and 10	5.7 km	4.30	0.65	LCB
Package C18	Sections 11 and 12	3.8 km	2.24	0.34	LCB
Package C19	Section 13	6.1 km	4.88	0.73	LCB
Package C20	Sections 14, 15 and 16	3.5 km	2.58	0.39	LCB
Package C21	Sections 17 and 18	3.4 km	2.19	0.33	LCB
Package C22	Section 19	3.6 km	2.25	0.34	LCB
Subtotal			31.04	4.66	
Total			52.36	7.85	
<u>Southern Conveyor, Water Treatment Plants and Distribution Network</u>					
A. Pipe Installation					
Package C1	Prestressed Concrete Cylinder Pipe	43.60 km	11.80	4.72	ICB
Package C2	Steel Pipe	24.0 km	6.00	2.40	ICB
Total			17.80	7.12	
GRAND TOTAL			70.16	14.97	

LCB = local competitive bidding, ICB = international competitive bidding.

^a The cost of contracts procured under LCB excludes direct foreign exchange costs (e.g., imported construction materials such as cements, steel bars) and imported construction equipment.

FINANCIAL PERFORMANCE AND PROJECTIONS

A. Past Financial Performance

1. The financial performance of the Dalian Water Supply Company (DWSC) has not been satisfactory. Operating revenues were not sufficient to meet operating expenses. The inadequate operating revenue generation was due to the low water tariff level, which has not been adjusted since 1952. During this time the average water tariff remained at Y 0.2 per cubic meter (cum), (Y 0.13 per cum for domestic users and Y 0.22 per cum for industrial and commercial consumers). The Dalian municipal government (DMG) announced a full cost recovery policy for water supply services, and increased water tariffs by about 260 per cent in July 1992. The rate was again adjusted upward in October 1993, by about 180 per cent, to an average level of Y 0.92 per cum (Y 0.4 per cum for domestic, Y 1.2 per cum for industrial users and Y 1.8 per cum for commercial users). Despite the sharp water tariff increases in 1992 and 1993, operating deficits of Y 118 million in 1992 and Y 81 million in 1993 resulted. The operating deficits were caused mainly by a salary adjustment in 1993, and by power rate and maintenance cost increases. The DMG has subsidized the water supply operations of DWSC by Y 20 million - Y 120 million annually. Past financial statements of DWSC are presented in Tables 1 and 2.

B. Financial Projections

2. Financial projections for the next ten-year period have been prepared for both DWSC and the Dalian Yinbi Northern Water Supply Company (NWSC). The financial projections presented in Tables 3 to 10 are based on past financial performance and the following assumptions.

1. Price Escalation and Foreign Exchange Rate

3. All figures are expressed at current prices. Domestic inflation factors applied were 10 per cent for 1994, and 7 per cent for 1995 and thereafter. An official foreign exchange rate of Y 8.7 per \$1 was applied.

2. Revenue Projections

4. The financial objective of DWSC and NWSC is to achieve a debt-service coverage ratio of not less than 1.2 times without operational subsidies from the DMG. The DMG has agreed to increase the water tariff gradually to a level that will achieve the financial target. The following average water tariff levels are used for each financial year:

Assumed Water Tariff *
(Y/cum)

Year	DWSC		NWSC	
	Current	1993 Constant	Current	1993 Constant
1994	0.93	0.84	0.34	0.31
1995	1.20	1.02	0.48	0.41
1996	1.50	1.19	0.51	0.41
1997	2.20	1.63	0.55	0.41
1998	2.35	1.63	0.59	0.41
1999-2004	2.60-3.65	1.69	0.63-0.88	0.41

* Average tariff for domestic and industrial.

(Reference in text: page 20 para 61)

5. Water sales were projected to increase gradually from 195 million cum in 1994 to about 346 million cum by 2000, or an average annual increase of about 10 per cent. The advance action approved by the Bank will enable completion of one of the two new southern conveyor lines, providing substantial additional volumes of water. The nonrevenue water rate is anticipated to remain at the 16-17 per cent level. A separate bulk water rate (Y 0.34 - Y 0.88 per cum) was applied for bulk water supply to the Dalian Economic and Technology Development Zone.

3. Expenditure Projections

6. Operating costs were estimated to increase at the same rate as domestic price escalation factors. Power, chemical and administrative costs are based on the projected water production and other incidental costs.

7. Depreciation allowances are calculated on a straight line method. Annual depreciation factors used were 5 per cent up to 1997, and 3.63 per cent thereafter. The two Executing Agencies (EAs) use the following asset lives: 30 years for dams, 15 years for pipelines and 20 years for pumping stations.

4. Interest Expenses

8. Interest charges were estimated based on the prevailing terms and conditions of the loans to be secured. For the Bank loan, a prevailing interest rate for US dollar loan facility, which is currently set at 6.67 per cent per annum, was applied. For the local loans to the EAs from the Construction Bank of China, the prevailing fixed interest rate of 14.04 per cent per annum was used.

5. Taxes

9. The DMG adopted a value-added tax system starting in 1994. Under this system, the EAs are required to pay about 11.5 per cent on taxable items.

6. Fixed Assets

10. The fixed assets of DWSC have not been revalued thus far. Capital expenditures are initially recorded under the Work-in-Progress account and transferred to the fixed assets upon commissioning of the facilities.

D. Conclusions Drawn from the Financial Projections

11. The financial projections indicate that:

- (i) overall financial performance of DWSC and NWSC will be satisfactory for the next ten-year period; revenues will be sufficient to cover operating costs;
- (ii) internal cash generation of DWSC and NWSC will exceed 1.2 times the debt-service requirements, the minimum required level stipulated in the related loan covenants;
- (iii) subsidies from the DMG to DWSC and NWSC will be phased out before Project commissioning in 1998;

- (iv) there is a need to control operation and maintenance expenses to improve financial performance through elimination of duplication and redundancy of staff positions and other controllable measures; and
- (v) study and implementation of a mechanism for protection of foreign exchange rate risk is recommended when annual reviews of water tariff are undertaken.

