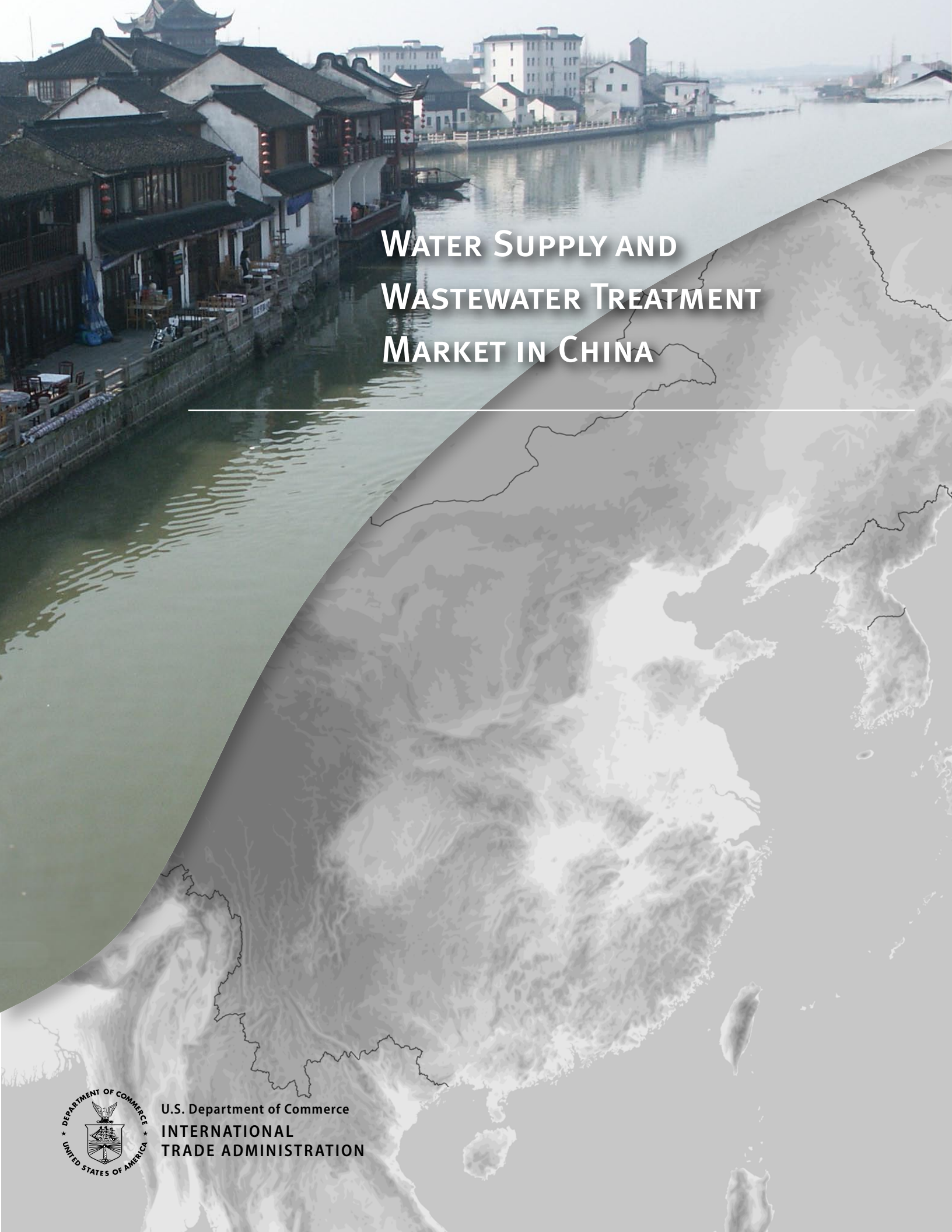

Water Supply and Wastewater Treatment Market in China

U.S. Department of Commerce
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U.S. Department of Commerce
International Trade Administration
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Abbreviations and Acronyms

A/A/O	anaerobic-anoxic-aerobic activated sludge
AB	absorption-biodegrading
ADB	Asian Development Bank
A/O	anaerobic-aerobic activated sludge
AWWA	American Water Works Association
BAF	biological aeration filter
BET	Beijing Economic and Technological (Development Zone)
BJET	Beijing Golden State Engineering and Technology Co., Ltd.
BOT	build-operate-transfer
CAS	conventional activated sludge
CASS	cyclic activated sludge system
CAST	cyclic activated sludge technology
CIEPEC	China International Environmental Protection Exhibition and Conference
DAT–IAT	demand aeration tank–intermittent aeration tank
DBO	design-build-operate
DIN	Deutsches Institut für Normung
EIA	environmental impact assessment
EIF	EIA form
EIR	environmental import registration
EMS	Environmental Monitoring Station
EPB	environmental protection bureau
EPI	environmental protection institute
EPL	Environmental Protection Law
Ex-Im Bank	Export-Import Bank of the United States
GDP	gross domestic product
GEF	Global Environment Facility
ICEAS	intermittent cyclic extended aeration system
JBIC	Japan Bank for International Cooperation
M&A	merger and acquisition
NPC	National People's Congress
P3	private and public partnership
PFS	polymeric ferric sulfate
PRC	People's Republic of China
SBR	sequencing batch reactor
SDB	State Development Bank
SEPA	State Environmental Protection Administration
TDA	U.S. Trade and Development Agency
TSP	total suspended particulate
UASB	upflow anaerobic sludge bed

UCT	University of Cape Town
UNDIP	United Nations Industrial Development Organization
WB	World Bank
WPL	Water Pollution Prevention and Control Law
WTO	World Trade Organization

Note: Unless otherwise noted, dollar figures given are U.S. dollars. The exchange rate for the Chinese yuan, or RMB, has been calculated at approximately 8.3 to the U.S. dollar.

Executive Summary

At present, China is encountering severe water shortages, resulting from both a large population and water pollution caused by rapid economic development with a minimal regard for environmental impacts. Although China significantly improved its water and wastewater infrastructure, with annual water supply at 549.7 billion cubic meters in 2002, there are still annual water shortages of 40 billion cubic meters. Accelerated urbanization and high-speed economic growth in China continue to aggravate the water shortage problem. The official municipal wastewater treatment rate was 39.9 percent at the end of 2002, which is far from adequate given China's serious water pollution.

The water and wastewater treatment industry was a commonwealth enterprise in China for many years, with only limited fees levied for the consumption of resources and provision of services. This system led to huge amounts of water being squandered and polluted, as well as to a scarcity of capital in the construction, renovation, operation, and maintenance of water and wastewater infrastructures or facilities. Fortunately, the Chinese government realized the need to value water as a resource and introduced market mechanisms in the water supply and wastewater treatment sector. China revised its main legislation, the Water Resource Law, in 2002 and issued many related regulations and policies. Water tariff and wastewater treatment fees are rising to rational levels, and public water infrastructure was opened to foreign and non-state-owned capital financing. China's water market is quite brisk, and China's World Trade Organization (WTO) accession significantly affected water market reforms.

China's water market reforms have created many opportunities for foreign enterprises. Significant amounts of new water infrastructures are to be built, and the operation and maintenance of all existing and newly built municipal water and wastewater treatment plants have been or will be transferred to authorized enterprises. Many forms of private and public partnership (P3) are now accepted by the Chinese government for supplying technology and equipment and for providing long-term investment opportunities for foreign enterprises. The following technology needs offer the most opportunity:

- Biological denitrification and phosphorus removal technologies
- Membrane separation and manufacturing technologies and equipment
- Manufacturing technology of anaerobic biological reactors
- High-concentration organic wastewater treatment technology and equipment
- Series-standard water and wastewater treatment equipment with high efficiency
- Water-saving technologies and equipment
- Water treatment agents
- Monitoring instruments
- Natural water-body rehabilitation technology

China's pollution control strategy drives market opportunities for foreign investors. According to China's Tenth Five-Year Plan, the municipal wastewater treatment rate needs to increase to 60 percent in 2005. New municipal wastewater treatment plants are rapidly being constructed in

Table ES.1
Major Water Supply and Wastewater Treatment Projects in China

Project	Water Supply Investment (billions)	Water Supply Time Frame	Wastewater Treatment Investment (billions)	Wastewater Treatment Time Frame
South-to-North Water Diversion	$12.1	Before 2010	$1.17	2001–2008
			$0.77	2009–2013
Three Gorges			$0.81	Before 2003
			$0.86	Before 2005
			$0.93	2006–2010
Three-Rivers and Three-Lakes Pollution Control			$3.62	
National Western Development:				
Chongqing	$1.39	Before 2010		
Chengdu			$0.197	2003–2005

China's cities. The South-to-North Water Diversion Project, the Three Gorges Project, the comprehensive pollution control and ecological rehabilitation project in the Three-Rivers and Three-Lakes regions, and the National Western Development Project will account for an anticipated total investment of approximately $22 billion in water supply and wastewater treatment facilities before 2013 (see Table ES.1). Besides key state projects, there are several water and wastewater treatment projects in special economic regions, such as the Beijing-Tianjin-Tangshan Economic Delta, the Shanghai-Yangtze River Economic Delta, and the Pearl River Economic Delta.