Table 1. DALIAN WATER SUPPLY COMPANY
Income Statement
(Y '000)

Item	1988	1989	1990	1991	1992	1993
[REVENUE]						
Operating Income:						
Industrial	14,903	14,890	16,018	18,242	17,222	57,900
Domestic	3,128	3,493	4,406	5,158	5,829	19,130
Others	4,048	4,311	4,842	5,888	11,989	34,750
Subtotal	22,079	22,694	25,266	29,288	35,040	111,780
Non-operating Income (Subcompanies)	30,925	35,050	39,806	45,758	44,921	33,270
Total Income	53,004	57,744	65,072	75,046	79,961	145,050
[EXPENSES]						
Operating Expenses:						
Salaries and Wages	3,630	4,405	6,040	6,730	8,410	17,210
Raw Water	5,200	11,350	14,200	20,500	26,030	28,440
Power	13,150	24,822	31,080	48,100	62,910	81,430
Chemicals	800	991	900	1,510	1,570	1,700
Maintenance	5,180	2,136	2,230	2,460	4,840	18,060
Administration	6,690	7,080	10,840	11,460	14,720	15,870
Subtotal	34,650	50,784	65,290	90,760	118,480	162,710
Other Overhead Expense (Subcompanies)	30,389	34,537	40,416	41,641	47,058	28,690
Sales Tax	1,023	1,235	1,504	3,095	2,328	3,650
Depreciation	3,970	12,706	15,800	23,680	30,180	30,740
Subtotal	35,382	48,478	57,720	68,416	79,566	63,080
Net Income before Subsidy	(17,028)	(41,518)	(57,938)	(84,130)	(118,085)	(80,740)
Subsidy	20,000	44,500	61,080	87,080	120,460	69,190
NET INCOME	2,972	2,982	3,142	2,950	2,375	(11,550) ^a

^a Recovered from internal reserves.

Table 2: DALIAN WATER SUPPLY COMPANY
Balance Sheet
(Y '000)

Item	1988	1989	1990	1991	1992	1993
[ASSETS]						
Fixed Assets	271,036	282,660	414,006	568,490	580,792	612,608
Accumulated Depreciation	(111,691)	(122,556)	(138,561)	(162,656)	(193,259)	(218,674)
Net Fixed Assets	159,345	160,104	275,445	405,834	387,533	393,934
Work-in-Progress	12,386	13,349	17,760	12,018	20,843	46
Total Fixed Assets	171,731	173,453	293,205	417,852	408,376	393,980
Cash	6,780	11,391	25,455	20,469	30,975	24,941
Accounts Receivable (Nontrade)	13,859	16,307	9,997	44,134	48,464	91,691
Inventories	2,329	3,663	4,808	6,503	7,789	45,772
Others	42	519	410	354	421	1,049
Total Current Assets	23,010	31,880	40,670	71,460	87,649	163,453
Total Assets	194,741	205,333	333,875	489,312	496,025	557,433
[EQUITY & LIABILITIES]						
Capital	159,345	163,246	278,587	408,976	390,675	362,474
Reserves	2,970	2,940	3,140	2,950	2,375	2,363
Others	13,742	19,382	25,839	25,760	42,062	42,062
Subtotal	176,057	185,568	307,566	437,686	435,112	406,899
Current Liabilities	18,684	19,765	26,309	51,626	60,913	150,534
Total Equity & Liabilities	194,741	205,333	333,875	489,312	496,025	557,433

Table 3. DALIAN WATER SUPPLY COMPANY
Water Demand and Sales Projections

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Actual												
Population (000)	1808.0	1852.5	1898.2	1945.0	1993.5	2043.3	2094.2	2146.5	2200.0	2227.4	2255.2	2283.3	2311.7
Population Increase (%)	2.47	2.47	2.47	2.47	2.49	2.49	2.49	2.49	2.49	1.25	1.25	1.25	1.25
Domestic Water Demand (m cum)	44.84	52.00	50.30	54.60	58.32	62.30	66.55	71.09	75.94	79.37	82.96	86.71	90.63
Industrial (m cum)	78.28	77.21	107.90	121.18	128.89	137.08	145.80	155.08	164.94	170.79	176.86	183.14	189.64
Institutional and Others (m cum)	52.16	61.22	57.40	62.78	67.66	72.92	78.58	84.69	91.27	95.59	100.13	104.89	109.85
Bulk Water to DETDZ (m cum)	13.00	17.71	25.55	31.77	42.60	62.41	84.39	86.56	89.46	93.14	94.85	94.85	94.85
Total Water Demand (m cum)	188.28	208.14	241.15	270.33	297.47	334.71	375.32	397.42	421.61	438.89	454.80	469.59	484.97
Domestic Water Sales (m cum)	44.84	47.82	58.45	59.85	61.25	62.65	64.05	65.45	66.80	69.55	70.83	70.83	70.83
Industrial Water Sales (m cum)	78.27	77.21	77.21	82.24	87.61	93.32	99.40	105.88	112.79	117.41	119.58	119.58	119.58
Institutional Water Sales (m cum)	29.42	29.88	20.18	22.49	25.07	27.94	31.14	34.71	38.69	40.28	41.02	41.02	41.02
Commercial Water Sales (m cum)	9.74	13.63	13.73	15.16	18.28	22.05	26.59	32.07	38.68	40.27	41.01	41.01	41.01
Bulk Water to DETDZ (m cum)	13.00	17.71	25.55	31.77	42.60	62.41	84.39	86.56	89.46	93.14	94.85	94.85	94.85
Total Water Sales (m cum)	175.27	186.25	195.12	211.51	234.81	268.37	305.58	324.67	346.41	360.65	367.29	367.29	367.29
Nonrevenue Water (m cum)	44.11	38.90	45.78	37.75	40.36	43.25	46.45	45.24	48.82	50.83	51.76	51.76	51.76
Raw Water Supply (m cum)	219.38	225.15	240.90	249.26	275.17	311.62	352.03	369.92	395.23	411.47	419.05	419.05	419.05
NRW Rate (excl. bulk water)	21.4%	18.8%	21.3%	17.4%	17.4%	17.4%	17.4%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%
Domestic Water Charge (Y/cum)	0.40	0.40	1.00	1.00	1.25	1.84	1.97	2.17	2.32	2.49	2.66	2.85	3.04
Industrial (Y/cum)	0.60	0.60	1.02	1.32	1.65	2.42	2.59	2.86	3.06	3.27	3.50	3.75	4.01
Institutional and Others (Y/cum)	0.40	0.80	0.94	1.21	1.52	2.22	2.38	2.63	2.81	3.01	3.22	3.44	3.68
Average Water Charge (Y/cum)	0.52	0.59	0.93	1.20	1.50	2.20	2.35	2.60	2.78	2.98	3.19	3.41	3.65
Bulk Water Rate to DETDZ (Y/cum)	0.52	0.80	0.80	1.00	1.00	1.20	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Treated Water Revenue (Y million)	28.28	97.61	157.70	215.69	288.31	453.11	520.67	619.10	714.84	796.29	867.74	928.49	993.49
Bulk Water Revenue (Y million)	6.76	14.17	20.44	31.77	42.60	74.89	151.90	155.81	161.03	167.65	170.73	170.73	170.73
Total Water Revenue (Y million)	35.04	111.78	178.14	247.46	330.91	528.00	672.57	774.90	875.87	963.95	1038.47	1099.22	1164.22

DETDZ = Dalian Economic and Technology Development Zone.

m cum = million cubic meter

Table 4. DALIAN WATER SUPPLY COMPANY
Projected Income Statement
(million yuan)

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
[REVENUE]	Actual												
Water Revenue	35.0	111.8	178.1	247.5	330.9	528.0	672.6	774.9	875.9	963.9	1038.5	1099.2	1164.2
Other Revenue (Net) ^a	44.9	33.3	36.6	39.2	41.9	44.8	48.0	51.3	54.9	58.8	62.9	67.3	72.0
Operating Revenue	80.0	145.0	214.7	286.6	372.8	572.8	720.5	826.2	930.8	1022.7	1101.3	1166.5	1236.2
[EXPENSES]													
Salaries	8.4	17.2	20.0	21.4	22.9	24.5	26.2	28.0	30.0	32.1	34.3	36.7	39.3
Power	62.9	81.4	110.6	118.3	126.6	135.6	145.1	155.3	166.2	177.8	190.3	203.6	217.8
Raw Water	26.0	28.4	68.3	100.4	119.9	149.4	184.1	207.8	238.0	267.5	291.9	310.8	333.6
Chemicals	1.6	1.7	2.0	2.2	2.6	3.2	3.8	4.3	4.9	5.5	6.0	6.4	6.8
Maintenance	4.8	13.1	14.5	15.5	16.5	17.6	34.0	36.8	36.8	36.8	36.8	45.8	45.8
Administration/overhead	14.7	15.9	11.0	13.2	15.3	17.4	21.4	23.5	25.6	27.8	29.8	32.5	34.5
Repairs	0.0	4.9	4.9	6.6	17.6	17.6	34.0	36.8	36.8	36.8	36.8	45.8	45.8
Total Operating Expenses	118.5	162.7	231.2	277.6	321.5	365.1	448.5	492.5	538.3	584.3	625.9	681.6	723.6
Overhead Expenses (Subcompanies)	47.1	28.7	31.6	33.8	36.1	38.7	41.4	44.3	47.4	50.7	54.2	58.0	62.1
Depreciation	30.2	30.7	30.6	30.6	82.0	82.0	115.1	124.8	124.8	124.8	124.8	155.2	155.2
Net Income before Interest/Tax	-115.8	-77.1	-78.7	-55.4	-66.8	87.1	115.6	164.7	220.3	263.0	296.5	271.7	295.3
Interest	0.0	0.0	11.7	17.6	32.3	53.0	68.1	128.3	125.6	122.6	119.3	115.6	111.6
Tax ^b	2.3	3.7	3.9	7.6	14.2	32.8	44.6	52.8	60.0	65.8	70.6	74.3	78.0
Net Income before Subsidy	-115.8	-77.1	-90.4	-73.0	-99.1	34.1	47.5	36.4	94.7	140.4	177.2	156.1	183.8
DMG Subsidy	120.5	69.2	95.0	80.0	120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET INCOME	2.4	-11.6	0.7	-0.5	6.7	1.4	2.9	-16.4	34.7	74.6	106.6	81.8	105.8
Operating Ratio	1.33	1.22	1.08	1.08	1.08	0.78	0.78	0.75	0.71	0.69	0.68	0.72	0.71
Power Rate (Y/Kwh)	0.40	0.40	0.40	0.42	0.45	0.48	0.51	0.55	0.59	0.63	0.67	0.72	0.77
Average Charge Of Raw Water	0.16	0.34	0.34	0.48	0.51	0.55	0.59	0.63	0.67	0.72	0.77	0.82	0.88

^a Net Revenue of subcompanies and interest on government bonds and securities.

^b Value – added tax starting from 1994 at about 11.5 per cent on taxable items.

Table 5. DALIAN WATER SUPPLY COMPANY
Projected Source and Uses of Funds
(million yuan)

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
[SOURCES]	Actual												
Net Income	2.4	-11.6	0.7	-0.5	6.7	1.4	2.9	-16.4	34.7	74.6	106.6	81.8	105.8
Add back: Depreciation and Interest	30.2	30.7	42.3	48.2	114.3	135.0	183.2	253.1	250.4	247.4	244.1	270.8	266.8
Net Internal Cash Generation	32.6	19.2	43.1	47.7	121.0	136.4	186.1	236.7	285.1	322.0	350.7	352.6	372.5
Grant from Central Government	0.0	0.0	18.6	11.5	16.5	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DMG Contribution	0.0	0.0	251.1	155.2	223.5	184.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DETDZ Contribution	0.0	0.0	0.0	0.0	46.4	46.4	46.4	0.0	0.0	0.0	0.0	0.0	0.0
Bank Loan	0.0	0.0	258.6	159.8	230.2	189.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
World Bank Loan	0.0	0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0	0.0	0.0	0.0
OECF Loan	0.0	0.0	0.0	0.0	153.7	153.7	153.7	0.0	0.0	0.0	0.0	0.0	0.0
Construction Bank of China	0.0	0.0	97.7	55.2	125.9	111.8	46.4	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	0.0	0.0	626.1	401.7	816.3	719.0	266.5	20.0	20.0	0.0	0.0	0.0	0.0
Total Sources	32.6	19.2	669.1	449.4	937.3	855.3	452.6	256.7	305.1	322.0	350.7	352.6	372.5
[USES]													
Capital Expenditures	0.0	11.0	626.1	401.7	816.3	719.0	266.5	220.0	220.0	200.0	200.0	200.0	200.0
Amortization	0.0	0.0	0.0	0.0	0.0	0.0	6.8	29.5	32.2	35.2	38.5	42.2	46.2
Interest Payment	0.0	0.0	11.7	17.6	32.3	53.0	68.1	128.3	125.6	122.6	119.3	115.6	111.6
Total Debt Service	0.0	0.0	11.7	17.6	32.3	52.99	74.87	157.78	157.77	157.77	157.77	157.77	157.77
Changes in Working Capital	1.2	-7.7	47.8	-4.3	-3.2	-2.6	-12.1	-1.7	-1.5	-0.9	0.8	-2.0	2.2
Appropriation of Reserves	0.0	21.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Uses	1.2	25.2	685.6	415.0	845.4	769.3	329.3	376.1	376.2	356.8	358.6	355.8	360.0
NET FLOW OF FUNDS	31.4	-6.1	-16.5	34.4	91.9	86.0	123.3	-119.4	-71.2	-34.9	-7.9	-3.2	12.5
Accumulated Net Funds	31.0	24.9	8.5	42.8	134.7	220.7	344.0	224.6	153.4	118.5	110.6	107.5	120.0
Debt - Service Ratio				2.71	3.74	2.57	2.49	1.50	1.81	2.04	2.22	2.23	2.36