Competition for water and wastewater infrastructure projects in China is fierce. China's domestic technology, equipment, and service sectors do not compare favorably to imported products; however, they do compete favorably with low prices, easy access to domestic markets, and continuous improvements in quality. Foreign enterprises from France, Germany, and the United Kingdom gained a comparatively strong market share in China's water market. The long investment history of successful foreign enterprises in China helped these enterprises build solid relationships with the Chinese government and sound reputation for providing technology and services. The foreign enterprises also gained a good understanding of China's market status and its associated business risks.

Although the imported products market share of U.S. enterprises in the Chinese water and wastewater industry is relatively low compared with other countries, U.S. firms do enjoy a solid reputation for product quality. For U.S. enterprises, the most effective mechanisms for accessing China's water market include joint ventures, cooperation and build-operate-transfer (BOT) modes, technology and equipment exports, trading companies and local agents, and representative offices or Chinese subsidiaries.

China's water sector policy reforms unleashed a wave of optimism in China's water market and created significant market opportunities for investors. These opportunities are not without risk. Investors know certain factors could influence these policy changes and affect the long-term development of the market. Rewards in the Chinese water market will come from long-term strategic investment and business performance, so the risk is clearly manageable. Investors with strong management knowledge and skills will be better able to avoid potential risks and achieve success in China. In addition, risk will likely be lower for technology and equipment import companies where U.S. products already enjoy distinct market advantages.

CHAPTER 1

Background

Distribution of Water Resources in China

The total annual average water resource volume in China is estimated at approximately 2.8 trillion cubic meters, making China the fourth largest source for water in the world. However, the water resource volume per capita is 2,200 cubic meters. In this respect, China ranks 88th in the world and has only one-quarter of the global average of water per capita because of its large population. China's forecasted population growth to 1.6 billion in the mid-21st century will decrease the per capita water resource to 1,760 cubic meters, presaging serious water shortages.

Water resources vary significantly throughout China. Per capita water volume in Northern China is 10 percent of the world average and one-fifth of the per capita water resources available in Southern China. Per capita water resources in the Yellow River and Hai River watersheds are only 350 to 750 cubic meters, while per capita water resources in the Songhua–Liao River Watershed are 1,700 cubic meters. In 2002, the total water volume in the five major watersheds in Northern China was only 415.8 billion cubic meters, while that available in the four major watersheds of Southern China was about 2.41 trillion cubic meters.[1]

China's water resources are also subject to significant seasonal variability, particularly in Northern China. The precipitation in Northern China is concentrated in July, August, and September and accounts for 70 to 80 percent of the annual precipitation in the region. As a result, reservoirs and aquifers play an extremely important role in balancing the water resource distribution in Northern China.

Table 1.1 summarizes water resource distribution in Northern and Southern China.

Natural Water Resource Pollution

Despite the greater abundance of water in Southern China, the region still lacks water resources because of extensive water pollution. According to a national surface water quality monitoring survey in 2002, 35.3 percent of the river sections surveyed could only fulfill the water quality requirements for Types IV and V water bodies.[2] (Type II is required for drinking water.) In some sections, water quality is even worse. Among all the monitored rivers, water pollution in the four northern river watersheds—the Songhua–Liao River, Hai River, Yellow River, and Huai River watersheds—is severe.

Almost 75 percent of China's lakes are significantly polluted. According to a study of 24 primary lakes, only 6 are equal to or better than a Type III water body, 6 are partially deteriorated, and 12 are severely polluted. Large water bodies such as the Tai, Dianchi, and Chao lakes in Southern China are seriously polluted. Reportedly, 83.5 percent of Tai Lake does not meet Type III standards for a water body, while the Dianchi and Chao lakes meet Type IV and V standards, respectively. Besides these three large lakes, other heavily polluted water bodies are the Huai, Liao, Fen, Hai, Huangpu, and Suzhou rivers, and the Baiyangdian, Hongze, and Dongting

Table 1.1
Water Resource Distribution Summary in Northern and Southern China

National Values	Northern Five Major Watersheds	Southern Four Major Watersheds
Water resources (percent)	19	81
Population (percent)	46.5	53.5
Per capita water resources (m3)	1,127	3,381
Gross domestic product (percent)	45.2	54.8
Cultivated land (percent)	65.3	34.7

Source: PRC, Ministry of Commerce, "General Condition of Water Resources in China" (unpublished report, July 22, 2002).

lakes. The central government is increasingly concerned about China's surface water pollution.

Groundwater pollution also occurs in nearly half of all urban areas in China. Of the total national groundwater resources, only 63 percent are usable as drinking water without treatment, 17 percent can be used for drinking water after appropriate treatment, 12 percent are unsuitable for drinking water but can be used as industrial and agricultural water sources, and 8 percent can be used as industrial water only after special treatment.

Supply and Demand: Current Conditions and Trends

Water Supply

Water shortages are affecting China's economic and social development. Official data cite that the annual total amounts of water resources available from 2000 to 2002, including surface water and groundwater, were between 2.7 trillion to 2.8 trillion cubic meters, while water consumption was 549.7 billion to 556.7 billion cubic meters. The water supply volume accounted for almost 20 percent of total water resources. Some of the water resources are difficult to use and many are severely polluted. Because of these conditions, there was still a water supply and demand deficit of approximately 40 billion cubic meters in 2000.

Water supply shortages are pronounced in many major Chinese urban areas. More than 400 cities throughout China face water shortages, with more than 100 cities facing serious water shortages, especially large cities such as Beijing and Tianjin. By the end of 2000, the annual water supply volume in all cities was 64 billion cubic meters, and the daily water supply capacity of all cities was about 2.2 billion cubic meters.

Scarce water resources, particularly in Northern China, led to over-extraction of surface water and groundwater. Water usage rates of the Hai and the Liao rivers accounted for 30 percent of the total water resources, while that of the Huai and Yellow rivers accounted for more than 80 percent of the total water resources.[3]

An increasing population, a rapidly developing economic and social system, accelerated urbanization, and improvements in both the standard of living and the ecological environment mean that China's per capita water resources will decrease even further while demand increases. This conflict between water supply and demand will accentuate as the country develops. Water shortages may limit sustainable economic and social development in China.

Water Consumption. Domestic water consumption is largely used for irrigation and industrial purposes. From 2000 to 2002, water used for agricultural irrigation accounted for almost two-thirds of the total water consumption, and industrial water consumption accounted for one-fifth of the total water supply. Domestic water consump-

Table 1.2
Water Consumption in China, 2000–2002 (billion cubic meters)

Year	Domestic		Industrial	Irrigation	Other*	Total
	Urban	Rural				
2000	28.6	29.1	113.8	346.4	31.9	549.8
2001	30.7	29.4	114.2	348.5	33.9	556.7
2002	31.9	29.7	114.3	337.5	36.3	549.7

** "Other" consists of forestry, animal husbandry, and agriculture.*

Source: PRC, Ministry of Water Resources, "China's Water Resources "; English text available at www.mwr.gov.cn/english.

tion in urban areas with municipal water supply facilities and piping systems accounted for 5 to 6 percent of the total water supply used. The water consumption amounts in various sectors from 2000 to 2002 are shown in Table 1.2. Among all water consumed, about 80 percent was extracted from surface water, about 19.5 percent from groundwater, and only about 0.5 percent from reused water and storm water.

Water Demand and Trends. Industrial growth, agricultural development, and population growth are the key issues for water demand in China. The Tenth Five-Year Plan (2001–2005) targeted a gross domestic product (GDP) growth rate of 7 percent per year. The GDP growth figures for 2001–2003 show China's long-term growth rate tracking below the 7 percent per year level. In 2002, water consumption for every 10,000 RMB yuan (approximately $1,200) of industrial growth was 241 cubic meters, which is only 60 percent of the 1990 figure. Water consumption in industry is not rising in direct proportion to industrial economic growth. China's key economic performance indicators, as provided by the World Bank, are shown in Table 1.3.

The estimated population in China will be 1.5 billion in 2020 and 1.6 billion in 2050. The net population growth rate is expected to decrease in the future, but quality of life improvements and urbanization will increase the demand for water supply after 2002. In 2002, the per capita water con-

Table 1.3
Key Economic Performance Indicators

Indicator	2001	2002	2003	2004	2005
GDP (annual percent growth)	7.3%	7.7%	7.5%	7.2%	7.0%
Consumption (annual percent growth)	7.3%	7.5%	8.0%	8.0%	7.8%
Investment (annual percent growth)	12.8%	11.5%	7.2%	6.1%	5.4%
Net foreign direct investment inflows (billions of U.S. dollars)	$37.4	$45.0	$45.0	$50.0	$55.0
Stock of international reserves (billions of U.S. dollars)	$212	$264	$296	$323	$348

Source: World Bank, China Country Management Unit, East Asia and Pacific Region, "Memorandum . . . on a Country Assistance Strategy for the World Bank Group for the People's Republic of China," report no. 25141 (Beijing: World Bank Office, 2003; available at www.worldbank.org.cn/English/Overview/overview_cas.htm).