DMG = Dalian Municipal Government, DETDZ = Dalian Economic and Technology Development Zone, OECF = Overseas Economic Cooperation Fund (of Japan).

Table 6. DALIAN WATER SUPPLY COMPANY
Projected Balance Sheets
(million yuan)

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Actual													
[ASSETS]													
Gross fixed assets	580.8	612.6	612.6	612.6	1640.3	1640.3	3175.6	3442.1	3442.1	3442.1	3442.1	4282.1	4282.1
Accumulated Depreciation	193.3	218.7	249.3	280.0	362.0	444.0	559.1	683.9	808.7	933.4	1058.2	1213.4	1368.7
Net fixed assets	387.5	393.9	363.3	332.6	1278.4	1196.3	2616.4	2758.2	2633.4	2508.6	2383.8	3068.6	2913.4
Work-in-Progress	20.8	0.0	626.1	1027.7	816.3	1535.2	266.5	220.0	440.0	640.0	840.0	200.0	400.0
Cash	31.0	24.9	8.5	42.8	134.7	220.7	344.0	224.6	153.4	118.5	110.6	107.5	120.0
Accounts receivable – sales	0.4	1.1	2.0	2.9	3.9	4.8	5.7	6.6	7.5	8.4	9.4	10.3	11.2
Other receivables	48.5	91.7	91.7	98.1	105.0	112.3	120.2	128.6	137.6	147.3	157.6	168.6	180.4
Inventories	7.8	45.8	57.8	69.4	80.4	91.3	112.1	123.1	134.6	146.1	156.5	170.4	180.9
Current Assets	87.6	163.5	160.0	213.3	323.9	429.1	582.0	482.9	433.1	420.3	434.0	456.7	492.5
Total Assets	496.0	557.4	1149.3	1573.6	2418.5	3160.6	3465.0	3461.1	3506.5	3568.9	3657.9	3725.3	3805.9
[LIABILITIES & EQUITY]													
Accounts payable	60.9	150.5	115.6	138.8	160.7	182.5	224.2	246.3	269.2	292.1	312.9	340.8	361.8
Short-term Loans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Taxes payable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Current Liabilities	60.9	150.5	115.6	138.8	160.7	182.5	224.2	246.3	269.2	292.1	312.9	340.8	361.8
ADB Loan	0.0	0.0	258.6	418.4	648.6	838.1	838.1	818.7	798.0	775.9	752.3	727.2	700.4
OECF Loan	0.0	0.0	0.0	0.0	153.7	307.4	461.1	461.1	461.1	461.1	461.1	461.1	461.1
World Bank Loan	0.0	0.0	0.0	20.0	40.0	60.0	80.0	100.0	120.0	120.0	120.0	120.0	120.0
Construction Bank Loan	0.0	0.0	97.7	153.0	278.9	390.7	430.3	420.2	408.8	395.7	380.7	363.7	344.3
Total Long-term Debt	0.00	0.00	356.35	591.38	1121.18	1596.15	1809.48	1800.00	1787.82	1752.65	1714.17	1672.02	1625.80
Total Liabilities	60.9	150.5	472.0	730.2	1281.9	1778.7	2033.7	2046.3	2057.0	2044.8	2027.1	2012.8	1987.6
Equity and Reserves	435.1	406.9	677.3	843.5	1136.6	1381.9	1431.2	1414.8	1449.5	1524.1	1630.8	1712.5	1818.3
Total Liabilities and Equity	496.0	557.4	1149.3	1573.6	2418.5	3160.6	3465.0	3461.1	3506.5	3568.9	3657.9	3725.3	3805.9

Table 7: DALIAN YINBI NORTHERN WATER SUPPLY COMPANY
Water Demand And Sales Projections

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Actual												
Billable Water Demand (m cum)	144.80	144.80	163.05	192.35	192.35	192.35	289.56	333.36	364.56	364.56	364.56	364.56	364.56
Average Water Charge (Y/cum)	0.16	0.16	0.34	0.48	0.51	0.55	0.59	0.63	0.67	0.72	0.77	0.82	0.88
Water Revenue (Y million)	23.17	23.17	55.44	92.33	98.79	105.71	170.27	209.74	245.43	262.61	280.99	300.66	321.71
Other Sales (Y million)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Revenue (Y million)	23.17	23.17	55.44	92.33	98.79	105.71	170.27	209.74	245.43	262.61	280.99	300.66	321.71
Local Price Escalation Factor													
Cumulative Factors	10.0%	10.0%	10.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Raw Water Charge (Y/cum)	1.0000	1.0000	1.1000	1.1770	1.2594	1.3475	1.4419	1.5428	1.6508	1.7664	1.8900	2.0223	2.1639
- At 1993 Constant Price	0.16	0.16	0.31	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Increase Rate			93.2%	31.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.0%	0.0%
- At Current Prices	0.16	0.16	0.34	0.48	0.51	0.55	0.59	0.63	0.67	0.72	0.77	0.82	0.88
Increase Rate			112.5%	41.2%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%

m cum = million cubic meter

Table 8: DALIAN YINBI NORTHERN WATER SUPPLY COMPANY
Projected Income Statements
(million yuan)

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
[REVENUE]	Actual												
Water Revenue	25.6	27.2	55.4	92.3	98.8	105.7	170.3	209.7	245.4	262.6	281.0	300.7	321.7
Other Revenue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Revenue	25.6	27.2	55.4	92.3	98.8	105.7	170.3	209.7	245.4	262.6	281.0	300.7	321.7
[EXPENSES]													
Salaries	0.6	0.7	0.8	0.8	0.9	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.3
Power	25.9	27.5	34.1	43.0	46.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raw Water	6.7	7.1	31.1	36.7	36.7	34.2	51.4	59.2	64.8	64.8	64.8	64.8	64.8
Chemicals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	3.2	3.5	3.9	4.1	4.4	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.0
Admin./overhead Expenses	2.5	2.8	3.1	3.3	3.5	3.6	5.4	6.2	6.7	6.8	6.8	6.8	6.8
Repairs	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.0
Subtotal	38.9	41.6	73.5	88.6	92.3	40.6	59.8	68.5	74.9	75.1	75.4	75.7	76.0
Depreciation	1.9	1.9	1.9	1.9	1.9	1.6	34.0	34.0	34.0	34.0	34.0	46.5	46.5
Operating Income	-15.1	-16.3	-20.0	1.8	4.6	63.5	76.5	107.2	136.6	153.5	171.6	178.5	199.2
Operating Interest	0.0	0.0	0.0	3.6	11.1	18.9	22.8	59.2	57.8	56.2	54.4	52.5	50.4
Value-added Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	8.5	8.5	8.5	11.6	11.6
Net Income before Subsidy	-15.1	-16.3	-20.0	-1.8	-6.4	44.6	53.8	39.5	70.3	88.9	108.7	114.4	137.2
DMG Subsidy	13.3	16.5	20.0	2.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Income	-1.9	0.2	0.0	0.2	0.1	44.6	53.8	31.0	61.8	80.4	100.2	102.8	125.6
Operating Ratio	1.52	1.53	1.33	0.96	0.93	0.38	0.35	0.33	0.31	0.29	0.27	0.25	0.24
Inflation factor	1.10	1.10	1.10	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07

* Gravity flow after Project completion.

Table 9: DALIAN YINBI NORTHERN WATER SUPPLY COMPANY
Projected Source and Uses of Funds
(million yuan)

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Actual												
[Sources]													
Net Income	-1.9	0.2	0.0	0.2	0.1	44.6	53.8	31.0	61.8	80.4	100.2	102.8	125.6
Add back: Depreciation and Interest	1.9	1.9	1.9	5.5	13.0	20.5	56.7	93.2	91.7	90.1	88.4	99.0	96.9
Net Internal Cash Generation	-0.0	2.1	1.9	5.7	13.0	65.1	110.5	124.2	153.6	170.5	188.6	201.7	222.5
DMG Contribution	0.0	0.0	37.3	155.2	175.6	169.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bank Loan	0.0	0.0	38.4	159.8	180.9	174.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grant from Central Government	0.0	0.0	2.8	11.5	13.0	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction bank of China	0.0	0.0	0.4	50.4	56.3	55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	0.0	0.0	78.8	376.8	425.8	412.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Sources	-0.0	2.1	80.7	382.5	438.8	477.5	110.5	124.2	153.6	170.5	188.6	201.7	222.5
[Uses]													
Capital Expenditures	0.0	0.0	78.8	376.8	425.8	412.3	0.0	100.0	100.0	150.0	150.0	100.0	100.0
Amortization	0.0	0.0	0.0	0.0	0.0	0.0	3.7	17.0	18.5	20.1	21.8	23.7	25.8
Interest Payment	0.0	0.0	0.0	3.6	11.1	18.9	22.8	59.2	57.8	56.2	54.4	52.5	50.4
Total Debt Service	0.0	0.0	0.0	3.6	11.1	18.9	26.5	76.2	76.2	76.2	76.2	76.2	76.2
Changes in Working Capital	0.0	-1.4	2.5	-2.5	-3.5	-7.8	-17.2	-16.3	-17.0	-16.3	-16.8	-20.5	-21.1
Total Uses	0.0	-1.4	81.4	377.9	433.4	423.4	9.3	159.9	159.2	210.0	209.4	155.7	155.1
Net Flow of Funds(cash)	-0.0	3.5	-0.6	4.6	5.4	54.1	101.3	-35.7	-5.7	-39.5	-20.8	46.0	67.4
Accumulated Net funds(cash)	-0.0	3.5	2.9	7.5	12.9	67.0	168.2	132.6	126.9	87.4	66.6	112.7	180.0
Debt-Service Ratio						3.45	4.18	1.63	2.01	2.24	2.47	2.65	2.92

Table 10: DALIAN YINBI NORTHERN WATER SUPPLY COMPANY
Projected Balance Sheets
(million yuan)

Item	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Actual													
[ASSETS]													
Gross Fixed Assets	65.2	65.2	65.2	65.2	65.2	65.2	1359.0	1359.0	1359.0	1359.0	1359.0	1859.0	1859.0
Less: Accumulated Depreciation	6.7	8.5	10.4	12.3	14.2	15.8	49.8	83.8	117.8	151.7	185.7	232.2	278.7
Net Fixed Assets	58.6	56.7	54.8	52.9	51.0	49.4	1309.1	1275.2	1241.2	1207.2	1173.2	1626.8	1580.3
Work-in-Progress	0.0	0.0	78.8	455.7	881.4	1293.8	0.0	100.0	200.0	350.0	500.0	100.0	200.0
Cash	0.0	3.5	2.9	7.5	12.9	67.0	168.2	132.6	126.9	87.4	66.6	112.7	180.0
Accounts Receivable -- Sales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Receivables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inventories	0.0	0.0	19.5	23.5	24.4	10.1	10.8	11.6	12.4	13.3	14.2	15.2	16.3
Total Current Assets	0.0	3.5	22.4	31.0	37.3	77.1	179.1	144.2	139.3	100.7	80.8	127.9	196.3
TOTAL ASSETS	58.6	60.1	156.0	539.5	969.8	1420.2	1488.2	1519.3	1580.5	1657.9	1754.1	1854.6	1976.6
[LIABILITIES & EQUITY]													
Accounts Payable	0.0	0.0	14.7	17.7	18.5	8.1	12.0	13.7	15.0	15.0	15.1	15.1	15.2
Short-term Bank Loans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Taxes Payable	1.3	2.7	5.0	8.4	12.2	16.0	30.1	45.4	61.9	79.0	96.7	118.2	140.3
Total Current Liabilities	1.3	2.7	19.7	26.2	30.6	24.1	42.0	59.1	76.9	94.1	111.8	133.3	155.5
(Long-term Liabilities)													
ADB Loan	0.0	0.0	38.4	198.2	379.0	553.9	553.9	541.1	527.4	512.8	497.3	480.7	462.9
Construction Bank Loan	0.0	0.0	0.4	50.8	107.1	162.1	158.4	154.2	149.4	144.0	137.7	130.6	122.5
Other Long-term loans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Long-term Debts	0.0	0.0	38.8	249.0	486.1	716.1	712.4	695.3	676.9	656.8	635.0	611.3	585.5
Total Liabilities	1.3	2.7	58.4	275.2	516.7	740.2	754.4	754.5	753.8	750.9	746.8	744.6	741.0
Equity and Reserves	57.2	57.5	97.5	264.4	453.0	680.1	733.8	764.9	826.7	907.1	1007.3	1110.1	1235.6
TOTAL LIABILITIES AND EQUITY	58.5	60.1	156.0	539.5	969.8	1420.2	1488.2	1519.3	1580.5	1657.9	1754.1	1854.6	1976.6