Table 1.4
Future Water Demand Trends in China

Year	Agriculture Amount (billion m³)	Agriculture Growth Rate	Agriculture Proportion	Industry Amount (billion m³)	Industry Growth Rate	Industry Proportion	City and Town Amount (billion m³)	City and Town Growth Rate	City and Town Proportion	Total (billion m³)
2010	465.3	−0.13%	79.5%	92.9	3.64%	15.9%	26.8	2.69%	4.6%	585.0
2030	453.0	−0.43%	65.8%	189.9	3.00%	27.6%	45.6	2.38%	6.6%	688.5
2050	415.7		49.9%	343.6		41.3%	73.0		8.8%	832.3

Source: Chinese Academy of Science, "Analysis of Water Resource Demand and Supply in the First Half of the 21st Century," China Water Resources (January 2000). English-language abstract available at www.chinawater.net.cn/CWR_Journal/200001/.

sumption in urban and rural areas was 219 liters per day and 94 liters per day, respectively.

According to China's Tenth Five-Year Plan, prepared by the Ministry of Water Resources, the net increase in water demand could reach 40 billion cubic meters from 2000 to 2005, including 16 billion cubic meters in urban areas and 8 billion cubic meters in the suburban and rural townships. Table 1.4 shows China's water demand forecasts for 2010, 2030, and 2050.

The projected negative growth rate in agricultural water consumption is attributed to continuously improving irrigation technology. The projected growth rate decrease in industry is primarily because of improved manufacturing technologies.

Wastewater Treatment

The total amount of wastewater discharged in 2002 was 63.1 billion cubic meters. Industrial wastewater made up 61.5 percent, and domestic wastewater made up 38.5 percent. The amount of municipal wastewater treated in 2002 was 13.5 billion cubic meters, with a treatment rate of 39.9 percent. In counties, towns, and extensive rural areas, wastewater treatment rates were significantly lower. A large amount of wastewater is now discharged directly into surface water bodies without treatment. The actual wastewater treatment rate in China may be less than 20 percent.

All cities in China are now required by the Chinese government to construct wastewater treatment facilities. Wastewater treatment facilities include wastewater collection systems, sewer systems, wastewater treatment plants, sludge disposal systems, and any other auxiliary systems. All large and middle-sized cities must construct wastewater treatment plants. The treatment rate of city municipal wastewater is estimated to increase to 45 percent by 2005, and the wastewater treatment rate in the cities with populations greater than 500,000 will increase to 60 percent.

Review of Water Infrastructure in China

Water Supply Infrastructure

Municipal Water Supply Infrastructure. At the end of 2002, the 660 cities in China had a total population of 353.44 million. Each city has established its own water supply plant; the water supply piping network covers 77.34 percent of the total population in these cities.

In most water supply plants, traditional water treatment processes, such as screening, flocculation, sedimentation, filtration, and disinfection, are still used. Some water plants use activated carbon absorption. Treated water is chlorinated and pumped into the water piping network and distributed to end users.

All water supply plants and piping networks are still state-owned property, although operation strategies changed significantly after the water sector opened to non-state-owned investment in 1998. Many municipal water supply and piping systems constructed before the 1950s are encountering serious problems from deterioration, exacerbated by poor operation and inadequate maintenance. Pipe breakages occur frequently, resulting in water loss and decreased water supply efficiency.

Industrial Water Supply Infrastructure. Industrial water supply generally comes from two water sources: the municipal water supply system and company-owned water supply plants. Municipal water supply can be used directly in the production process if there are no higher water quality requirements. Industrial end users with their own water supply plants generally lack access to municipal water piping systems, or make products with strict requirements for water quality.

Company-owned water supply plants are operated and maintained by the enterprises themselves; however, the water amount extracted from either surface water or groundwater must comply with the water extraction permit issued by the Ministry of Water Resources.

Wastewater Treatment Infrastructure

Municipal Wastewater Treatment Infrastructure. By 2002, 310 of the 660 cities in China had constructed municipal wastewater treatment facilities, but there were no municipal wastewater treatment facilities in most of the 17,000 towns. Approximately 500 municipal wastewater treatment plants were in operation by 2002. The annual wastewater treatment amount was 13.5 billion cubic meters, equal to 39.9 percent of the total wastewater volume. The actual treatment rate of domestic wastewater, however, is only 22.3 percent, because treatment plants often operate below design standards or capacity.

Secondary treatment processes are commonly used to treat municipal wastewater in most municipal plants, especially in the larger plants. Such processes include screening, primary sedimentation, conventional activated sludge, and secondary sedimentation. Newer wastewater treatment technologies that have also been applied in China include absorption-biodegrading process (AB process), anaerobic-aerobic activated sludge process (A/O), anaerobic-anoxic-aerobic activated sludge process (A/A/O), cyclic activated sludge system (CASS), sequencing batch reactor (SBR) plus activated sludge process, oxidation ditches, and stabilized ponds.

All municipal wastewater treatment plants and piping networks are state-owned property, although operation rights may be transferred to some enterprises through special authority by the government. The municipal wastewater treatment systems in many cities are now encountering problems because of a shortage of capital and aging equipment.

Industrial Wastewater Treatment. Over 61,220 industrial wastewater treatment facilities had been constructed in China by the end of 2001. Official data cite 85.6 percent of discharged industrial wastewater complied with relevant 2001 standards. In 2002, the compliance percentage increased to 88.3 percent.

Industrial wastewater differs from domestic wastewater because it is usually unstable, contains high pollutant concentrations, and has a low biodegradability. Despite these characteristics, biological treatment is still widely used to treat industrial wastewater, because it achieves the targeted treatment effects with relatively low construction and operation costs. Some high-efficiency biological treatment technologies or reactors have been developed and used in industrial wastewater treatment. For example, the upflow anaerobic sludge bed (UASB) is used to treat high-concentration brewage wastewater. Immobilized microorganism technologies are used for textile wastewater treatment, and A/A/O processes are widely used to treat wastewater containing elevated ammonium. A variety of biological wastewater treatment processes are emerging for many industry sectors.

Industrial wastewater treatment facilities are often owned by the enterprises, and the enterprises are also responsible for the operation and maintenance of the facilities. The enterprises are under pressure from the government for better treatment performance. Public pressure is not yet a major factor driving improved treatment. The quality of operation and maintenance is low because of the

Table 1.5
Wastewater Reclamation Projects in Municipal Wastewater Treatment Plants

Location	Project Name	Capacity (1,000 m^3/day)	End User or Purpose
Liaoning Province	Dalian Chunliuhe Wastewater Treatment Plant	710	Industrial water for chemical factory and steel plant
Tianjin	Tianjin Jizhuangzi Wastewater Treatment Plant	530 (planned)	Industrial water and municipal water
Beijing	Beijing Gaobeidian Wastewater Treatment Plant	300	Cooling water for the No. 1 Thermal Power Plant and municipal water for irrigation and dust suppression.
Shaanxi Province	Xi'an Beishi Qiao Wastewater Treatment Plant	100	Industrial cooling water and municipal irrigation
Shanxi Province	Taiyuan Beijiao Wastewater Treatment Plant	1	Cooling water for Taiyuan Steel Plant
Heilongjiang Province	Daqin Chengfengzhuang Wastewater Treatment Plant	Unknown	Oil exploitation

high wastewater treatment costs, low equipment quality, low environmental awareness, spotty monitoring by the government, low penalties for environmental violations, and poor economic condition of some enterprises.

Wastewater Reclamation

The earliest wastewater reclamation in China occurred in the 1950s, when wastewater was used for irrigation. Large-scale wastewater reclamation development began 20 years ago, mostly in commercial buildings, and spread gradually into the municipal and industrial sectors. Today, most buildings, residential areas, municipal wastewater treatment plants, and industrial enterprises have installed wastewater reclamation facilities.

The wastewater reclamation facilities in buildings and residential areas are usually gray water treatment and reuse and storm-water collection and reuse. Reused water can be used for toilets, lawn irrigation, and car washing. Wastewater reclamation systems may play an important role in water saving, given China's serious water shortages; however, only limited operations have been implemented to date.

Compared with wastewater reclamation in buildings and residential areas, the wastewater reclamation in municipal wastewater treatment plants has been highly emphasized because of the large volume of wastewater. Table 1.5 shows several wastewater reclamation projects for municipal wastewater treatment plants. Wastewater reclamation is especially important in Northern China, where severe water shortages are emerging. Municipal wastewater reclamation is in its infancy in China: the volume of reused water and the number of end users are still low. Water reclamation in industrial sectors is mainly achieved by recycling cooling water. The repetitive use rate of industrial water in 2002 was 71.5 percent.