FINANCIAL ANALYSIS**A. Water Tariff and Affordability**

1. The projected water tariff levels are considered affordable to the consumers. Water charges will be about 1.0 per cent and 1.92 per cent of household income in 1995 and 2000, respectively (see Table 1). The estimated affordability ratios are lower than the sector norm of the maximum 3 per cent level.

Table 1: Affordability

Item	1995	2000
Household Income (Y/month)(a)	896	1,295
Average Household Size (persons)	3.1	3.1
Daily Per Capita Consumption (lpcd)	84	96
Household Water Consumption (cum/month)	7.812	8.928
Average Water Tariff (Y/cum)	1.20	2.78
Household Water Charge (Y/month)(b)	9.37	24.82
Affordability Ratio [(b)/(a)]	1.0%	1.92%

B. Financial Internal Rate of Return

2. The financial internal rate of return (FIRR) has been estimated based on the established capital investment schedule and incremental revenue and expenses. The FIRR of the Project for the Dalian Yinbi Northern Water Supply Company (NWSC) and the Dalian Water Supply Company (DWSC) is forecast to be 8.6 per cent and 9.9 per cent, respectively (see Tables 4 and 5). The Project is financially acceptable, as the rates of return exceed the average cost of capital, which is calculated to be 4.3 per cent, as shown in Table 2.

Table 2: Average Cost of Capital

Source	Amount (Y million)	Cost	Foreign Exchange Risk Premium	Total Cost
Bank Loan	1392	6.67%	5.0%	11.7%
Central Government Grant	100	10.00%		10.0%
Construction Bank Loan	460	14.04%		14.0%
Dalian Government Grant	1352	10.00%		10.0%
Total	3304			11.3%
Weighted Average Financial Cost of Capital				11.3%
Local Inflation Rate				7.0%
Average Cost of Capital (Real Terms)				4.3%

Note: Financial cost for subsidies is implicitly assumed to be 10 per cent.

3. A sensitivity analysis on the FIRR has also been carried out assuming various adverse situations. The Project will be financially viable even under the most adverse case tested. The summary of the sensitivity tests are presented in Table 3.

Table 3: FIRR Sensitivity Analysis

Key Variables	Part A - NWSC		Part B - DWSC		Total Project	
	FIRR	SI	FIRR	SI	FIRR	SI
Base Case	8.6%		9.9%		9.6%	
1. Capital Cost +10%	7.8	0.93	9.0	0.91	8.8	0.83
2. O&M Cost +10%	8.4	0.23	8.7	1.21	9.2	0.42
3. Revenue - 5%	8.0	1.40	8.8	2.22	9.0	1.25
4. Combination (1+2)	7.6		7.9		8.4	
5. Combination (1+3)	7.3		8.0		8.1	
6. Combination (2+3)	7.9		7.5		8.5	

SI = sensitivity indicator = $\frac{\text{percentage change in FIRR}}{\text{percentage changes in variable tested}}$

O&M = operation and maintenance

**TABLE 4. FIRR CALCULATION
PART A: NORTHERN CONVEYOR (NWSC)**

[At 1993 Prices]

Year	Capital Cost			Incremental O&M Cost	Incremental Revenue	Net Revenue
	Foreign Cost	Local Cost	Total			
1992						
1993						
1994	-10.85	-69.76	-80.61			-80.61
1995	-193.39	-171.81	-365.20			-365.20
1996	-165.48	-206.18	-371.67			-371.67
1997	-124.99	-201.66	-326.66			-326.66
1998				-12.61	99.22	86.62
1999				-17.47	118.32	100.85
2000				-20.17	132.20	112.03
2001				-18.99	133.27	114.28
2002				-17.89	134.28	116.39
2003				-16.87	135.22	118.35
2004				-15.91	136.10	120.19
2005				-17.17	136.93	119.76
2006				-18.34	137.69	119.35
2007				-19.44	138.41	118.97
2008				-20.47	139.08	118.62
2009				-21.42	139.71	118.29
2010				-22.32	140.30	117.98
2011				-23.16	140.85	117.69
2012				-23.94	141.36	117.42
2013				-24.67	141.84	117.16
2014				-25.36	142.28	116.93
2015				-26.00	142.70	116.71
2016	-8.42	-8.42	-16.83	-26.59	143.09	99.67
2017				-27.15	143.46	116.31
2018				-27.67	143.80	116.13
2019				-28.16	144.12	115.96
2020				-28.62	144.42	115.80
2021				-29.04	144.69	115.65
2022				-29.44	144.95	115.51
2023				-29.81	145.20	115.39
2024				-30.16	145.43	115.27
2025				-30.48	145.64	115.15
2026				-30.79	145.84	115.05
2027				-31.07	146.02	114.95
2028				-31.34	146.20	114.86
2029				-31.58	146.36	114.77
2030				-31.82	146.51	114.69
2031				-32.03	146.65	114.62
2032				-32.24	146.78	114.55
2033				-32.42	146.91	114.48
2034				-32.60	147.02	114.42
2035				-32.77	147.13	114.36
2036				-32.92	147.23	114.31
	-378.14				FIRR =	8.56%