Traditional treatment technologies commonly used to reclaim water include clarification, sand filtration, and disinfection. More technical systems, including reverse osmosis, electrodialysis,

Table 1.6
Comparison of the New and Old Water Resource Laws

New Water Resource Law (2002)	Old Water Resource Law (1988)
Article 7: The state will establish a water abstraction permit system, and anyone who consumes the water resource shall pay accordingly for this usage.	**Article 32:** The state will establish a water abstraction permitting system.
Article 12: The State Council's Department of Water Administration shall be in charge of the unified administration of water resources throughout the entire country.	**Article 9:** The state shall carry out a system of unified administration on water resources in association with administration at various levels and by various departments.
Article 30: The Department of Water Administration should consider maintaining the flux in rivers, the water level in lakes and water reservoirs, and the water table of groundwater at a reasonable level and should consider maintaining the self-purification capability of water bodies when drafting the development and utilization plan of water resources.	*No corresponding rules.*
Article 49: Water consumption will be charged based on the actual amount of water consumption, and the progressive water tariff system will be executed if users exceed their water quotas.	*No corresponding rules.*

nanofiltration, ultrafiltration, microfiltration, electrodeionization, ion exchange, activated carbon filter, cartridge filter, ultraviolet disinfection, and ozone generators, are also used in this process.

Measures to Reform the Subsector

Legislation

China's numerous ongoing water reforms are moving toward a user-pay market-driven sector. Legislation serves as the basis to regulate and enforce these reforms. The Water Resource Law, amended and put into effect on Oct. 1, 2002, is a very important water law. Compared to the Water Resource Law enacted in 1988, the amended law significantly changes water resource management systems, water resource protection, water conservation, and legal responsibilities. The amended law is expected to play an important role in the sustainable use of water resources in China. Important changes in the law are identified in Table 1.6.

Furthermore, water conservation is emphasized in the amended law as follows:

- Use of water-saving technologies, products, and equipment must increase.
- The water-saving proposal and relevant facilities must be part of the engineering plans for new, expansion, and renovation construction projects, and facilities must conduct the Three Synchronies System—design, construction, and commission of water-saving facilities undertaken concurrently with the main construction phase of a project.

New Policies

Regulation for Management of Pollutant Discharge Fee Levy and Uses. The revised pollutant discharge fee levy and use policy was put into effect July 1, 2003, and the former Temporary Management Methods on Pollutant Discharge Fee Levy, enacted in 1982, was abandoned. The most significant change in this new policy is the method used to calculate pollution fees. According to the old policy method, if discharged wastewater at the same outlet contained more than two pollutants, the pollutant discharge fee would be calculated and based solely on the single pollutant that incurred the maximum discharge fee. The new policy stipu-

lates that all the pollutants listed on the standard will be calculated into the total pollutant discharge fee. The new policy clearly encourages and accelerates the industrialization of municipal wastewater treatment.

Water Supply Tariff Management Methods for the Water-Resource System. The newly revised management methods were effective Jan. 1, 2004. The management methods enacted in 1985 were abandoned. The new policy emphasizes the monetary value of water and treats water as a special commodity. The new policy also incorporates market-oriented mechanisms into water resource management and changes the behavior of state financing and administration in water resource engineering.

The new policy prescribes a water tariff approach, comprising water production costs, expenses, profit, and tax. Water production costs include labor, materials, capital assets depreciation, repair and maintenance, and water resource pricing. Expenses include administration and operation, selling, and finance costs. Pertinent pricing is expected to be in accord with local market demand. The local or central government must approve the water tariff.

The new policy also has a special condition for water resource projects supported by loans or bonds. This condition prescribes that the water tariff level should allow for a rational profit and should contract the operator to pay back the loan or bond over a specified operating term.

By enacting this new policy, China expects to promote reasonable exploitation of water resources and provide new investment opportunities, while also promoting needed market reforms in the water resource sector.

Institutional Changes

China's newly revised Water Resource Law facilitates a unified management of water resources by authorizing one administration department under the State Council to oversee all water affairs. This modification eliminates separate management of water resources, water supply, and wastewater.

Water bureaus have been established at the local government level to integrate the management of all local water-related affairs, including water extraction, water treatment and distribution, and wastewater collection and treatment. Nearly 1,200 water bureaus have been established, covering nearly 50 percent of all the cities and counties in China. A Beijing water bureau was established in May 2004.

In addition, some watershed management institutes have been or will be established to integrate administration of key rivers and lakes at the state level. For example, the Tai Lake Watershed Management Bureau was established to prevent inter-regional conflicts among the upper, middle, and lower reaches of a river or along different sections of Tai Lake. This approach is expected to favorably influence reasonable distribution of water resources throughout different areas.

Environmental Regulations

In China, environmental laws and regulations are stipulated and implemented through legislation and through administrative authorities at various levels of government.

Legislative and Administrative Authority

The Legislative Body. The national legislature formulates and enacts relevant laws and ensures that they are implemented and enforced by national, provincial, municipal, and local government administrations.

The National People's Congress (NPC) is the highest legislative authority in China and may amend the Constitution and enact statutes for establishing government institutions. The Standing Committee of the NPC is authorized to enact laws, with the exception of the basic state laws, such as those governing criminal offenses, civil affairs, and state organs, which may be enacted only by the NPC. The Standing Committee has the authority to interpret the Constitution and supervise its enforcement.

The State Council is the highest administrative organ of the country and the executive body of the NPC. Its functions and powers include the ability to adopt administrative measures, enact administrative rules and regulations, issue decisions and

orders in accordance with the Constitution and other laws, submit legislative proposals to the NPC or its Standing Committee, and oversee the work of the ministries and commissions.

Basic environmental regulations and laws (air, water, solid waste, and noise pollution laws) are formulated by the State Environmental Protection Administration (SEPA) and reviewed and enacted into laws by the NPC. SEPA also develops environmental standards.

The Local People's Congress and local governments are empowered to issue local environmental regulations according to national regulations. The local regulations must not conflict with national ones. Local environmental protection bureaus (EPBs) are responsible for preparing local environmental standards. Local standards are required to be equivalent to, or more stringent than, national standards.

Related Administrative Authorities. SEPA, formerly the National Environmental Protection Agency, was approved by the State Council and made official on July 7, 1998.

In addition to SEPA, almost every province, city, or county in China funds its own environmental protection bureau. Relevant local governments also appoint EPB directors. Provincial EPBs are part of provincial governments, and municipal EPBs operate within their local municipal frameworks. Generally, the enforcement of environmental regulations is the responsibility of local EPBs. Therefore, enforcement varies considerably throughout regions within China, depending on the funding and resources available to local government agencies.

Local government, although it does not deal with environmental issues directly, must approve applications provided by the EPBs to shut down facilities that cause significant pollution as determined by applicable regulations.

Local EPBs are responsible for routinely inspecting sites, including issuing pollutant discharge permits, checking the discharge compliance status, reviewing pollutant discharge registrations, transmitting regulatory information, and allocating mass loading targets. Environmental Monitoring Stations (EMSs) are independent subsidiaries of the EPB that are responsible for environmental monitoring. The monitoring data are used as evidence for the EPB to verify the discharge status of facilities.

Environmental Laws and Regulations

Current environmental laws and regulations can be classified into two categories: environmental management and environmental pollution prevention and control. All environmental laws and regulations are stipulated on the basis of the Environmental Protection Law.

Environmental Protection Law. Effective in December 1989, the Environmental Protection Law (EPL), sets the framework for environmental management and pollution control legislation in China. Other laws outline goals, policies, and requirements to protect various environmental media, such as surface water, groundwater, and the atmosphere, and specify control requirements for materials such as solid wastes. The EPL functions primarily as a policy statement, and it outlines goals. Detailed regulations on the general requirements outlined in the EPL are discussed in the next section.

Environmental Management Law and Regulation. China's environmental management measures include environmental impact assessment (EIA), the Three Synchronies Policy, permitting requirements, and reporting requirements. Each of these is described below:

1. **Environmental impact assessment.** The 1989 Environmental Impact Assessment Law was revised in October 2002. These revisions became effective in September 2003 and apply to all construction projects that may negatively impact the environment. An EIA must be prepared during the project feasibility stage to assess the project's environmental impact. EIA approval is necessary to secure a construction and operating permit. For operations that have only limited impact on the environment, an EIA form (EIF) may be required in lieu of an EIA. An EIA must be prepared by an EIA agency licensed by SEPA. Licensed agencies include the environmental protection institutes (EPIs), which are under the provincial EPBs; private companies; or other research institutes. During the feasibil-

ity phase, an EIA report must be prepared and submitted for approval to either the provincial EPB or the SEPA, depending on which level of the government approved the project proposal and on the scale of the investment. Projects with an investment value greater than $30 million must be approved by SEPA if the proposal for such projects was approved at the national level.

2. **Three Synchronies Policy.** Article 26 of the EPL, defines the Three Synchronies Policy as the installation of pollution prevention and control facilities in a construction project to be undertaken concurrently with the main construction phase. The pollution prevention and control facilities are to be installed and commissioned only after they are inspected and approved by the EPB. The 1988 Management Regulations of Environmental Protection for Construction Projects[4] stipulates the detailed requirements for EIAs and the Three Synchronies Policy. According to the degree of possible impacts on the environment, the EIA may be in the form of a simple environmental impact registration (EIR), an EIF, or a full EIA report.

3. **Permitting requirements.** Pollutant discharges in China are subject to registration and permitting requirements. The EPL defines requirements for pollution discharge registration and permits. Pollution discharges must be registered with the relevant environmental authority. A pollution discharge permit is issued after registration. The Management Regulation on the Registration of Discharged Pollutants, issued by SEPA, effective Oct. 1, 1992, details requirements for pollutant discharge registration, including the type, concentration, and quantity of the discharges: the nature of the discharge; noise sources; waste storage and disposal sites; and pollution control equipment. At the state level, the Department of Pollution Control under SEPA implements pollution discharge registration and permitting policies. (The contact number is +86-10-67117427.) Pollution control departments under local EPBs are in charge of the registration procedures and issue a pollution discharge permit. The Regulation for Management of Pollutant Discharge Fee Levy and Uses, issued by the State Council and effective July 1, 2003, defines pollutant discharge fees. Pollutant discharge fees are determined on the basis of the degree of impact on the environment imposed by the discharge, as calculated using a pollutant discharge equivalent method. The Management Guidelines on the Calculation of Pollutants Discharge Fee, effective July 1, 2003, details fee levy methods and standards and was jointly issued by the former National Planning and Development Committee of SEPA and the former State Economic and Trade Commission.

4. **Reporting requirements.** According to Article 31 of the EPL, any organization that causes or threatens to cause an accident resulting in environmental pollution must promptly take measures to prevent and control the pollution hazard and notify the relevant authority. In addition, enterprises and institutions that are likely to cause severe pollution accidents must adopt effective pollution prevention measures.

Environmental Pollution Law and Regulation. Environmental pollution prevention and control measures in China apply to various environmental media, including water, water supply, wastewater discharge, air emissions, hazardous waste management, noise, and soil and groundwater. Except for specific laws and regulations, standards were established to guide environmental practices in different sectors:

- **Water.** Three laws apply in the water sector:

1. The **Water Resources Law** was initially enacted in 1988, was amended in 2002, and took effect in October 2002. The amended law marks a new stage for China, in which the country is changing from traditional water management to sustainable development management and is attempting to build a society that is based on water conservation and sustainability. The Water

Resources Law emphasizes the uniform management of river basins and the macro-management of water distribution and consumption. In addition, the new law identifies a water quality management system. Water authorities, together with EPDs, are to play a significant role in water environmental protection and water quality improvement.

2. The 1984 **Water Pollution Prevention and Control Law** (WPL) is the main law for water pollution control. It applies to discharges to rivers, lakes, canals, reservoirs, and groundwater. The WPL contains sections pertaining to water quality and discharge standards, pollution prevention, surface water, and groundwater. Amendments in 1996 introduced further controls on river basins, including requirements for cities and towns to establish central sewage treatment plants and to set treatment fees, mass-loading controls, provisions for strengthening the supervision and management of water pollution, and non-point-source pollution controls. The WPL requires water pollution discharges to be registered with the local EPB, and requires polluters to pay for their discharges.
3. The **Implementation Regulation of Water Pollution Prevention and Control Law** was enacted on March 20, 2000. This law regulates the supervision and management of surface and ground water pollution, prevention, and control measures.

- **Water supply.** In urban areas, water is usually supplied by the municipal water utility companies, which are responsible for ensuring that water quality complies with the National Drinking Water Standard (GB5749-85). Although this standard applies to all Chinese municipal water utility companies, water quality parameters, such as hardness, color, and total suspended particulate (TSP) may differ according to the quality of the local water source. A groundwater abstraction permit is required if any company intends to use groundwater directly. In Northern China, however, the use of groundwater is strictly controlled because of significant water shortages and ground settlement issues. Users must apply to provincial or higher level administrative committees for a groundwater abstraction permit.
- **Wastewater discharge.** Two types of wastewater discharge systems are defined in China: (1) polluted wastewater discharges (typically industrial and domestic wastewater) and (2) non-polluted wastewater discharges (for example, storm water). Separate drainage systems for wastewater and stormwater discharges are required for a facility in which a municipal sewer system is available.

For industrial and domestic wastewater discharges, the National Integrated Wastewater Discharge Standard (GB8978-1996) applies. Wastewater discharge limits are classified into Class I, Class II, and Class III. The Surface Water Environmental Quality Standard (GB3838-2002) classifies water bodies in China into five types:

- Type I water body refers to water sources and national nature reserves;
- Type II water body refers to Class I protection zones for drinking water sources, protection zones for valuable fish and spawning grounds;
- Type III water body refers to Class II protection zones for drinking water sources, general protection zones for fish and swimming areas;
- Type IV water body refers to general industrial water zones and water recreation areas where no direct contact with humans occurs; and
- Type V water body refers to agricultural water zones and scenic water areas.

Wastewater cannot be discharged to Type I and Type II water bodies. For wastewater discharged to a municipal wastewater treatment plant, Class III limits apply. Wastewater discharged to a Type IV or Type V water body as defined in GB3838-2002, and to a Type III marine area as defined in the Marine Water Quality Standard (GB3097-1997) must meet Class II standards. Wastewater discharged to a Type III water body as defined in GB3838-2002, and to a Type II marine

area as defined in the Marine Water Quality Standard (GB3097-1997), must meet Class I standards.

A facility with wastewater discharges must obtain a wastewater discharge permit from the local EPB before operations begin, according to the Implementation Regulation of Water Pollution Prevention and Control Law. The local EPB is responsible for inspecting wastewater discharges through a routine monitoring program (up to four times annually). Noncompliance results in a warning or penalty from the EPB, indicating that the facility needs to address the issue. Repeated noncompliance can result in the operation being shut down.

- **Air emissions.** The PRC Air Pollution Prevention and Control Law, effective Sept. 1, 2000, provides the basis for air protection regulations in China. The Comprehensive Emission Standard of Air Pollutants (GB16297-1996) specifies the limits for air pollutant emissions. GB16297-1996 does not cover the operation of boilers and industrial kilns, which are regulated under two industrial-specific standards: the Emission Standard of Air Pollutants for Boiler (GB13271-2001) and the Emission Standard of Air Pollutants from Industrial Kilns (GB9078-88).

- **Hazardous waste management.** Several laws and regulations apply to hazardous waste management:

1. The Solid Waste Pollution Prevention and Control Law, effective on April 1, 1996, defines requirements for waste management. Specific requirements of this law include provisions for reporting hazardous waste generation types and quantities, transportation and disposal license requirements, disposal fees, manifest tracking systems, and hazardous waste documentation requirements.
2. The National Catalog of Hazardous Wastes was prepared by SEPA and became effective on July 1, 1998. This catalog defines 47 categories of industrial wastes as hazardous waste. For potentially hazardous wastes that are not specifically addressed in the catalog, the Identification Standard of Hazardous Waste (GB5085-96) is used to determine whether the material exhibits hazardous characteristics, such as corrosiveness, toxicity, flammability, and reactivity.
3. To efficiently strengthen the supervision of hazardous waste transfer, the national Management Regulation for Hazardous Waste Transfer Manifests (effective Oct. 1, 1999) stipulates manifest tracking and documentation procedures for waste generators, transporters, and disposal contractors.
4. The Pollution Control Standard for Hazardous Waste Storage (GB18597-2001) includes general requirements for storage containers, storage site selection and design principles, storage facilities operation and management, storage safeguards and monitoring, and site closure. It applies to the pollution control and supervision of all hazardous waste storage facilities. Storage facilities in this standard are defined as those specially designed, built, or revised for storage purposes.

- **Noise.** Environmental noise is regulated under the 1996 Law on Environmental Noise Pollution Prevention and Control. This law sets the general requirements for noise control, including noise from transportation and construction sites. The Noise Limits for Construction Sites (GB12523-90) applies at the project construction stage, and the Standard for Noise at Boundary of Industrial Enterprises (GB12348-90) applies during routine operations. Within the facility boundary, noise is typically regarded as a health and safety issue. Different noise limits apply during day and night and in various functional areas. For industrial areas, the noise limit is 65 average decibels during daytime and 55 average decibels at night, measured at the site boundary.
- **Soil and groundwater.** In China, although there are no enforceable regulations concerning soil and groundwater remediation, the Environmental Protection Law stipulates that

"those who generate the contamination shall be responsible for treatment or remediation." From this point of view, if a site contaminates soil and groundwater, the EPB can issue a penalty or clean-up notice to the facility. The PRC Soil Environmental Quality Standard (GB15618-95) and the Groundwater Environmental Quality Standard (GB/T14848-93) define the quality standards for soil and groundwater on the basis of site use. The Environmental Quality Risk Assessment Criteria for Soil at Manufacturing Facilities (HJ/T25-1999), effective Aug. 1, 1999, establishes the risk assessment threshold values for soil environmental quality within site boundaries during the location selection stage or during post-industrial production activities. This standard is the only soil quality standard for industrial enterprises in China developed on the basis of potential human risk, and is regarded as the first step toward regulated industrial site clean-up. In addition, its promulgation will likely be treated as a significant step in establishing legal precedent for liability.