Table 5. FIRR CALCULATION
Part B: SOUTHERN CONVEYOR (DWSC)

[At 1993 Year-end Prices]

Year	Capital Cost		Total	Incremental O&M Cost	Incremental Revenue	Net Revenue
	Foreign Cost	Local Cost				
1992						
1993	0.0	-265.5	-265.5			-265.5
1994	-105.9	-267.7	-373.6			-373.6
1995	-174.4	-167.6	-342.1			-342.1
1996	-294.0	-172.8	-466.8			-466.8
1997	-219.6	-113.5	-333.1			-333.1
1998				-198.2	388.9	190.7
1999				-213.8	429.8	216.0
2000				-227.5	462.9	235.3
2001				-238.7	482.4	243.8
2002				-245.1	490.3	245.3
2003				-256.6	488.3	231.7
2004				-259.2	486.4	227.2
2005				-264.1	489.8	225.6
2006				-268.7	492.9	224.2
2007				-273.0	495.9	222.8
2008				-277.0	498.6	221.6
2009				-280.8	501.2	220.4
2010				-284.3	503.6	219.3
2011				-287.6	505.9	218.3
2012				-290.6	508.0	217.3
2013				-293.5	509.9	216.4
2014				-296.2	511.8	215.6
2015				-298.7	513.5	214.8
2016	-255.4		-255.4	-301.0	515.1	-41.3
2017				-303.2	516.6	213.4
2018				-305.2	518.0	212.8
2019				-307.1	519.3	212.2
2020				-308.9	520.5	211.6
2021				-310.6	521.7	211.1
2022				-312.2	522.7	210.6
2023				-313.6	523.7	210.1
2024				-315.0	524.7	209.7
2025				-316.2	525.6	209.3
2026				-317.4	526.4	208.9
2027				-318.5	527.1	208.6
2028				-319.6	527.8	208.3
2029				-320.5	528.5	208.0
2030				-321.5	529.1	207.7
2031				-322.3	529.7	207.4
2032				-323.1	530.3	207.2
2033				-323.8	530.8	206.9
2034				-324.5	531.2	206.7
2035				-325.2	531.7	206.5
2036				-325.8	532.1	206.3
					FIRR =	9.87%

PRELIMINARY ECONOMIC ANALYSIS

A. Background

1. Procedures for the economic analysis of water supply projects are at an early stage of development, both in the Bank and elsewhere. Water supply projects are usually appraised on the basis of financial analysis. With water scarcity emerging in many locations and the environmental costs of additional water supplies increasing rapidly, however, it is becoming important to complement financial analysis with economic analysis. The application of economic analysis would strengthen water resource management by taking account of economic efficiency and environmental sustainability.

2. The analytical framework for the benefit-cost analysis of water supply projects is well known, but not often practiced. Despite a large literature on the economics of water and the environment, the actual application of these principles and concepts to project appraisal has not been widespread. One of the reasons for this stems from the complications associated with estimating economic benefits. The Bank is currently undertaking applied research on benefit measurement, with the aim of producing practical guidelines for the economic analysis of water supply projects.

3. The economic value of water is difficult to measure, however. In rural situations the net economic benefit of a water supply project can often be approximated by the difference in expenditure (or value of time savings), with and without the project. In urban situations the net economic benefit can often be approximated through the difference in expenditure on piped water and vendored water, with and without the project. In the PRC, however, where in the past water supply was provided as a social service, there are no water markets to provide information on the willingness to pay for water. Because of this, the economic analysis has focused on estimating the average incremental cost (AIC)¹ of water and comparing the AIC with the average price being charged for water.

B. Average Incremental Cost

4. The average incremental cost can be divided into two categories: average incremental financial cost (AIFC) and average incremental economic cost (AIEC). AIFC is the AIC calculated at market prices. AIEC is the AIC calculated at economic prices. The AIEC differs from the AIFC to the extent that economic prices diverge from market prices and that nonrevenue water is treated as if consumed. Whereas the AIFC is based on market-priced outlays, the AIEC is based on economic costs, which may or may not be reflected by actual expenditures. In contrast to the AIFC, for example, the AIEC might include the opportunity cost of raw water and the cost of disposing of wastewater. However, in practice these are difficult to measure.

¹ AIC is defined as C/Q , where C and Q are the discounted present value of incremental costs and incremental water supplied, respectively. The discount rate is equal to the cost of capital, and "incremental" means the difference between the "with" and "without" project scenarios.

5. The difference between the AIC and the average price (tariff) charged for water provides an estimate of the level of subsidy being paid by the water utility, government or economy to the water consumer. The financial subsidy is the difference between the AIFC and the price of water, whereas the economic subsidy is the difference between AIEC and the price of water. In contrast to the financial subsidy, which is paid largely by the government, the economic subsidy is paid, sooner or later, by society at large, even by those not using piped water. To the extent that an individual's demand for water does not fully reflect the benefits to society of consuming clean water, there is a clear rationale for such subsidies. Thus, accounting for social benefits as well as costs is important in setting the prices of water. The problem is in measuring such benefits.

C. AIC of the Project

6. Pending release of the Bank's guidelines on economic analysis of water supply projects, the AIC of the Project has been preliminarily estimated to complement the financial justification of the Project. The AIC of the Dalian Water Supply Company (DWSC) has been estimated under the three categories: (i) AIFC, (ii) AIEC without considering associated incremental wastewater treatment cost, and (iii) AIEC with associated incremental wastewater treatment cost. One of the difficulties in quantifying the AIEC is the estimates for incremental wastewater treatment cost. Thus, the AIEC without incremental wastewater treatment cost was estimated as a first step, and thereafter the incremental wastewater treatment cost was incorporated as the capital cost to construct a sewage treatment plant for treatment of wastewater from the Project facilities. The operating cost was assumed to be at the same level as that of water supply operations.

7. The current 1994 average tariff (price) of water sold by DWSC¹ to its various consumer categories represents about 50 per cent of the AIFC and 25 per cent of the AIEC using a discount factor of 7 per cent. The planned tariff increases will result in the average price of water reaching more than 90 per cent of the AIFC, and about 50 per cent of the AIEC, by 1998, the year of Project completion (see Tables 1 and 2).