- **Hazardous materials.** The State Council issued the Safety Management Regulations for Hazardous Chemicals on Jan. 9, 2002. The regulations, which became effective on March 15, 2002, apply to all individuals and organizations involved in the manufacture, sale, storage, transportation, and use of hazardous chemicals, as well as those involved in the disposal of hazardous chemical waste. It covers permitting and licensing requirements. Violations may lead to fines of up to $24,200, or criminal prosecution.

Environmental Enforcement

In China, methods of enforcing environmental legislation include discharge fees, surcharge fees, fines, and administrative sanctions. Pollutant discharge activity is subject to a discharge permit, which must be registered and obtained before the pollutants are generated. A discharge fee is collected and supervised by the local EPB, even for discharges within the applicable standards. A surcharge or fine may be imposed on the facilities whose discharge violates the standards.

In major pollution control areas, such as Shanghai and Beijing, mass-loading targets are established and allocated to major emission facilities by the local EPB. In some pilot locations, emission quotas can be traded among facilities. All temporary and routine discharges must comply with relevant standards, or the facility may be ordered to treat the pollution within a given time frame.

In areas with significant pollution problems, such as those impacted by sulfur dioxide emissions, acid rain, and water quality deterioration, specific discharge limitations are adopted to prevent further degradation. The State Council's 1996 Decision on Certain Environmental Issues stipulates the gradual implementation of mass-loading controls for 12 priority pollutants. The SEPA initially allocates discharge quantity limits to municipal governments on the basis of compliance with quality standards. Municipal governments then allocate discharge limits to individual facilities. The system, which has not been uniformly and comprehensively enforced throughout China, often exists in tandem with concentration-based discharge controls within EIA specifications.

Regulations and standards not only exist at the national level but also at the provincial and municipal levels. Local regulations and standards can specify more stringent emissions requirements than national legislation and can regulate parameters that are not regulated at the national level. When local and national emissions and discharge standards vary, the more stringent standards apply.

There are specific items within the Con stitution of the People's Republic of China and the PRC Criminal Law to strengthen the enforcement of environmental legislation by disciplinary sanction, civil liability, and even criminal liability. Disciplinary sanctions may come in the form of a warning, a fine, a requirement to install environmental protection equipment, or a requirement to cease operations. The severity of the sanction ordered by SEPA or the local EPBs depends on the severity of the violation. Criminal liability can also be passed on to the legal representative of an enterprise if the polluting activity caused severe damage

to property, health, or interests of the state or its citizens. In these cases, the individual deemed responsible may be prosecuted. Civil liability also exists and is aimed at activities that may result in civil disputes (such as noise exposure). Generally, the dispute may be settled through financial compensation by the facility that caused the damage.

Environmental Considerations When Investing in China

All enterprises operating within China, including both foreign and domestic entities, are subject to national and local environmental regulations. Local regulations are often more stringent than the respective national regulations.

EIAs and the Three Synchronies Policy are the primary regulatory instruments used by SEPA and local EPBs to enforce environmental regulations. As a mechanism to promote sustainable development in China, an EIA is required by law for all industrial or development-related investments in China, including joint ventures and wholly owned foreign subsidiaries of multinational corporations.

Industrial development has resulted in considerable amounts of unrecorded site contamination in China. It is therefore imperative to conduct a due diligence environmental site assessment at any proposed site to determine a baseline profile of environmental conditions before establishing a facility. The assessment identifies site conditions attributed to past activities, particularly those associated with soil and groundwater contamination, and it may help minimize future liability. If soil and groundwater contamination is identified, it should be addressed during land-use rights negotiations.

Variations in the enforcement of environmental legislation are due to differences in financial resources and staff capabilities among provincial, municipal, county, and local EPBs. In some areas, the pressure for economic development and the desire to lure investment and jobs means that local leaders are more often concerned about development than the environment. In contrast, several EPBs located in wealthy areas with significant foreign investment, such as Beijing, Shanghai, and Guangdong, have reputations for implementing local regulations that are significantly stricter than corresponding national standards. While it may be possible to obtain local approval for substandard procedures or facilities, local leaders and policies can change, and fines, unexpected outlays, or criminal liability could result.

Potential regulations within the next three to five years include Superfund-type legislation similar to that in the United States. Such regulations are expected to hold generators liable for past polluting practices. According to the "polluter pays" principle, a project's proponent should document the environmental baseline of a proposed site before acquisition and register it with the local EPB, if appropriate. It is recommended that analytical data be recognized by a local qualified laboratory, preferably laboratories under the authority of the provincial EPB.

Current Water Treatment and Supply Policies and Initiatives

The Water and Wastewater Treatment Price System

The water and wastewater treatment price system in China consists of the following:

- The water resource price
- The water supply price of the water resource system
- The municipal water supply price
- The wastewater treatment price

The Water Resource Price. The Water Resource Law, effective October 2002, clearly stipulates the levy of a water resource fee. In response to the new law, relevant water administration departments drafted the Management Methods for Water Resource Fee Levy. The central government provides that the levy of a water resource fee may comply with provincial regulations before the state management method is enacted.

Under this situation, 28 provinces and autonomous regions started to levy water resource fees according to relevant local regulations. The average value of water resources is about $0.02 per cubic meter, and the maximum value is $0.14 per cubic meter.

Table 1.7
Domestic Water Prices in Large Cities

City	Province	Water Price ($/m³) Total	Tap Water and Water Resource	Wastewater Treatment
Beijing		0.35	0.28	0.07
Jinnan	Shandong	0.31		
Tianjin		0.31		
Changchun	Jilin	0.30		
Chongqing		0.29	0.24	0.05
Shijiazhuang	Hebei	0.24	0.18	0.06
Nanjing	Jiangsu	0.23	0.11	0.12
Guangzhou	Guangdong	0.19	0.11	0.08
Shenyang	Liaoning	0.19	0.17	0.02
Wuhan	Hubei	0.18	0.13	0.05
Wulumuqi	Xinjiang	0.18	0.15	0.04
Yinchuan	Gansu	0.14		
Nanning	Guangxi	0.13		

Note: The actual municipal water fee levied consists of three parts: the water resource fee, the tap water fee, and the wastewater treatment fee.

Source: China Resource Conservation and Environmental Protection Network, www.drccu.gov.cn.

The Water Supply Price of the Water Resource System. The water supply price was described earlier in this chapter under "New Policies."

The Municipal Water Supply Price. The Municipal Water Supply Price Management Method was enacted five years ago. According to this management method, municipal water plants are operated by municipal water supply enterprises. The price of water includes water supply costs, relevant expenses, taxes, and profit.

Before the reform of water pricing in 2000, water prices throughout China were relatively low. In 1999, the average domestic water price of 36 large and medium-sized cities was $0.14 per cubic meter, and there were no profits or losses at that time. In 2000, the government enacted the management method to reform water pricing to promote water conservation. Local governments adjusted water prices on the basis of the actual demand in the prefectures.

Table 1.7 shows the current water prices in some large cities. Water prices generally reflect the level of available water resources, as well as economic development. In the areas with water shortages and rapid economic development, such as Beijing and Tianjin, water prices are comparatively higher. The water price in Beijing is increasing to $0.48 per cubic meter because of water scarcities and continuous drought.

The Wastewater Treatment Price. According to the Management Methods of Municipal Water Supply Price, a municipal wastewater treatment fee is collected along with a water supply fee, which is based on the actual water consumed by users. All provinces in China levy wastewater treatment fees. Current prices range from $0.02 to $0.07 per cubic meter, which is lower than the actual costs of a secondary wastewater treatment plant at $0.07 to $0.1 per cubic meter.

According to a notice issued by the central government in April 2002, all cities throughout China were to levy wastewater treatment fees by the end of 2003. This notice reiterated that the wastewater treatment price level should be determined on the basis of cost recovery plus minimal profit. The levy of wastewater treatment fees is undoubtedly promoting the development of wastewater treatment and water pollution control.

Water Market Reform

The reform of the water sector market started with the reform of the water pricing system in 2000. The current water pricing system and the trend toward future increases provide sound opportunities for investors to profit in China's water market.

In 2002, the Chinese government enacted two additional policies to enforce water sector reforms: the Notice on Accelerating the Industrialization of Municipal Wastewater and Wastes Treatment and the Decisions on Accelerating the Market Conversion of Municipal Public Utilities. Two key points provide the basis for the first policy:

- Market mechanisms should be introduced into the construction of new municipal wastewater treatment facilities.
- In constructing municipal wastewater treatment facilities, investors are encouraged to either invest using a build-operate-transfer (BOT) mechanism or cooperate with enterprises authorized by the government.

The second policy focused on selling public utilities to private investors. Two key points provide the basis for this policy:

- Social and foreign capital should be encouraged in the construction of public utilities, such as water supply and wastewater treatment.
- The government will authorize enterprises to operate water supply and wastewater treatment facilities.

These two policies are designed to speed the reform of China's public utilities and make the water market more attractive to investors.

Promotion of Wastewater Reclamation

Increasingly severe water shortages in China prompted both the government and the public to pay closer attention to wastewater reclamation. Wastewater reclamation is clearly stipulated in the newly revised Water Resources Law. Relevant requirements are also part of the state's long-term development strategy. For example, the Water Resources Tenth Five-Year Plan includes the following items:

- If local conditions allow, the plan requires construction of a water reuse piping system and an increased recycling rate for treated wastewater.
- Wastewater treatment facilities must be constructed simultaneously with newly built water supply facilities.
- Construction of wastewater reclamation facilities must simultaneously accompany construction of the wastewater treatment facilities.
- In areas with water shortages, major industrial water users, large public buildings, and users located beyond the public water supply system and having their own water supply system are required to construct a water reuse system.

The water supply pricing policies also promote wastewater reclamation. Compared with the price of water from a municipal water supply plant, the low price of reused water should increase wastewater reclamation rates.

NOTES

1. The five major watersheds in Northern China are Songhua–Liao River, Hai River, Yellow River, and Huai River watersheds, and inland river watersheds. The four major watersheds in Southern China are Yangtze River, Pearl River, Southeast, and Southwest watersheds.

2. According to the PRC's National Environmental Quality Standard for Surface Water (GB3838-88, effective June 1, 2002), surface water areas are divided into five types based on use and protection objectives. Type IV areas are general industrial water zones and water recreation areas where no direct contact with humans occurs; Type V areas are agricultural water zones and scenic water areas.

3. *Xia Qing, Newsletter of Chinese Society for Sustainable Development*, 2002 (available at: *http://cssd.acca21.org.cn*).

4. The regulations apply to new, established, expanded, technical, renovated, and district development projects that affect the environment and may include industrial, transportation, water conservancy, agricultural and forestry, commercial, health care, educational, institutional, tourist, and municipal projects.

CHAPTER 2

Market Highlights and Best Prospects

Market Highlights and Developments since 2000

Transfer from a State-Planned to a Market-Oriented Water Sector

China's water infrastructures are state-owned property regulated by government administrations. However, a few cases exist in which water and wastewater treatment plants were funded or owned by non-state-owned capital. For example, the authority to operate the Sixth Chengdu Water Plant was transferred to a foreign-owned water group in 1999. Most municipal water and wastewater treatment systems are still managed by state-owned enterprises.

The pricing system reforms for water supply and wastewater treatment triggered and promoted the conversion of the water sector from a state-planned to a market-driven sector. Under this system, the policy allows non-state-owned capital, such as foreign and private capital, into the public water infrastructure sectors. It also makes China's water market attractive to investors and private sector utility companies.

Besides non-state-owned capital investing in the public water infrastructure, the authorized operation by a relevant authority of the public water infrastructure (such as a wastewater treatment plant) by private institutions is also allowable. The operational authority transfer occurs for both existing and new public infrastructures. In Liaoning Province, six old water facilities, four new water facilities, and six facilities that are under construction will be transferred to authorized private operation. The Liaoning government is taking measures to promote further transfers, and it promises to increase by 2005 the current wastewater treatment fee ($0.05 per cubic meter) to repay the private company's investment and allow for a profit.

Water Supply and Wastewater Treatment Projects

In large cities such as Beijing, Shanghai, Tianjin, and Chongqing, the water infrastructure has been developed for many years, but it needs to be expanded to meet growing demand. The best opportunities in these cities lie in the reconstruction of aging water supply facilities, including piping systems. This situation contrasts with that of medium-sized or small cities and counties in which the greater demand is for new water plants.

The capacity of China's municipal wastewater treatment plants lags far behind the country's social and economic development. The municipal wastewater treatment rate is estimated at or below 20 percent. To achieve a target municipal wastewater treatment rate of 45 percent in 2005 and 60 percent in cities with populations greater than 500,000, China needs to construct municipal wastewater treatment plants. Urban Beijing has 11 wastewater treatment plants, with an existing capacity of 1.69 million cubic meters per day, and more plants with a combined capacity of 1.11 million cubic meters per day are planned. Tianjin has two large wastewater treatment plants and a total capacity of 660,000 cubic meters per day and plans to construct four more plants with a total capacity of 1.05 million cubic meters per day. Xi'an built two waste-

Table 2.1
Active Large-Scale Water Supply and Wastewater Treatment Projects in China

	Water Supply			Wastewater Treatment		
Project	Capacity (million m³/day)	Investment ($ billion)	Time Frame	Capacity (million m³/day)	Investment ($ billion)	Time Frame
South-to-North Water Diversion Project	4.312	12.1	Before 2010	3.785	1.17	2001–2008
				2.905	0.77	2009-2013
Three Gorges				1.639	0.81	Before 2003
				3.266	0.86	Before 2005
				3.368	0.93	2006–2010
Three-Rivers and Three-Lakes Pollution Control					3.62	
National Western Development						
Chongqing	1.98	1.39	Before 2010			
Chengdu				0.895	0.197	2003–2005

water treatment plants with a total capacity of 310,000 cubic meters per day. It also has two plants under construction and another in the planning stage.

Mid-sized cities also need wastewater treatment plants because the water infrastructure is weak. To achieve its 2005 treatment aims, China needs to build an estimated 2,000 wastewater treatment plants throughout the country.

The large, national projects in China have also created opportunities in the water and wastewater market. Several water supply or wastewater treatment projects are currently under construction or planned as part of the South-to-North Water Diversion Project, the Three Gorges Project, and the National Western Development Project. The total investment expected is presented in Table 2.1, and details are provided in the following sections.

South-to-North Water Diversion Project

To mitigate Northern China's water scarcity, the Chinese government decided to implement the South-to-North Water Diversion Project. This project has eastern, middle, and western routes. These three routes strategically connect the Yangtze River, the Yellow River, the Huai River, and the Hai River. The plans for the three routes follow:

1. The starting point for the **eastern route** is in Yangzhou, Jiangsu Province, in the lower reach of the Yangtze River. Extracted water will be lifted and transported northward through the Jing-Hang Canal and other parallel watercourses, passing Hongze, Luoma, Nansi, and Dongping lakes. After flowing out of Dongping Lake, water will be subdivided into two routes. One route will head north, crossing the Yellow River at Wei Mountain. The other route will flow east through the water transportation pipeline in the Jiaodong Region to Jinan until it reaches Yantai and Weihai in Shangdong Province.
2. The water extraction point for the **middle route** is located at Danjiangkou Reservoir, Hubei Province. The extracted water will initially flow along the western Taibai River basin and pass through the watershed between the Yangtze River basin and the Huai River basin. At that point, the water will flow through the western edge of Huanghuaihai (Yellow River–Huai River–Hai River) Plain to Zhengzhou. At Gubaizui, west of

Table 2.2
Water Plant and Piping System Construction and Expansion Plan for before 2010

	Newly Built or Expanded Plants		Piping System	
Province	Capacity (1,000 m³/day)	Investment ($ billion)	Length (km)	Investment ($ billion)
Beijing	138.9	0.9	196.4	0.4
Hebei	420.3	0.4	257.6	0.3
Henan	696.9	0.6	570.1	0.6
Jiangsu	2,155.8	3.0	1,083.9	3.0
Shandong	519.3	0.3	170.1	0.3
Tianjin	380.4	0.9	66.4	1.4

Source: PRC, Ministry of Water Resources, Municipal Water Resource Planning Group of the South to North Water Diversion Project, "Introduction on the Planning for Municipal Water Resource of the South to North Water Diversion Project" (April 23, 2003); Chinese text available at www.cws.net.cn/Journal/cwr/200301B/07.htm.

Zhengzhou, the water will cross the Yellow River and then head north along the Jingguang Railway to eventually reach Beijing and Tianjin.

3. Water reservoirs for the **western route** will be constructed at the Tongtian River at the upper reach of the Yangtze River, the Yalong River, and the Dadu River—all branches of the Yangtze River. A water channel will be excavated through the Bayankela Mountain—the watershed between the Yangtze and Yellow rivers—enabling water in the Yangtze River to flow into the upper reach of the Yellow River through this new channel.

As planned, the total amount of water diverted will be 44.8 billion cubic meters annually by 2050: 14.8 billion cubic meters through the eastern route, 13 billion cubic meters through the middle route, and 17 billion cubic meters through the western route.

The construction of the South-to-North Water Diversion Project started in December 2002. It is divided into a number of separate phases, and only information on the first phase is currently available.

The construction period of the eastern route (Phase I) will be five years, with a total Phase I budget of $3.86 billion. Of this, about $1.69 billion is budgeted for pollution prevention projects along the route. The estimated construction period for the middle route (Phase I) is eight years, with a total Phase I budget of $11.1 billion. At present, no information is available for the investment plan of the western route.

According to the Municipal Water Resource Plan for the South-to-North Water Diversion Project, many large-capacity water plants and piping systems will be built to treat and supply the transferred water in the future. Table 2.2 summarizes the estimated systems that will be required along the western and middle routes. The later phases are not planned or funded yet.