¹ The AIC of the Dalian Yinbi Northern Water Supply Company is not separately estimated, because DWSC's water tariff structure includes the bulk water price charged to DWSC.

Table 1. AVERAGE INCREMENTAL FINANCIAL COST OF WATER

[Y million, at 1993 prices]

Year	Water (m cum)	Capital Cost		Operating Cost	Total Cost
		Foreign Cost	Local Cost		
1993		0.0	-265.5		-265.5
1994		-105.9	-267.7		-373.6
1995		-174.4	-167.6		-342.1
1996	78.5	-294.0	-172.8		-466.8
1997	78.5	-219.6	-113.5		-333.1
1998	220.9			-198.2	-198.2
1999	220.9			-213.8	-213.8
2000	220.9			-227.5	-227.5
2001	220.9			-238.7	-238.7
2002	220.9			-245.1	-245.1
2003	220.9			-256.6	-256.6
2004	220.9			-259.2	-259.2
2005	220.9			-264.1	-264.1
2006	220.9			-268.7	-268.7
2007	220.9			-273.0	-273.0
2008	220.9			-277.0	-277.0
2009	220.9			-280.8	-280.8
2010	220.9			-284.3	-284.3
2011	220.9			-287.6	-287.6
2012	220.9			-290.6	-290.6
2013	220.9			-293.5	-293.5
2014	220.9			-296.2	-296.2
2015	220.9			-298.7	-298.7
2016	220.9	-255.4		-301.0	-556.4
2017	220.9			-303.2	-303.2
2018	220.9			-305.2	-305.2
2019	220.9			-307.1	-307.1
2020	220.9			-308.9	-308.9
2021	220.9			-310.6	-310.6
2022	220.9			-312.2	-312.2
2023	220.9			-313.6	-313.6
2024	220.9			-315.0	-315.0
2025	220.9			-316.2	-316.2
2026	220.9			-317.4	-317.4
2027	220.9			-318.5	-318.5
2028	220.9			-319.6	-319.6
2029	220.9			-320.5	-320.5
2030	220.9			-321.5	-321.5
2031	220.9			-322.3	-322.3
2032	220.9			-323.1	-323.1
2033	220.9			-323.8	-323.8
2034	220.9			-324.5	-324.5
2035	220.9			-325.2	-325.2
2036	220.9			-325.8	-325.8

NET PRESENT VALUE

	Discount Rate			
	6%	7%	8%	14%
Water (million cum)	2588.5	2205.1	1897.0	901.8
Costs (Y million):				
Base Case	4585.8	4037.0	3594.7	2138.6
Capital + 10%	4741.0	4186.8	3739.5	2259.7
O&M + 10%	4889.1	4291.0	3809.4	2231.3
AIC (Y/cum):				
Base Case	1.77	1.83	1.89	2.37
Capital + 10%	1.83	1.90	1.97	2.51
O&M + 10%	1.89	1.95	2.01	2.47

Table 2. AVERAGE INCREMENTAL ECONOMIC COST OF WATER

[Y million, at 1993 prices]

Year	Water (m cum)	Capital Cost		Operating Cost	Incremental Sewerage Costs		Total Cost
		Foreign Cost	Local Cost		Capital	Operating	
1993		0.0	-295.0				-295.0
1994		-105.9	-297.5				-403.4
1995		-174.4	-186.3				-360.7
1996	78.5	-294.0	-192.0				-486.0
1997	78.5	-219.6	-126.1				-345.7
1998	220.9			-197.3	-88.3	-197.3	-482.9
1999	220.9			-212.8	-94.5	-212.8	-520.1
2000	220.9			-226.5	-101.1	-226.5	-554.1
2001	220.9			-237.6	-108.2	-237.6	-583.3
2002	220.9			-243.9	-115.8	-243.9	-603.6
2003	220.9			-255.4	-123.9	-255.4	-634.7
2004	220.9			-258.0	-132.5	-258.0	-648.6
2005	220.9			-262.9	-141.8	-262.9	-667.6
2006	220.9			-267.5		-267.5	-535.0
2007	220.9			-271.8		-271.8	-543.5
2008	220.9			-275.8		-275.8	-551.5
2009	220.9			-279.5		-279.5	-559.0
2010	220.9			-283.0		-283.0	-566.0
2011	220.9			-286.3		-286.3	-572.5
2012	220.9			-289.3		-289.3	-578.6
2013	220.9			-292.1		-292.1	-584.3
2014	220.9			-294.8		-294.8	-589.6
2015	220.9			-297.3		-297.3	-594.6
2016	220.9	-255.4		-299.6		-299.6	-854.6
2017	220.9			-301.8		-301.8	-603.6
2018	220.9			-303.8		-303.8	-607.7
2019	220.9			-305.7		-305.7	-611.5
2020	220.9			-307.5		-307.5	-615.0
2021	220.9			-309.2		-309.2	-618.3
2022	220.9			-310.7		-310.7	-621.4
2023	220.9			-312.2		-312.2	-624.3
2024	220.9			-313.5		-313.5	-627.0
2025	220.9			-314.8		-314.8	-629.6
2026	220.9			-316.0		-316.0	-631.9
2027	220.9			-317.1		-317.1	-634.1
2028	220.9			-318.1		-318.1	-636.2
2029	220.9			-319.1		-319.1	-638.1
2030	220.9			-320.0		-320.0	-639.9
2031	220.9			-320.8		-320.8	-641.6
2032	220.9			-321.6		-321.6	-643.2
2033	220.9			-322.3		-322.3	-644.7
2034	220.9			-323.0		-323.0	-646.1
2035	220.9			-323.7		-323.7	-647.3
2036	220.9			-324.3		-324.3	-648.5

NET PRESENT VALUE

	Discount Rate			
	6%	7%	8%	14%
Water (million cum)	2588.5	2205.1	1897.0	901.8
Costs (Y million):				
Base Case	8201.1	7116.2	6243.3	3396.8
Capital + 10%	8365.7	7275.2	6397.1	3525.9
O&M + 10%	8503.1	7369.0	6457.0	3489.1
AIC (Y/cum):				
Base Case	3.17	3.23	3.29	3.77
Capital + 10%	3.23	3.30	3.37	3.91
O&M + 10%	3.28	3.34	3.40	3.87

Note: Shadow exchange rate applied: 8.7/0.9=9.6667