The planning and implementation of the South-to-North Water Diversion Project will be done on the basis of principles of water conservation, pollution prevention, and ecological protection. The main pollution prevention and control work will focus on the eastern and middle routes.

The main water transportation channels of the eastern route are located in the Huai and Hai river basins, where water pollution is quite serious. Pollution prevention is a major component of the eastern route, especially for the construction of municipal wastewater treatment plants. The total budget for pollution prevention is $2.9 billion, including municipal wastewater treatment, industrial structure adjustment, and comprehensive industrial and regional environmental improvements. Of this total budget, $1.93 billion will be invested in the construction of municipal wastewater treatment plants, as shown in Table 2.3.

The construction of municipal wastewater treatment plants started ahead of the main engi-

Table 2.3
Construction Plan for Municipal Wastewater Treatment Plants

Year	Budget ($ billion)	Number of Plants	Capacity (million m^3/day)
2001–2008	1.17	78	3.785
2009–2013	0.77	57	2.905
Total	1.94	135	6.690

Source: PRC, State Environmental Protection Administration, "The Progress on the Wastewater Treatment on the Eastern Route of the South to North Water Diversion Project" (December 27, 2002); Chinese text available at www.zhb.gov.cn/eic/652460104116862976/20030103/1036571.shtml.

neering schedule. The status of projects for 2001–2008 is shown in Table 2.4.

The main target area for pollution prevention along the middle route focuses on the areas surrounding the upstream portions of the Danjiangkou Water Reservoir.

The Three Gorges Project

The Three Gorges Dam is located at Sandouping, Xiling Gorge, 40 kilometers upstream from the Gezhouba Dam. As planned, the normal water level will be 175 meters, and the total water capacity of the reservoir will be 39.3 billion cubic meters. The Three Gorges Dam area is located in China's western region, where economic conditions are more developed.

The construction of the Three Gorges Dam has three phases, with total construction stretching over a period of 18 years:

- **Phase I (1992–1997).** Preparation work, Phase 1 construction of the cofferdam, and excavation of the water induction channel.
- **Phase II (1998–2003).** Phase II construction of the cofferdam, construction of the power station facilities on the left side of the dam, installment of the equipment, and construction of the permanent navigation lock.
- **Phase III (2003–2009).** Construction of the right side of the dam and its power stations and installment of the remaining equipment.

The construction of the Three Gorges Dam will undoubtedly change the previous flow regime of surface waters, reduce pollutant diffusion, and potentially lead to more water pollution. To effectively prevent water quality degradation in the Three Gorges Dam area, the Chinese government established a comprehensive plan that includes increased municipal wastewater treatment, garbage and hazardous waste treatment, industrial pollution prevention, and ecological environmental protection.

The construction of the Three Gorges Dam has resulted in the resettlement of about 847,000 people. From 1992 to 2002, almost 140,000 people

Table 2.4
Current Status of the Municipal Wastewater Treatment Projects Planned for 2001–2008

Status	Number of Plants	Treatment Capacity (billion m^3/day)	Investment ($ billion)
Completed	16	1.19	0.21
Under construction	15	1.01	0.18
Incomplete	47	1.58	0.75

Source: PRC, State Environmental Protection Administration, "The Progress on the Wastewater Treatment on the Eastern Route of the South to North Water Diversion Project" (December 27, 2002); Chinese text available at www.zhb.gov.cn/eic/652460104116862976/20030103/1036571.shtml.

Table 2.5
Municipal Wastewater Treatment Plants or Facilities in the Reservoir Basin Area before 2003

Type	Number	Capacity (1,000 m³/day)	Investment ($ billion)	Requirement
Plants	21	1,595	0.80	Secondary biological treatment (including nitrogen and phosphorus removal)
Facility	20	44	0.01	

Source: PRC, State Environmental Protection Administration, Water Pollution Prevention Plan for the Three Gorges Reservoir and Upstream Areas (2001–2010) (Beijing: State Council of the PRC, 2001).

were relocated to the surrounding area or to other provinces, and another 25,000 people continue to be relocated from July 2003 to the end of 2004. This large-scale resettlement brings many new demands for water supply and piping systems in the relocation areas. A municipal water supply plant for the migration city of Ganning, which began operating on Nov. 10, 2003, now provides drinking water for 1 million citizens.

The reservoir basin area, influence area, and upstream area affect the water quality of the Three Gorges Dam reservoir. Wastewater treatment facilities are required in the following areas to treat all the wastewater:

- Reservoir basin area—20 districts and counties in this area and all towns along rivers
- Influence area—42 districts and counties, including all cities and towns where county-level governments are located
- Upstream area—214 districts and counties and all cities within them.

In addition, separate storm-water and sewage collection systems need to be built simultaneously with the municipal wastewater treatment facilities.

Tables 2.5, 2.6, and 2.7 detail the planned municipal wastewater treatment plants or facilities, which have been designed according to the pollution prevention plan.

Comprehensive Pollution Control and Ecological Remediation in Three-Rivers and Three-Lakes Regions

Three rivers (Huai, Hai, and Liao rivers) and three lakes (Tai, Chao, and Dianchi lakes) were identified as the most seriously polluted water bodies in China. The Chinese government decided to strengthen the pollution prevention work in these areas when it considered the significance of water resources for China's economic and social develop-

Table 2.6
Planned Municipal Wastewater Treatment Plants or Facilities before 2005

Area	Type	Number	Capacity (1,000 m³/ day)	Budget ($ billion)
Reservoir basin area	Plant	4	260	0.10
	Facility	22	76	0.02
Influence area	Plant	20	1,010	0.32
Upstream area	Plant	31	1,920	0.42

Source: PRC, State Environmental Protection Administration, Water Pollution Prevention Plan for the Three Gorges Reservoir and Upstream Areas (2001–2010) (Beijing: State Council of the PRC, 2001).

Table 2.7
Planned Municipal Wastewater Treatment Plants or Facilities in 2006–2010

Area	Type	Number	Capacity (1,000 m^3/day)	Investment ($ billion)
Reservoir basin area	Plant	17	685	0.28
	Facility	71	120	0.02
Influence area	Plant	24	928	0.27
Upstream area	Plant	34	1,635	0.36

Source: PRC, State Environmental Protection Administration, Water Pollution Prevention Plan for the Three Gorges Reservoir and Upstream Areas (2001–2010) (Beijing: State Council of the PRC, 2001).

ment. The pollutant treatment project in these water bodies is also one of 10 key state projects identified in the Tenth Five-Year Plan. The total investment in municipal wastewater treatment plants and piping networks is estimated at $3.62 billion for the respective regions. Construction of wastewater treatment plants began, but a significant implementation program still remains to be completed, as shown in Table 2.8.

National Western Development

The broad western region of China consists of 11 provinces (Xinjiang, Inner Mongolia, Tibet, Qinghai, Ningxia, Gansu, Shaanxi, Sichuang, Yunnan, Guizhou, Guangxi) and one municipality (Chongqing). Compared to provinces in Eastern China, these western provinces are relatively undeveloped with respect to gross domestic product, education, health, and roads and other infrastructure. On Jan. 1, 2001, the State Council implemented policies and measures to promote western development. The Chinese government stipulated preferential policies for infrastructure construction, absorption of foreign investment, loan applications, and financial support to encourage the plan for the western region.

Consistent with its ambitious National Western Development Plan, the western region faces huge demands for water and wastewater infrastructure. Two examples of planned projects are detailed below.

Table 2.8
Current Status of Municipal Wastewater Treatment Projects in Three-Rivers and Three-Lakes Regions

Location	Total	Completed	Under Construction	Incomplete
Huai River basin	161	22	33	106
Hai River basin	186	13	40	133
Liao River basin	65	7	15	43
Tai Lake basin	147	19	68	60
Chao Lake basin	17	2	5	10
Dianchi Lake basin	3	0	0	3

Source: PRC, State Environmental Protection Administration, "Circular on the Progress of the Water Pollution Prevention in the Three-Rivers and Three-Lakes Regions" (June 19, 2003); Chinese text available at www.zhb.gov.cn.eic/649086806737813504/20030707/1039391.shtml.

Table 2.9
Planned Expansion through 2010 of Chongqing's Water Supply Plants

Area	Capacity (1,000 m³/day)	Investment ($ billion)	Name of Water Plant
Urban area	900	0.79	Fengshouba, Liangtuo, Daojiao, Jinkou
Suburbs, counties, and towns	1,080	0.60	(name of plant unavailable)
Total	1,980	1.39	

Source: PRC, Ministry of Construction, "Environmental Infrastructure Construction in Chogqing" (report of the Chongqing People's Government, August 22, 2002); Chinese text available at www.cin.gov.cn/indus/exp/2002092005.htm.

Chongqing Municipality. The Chongqing municipality plans to construct new water treatment plants by 2010, as detailed in Table 2.9.

Besides planning the water supply plants, the Chongqing government also established plans for wastewater treatment plants. The municipal treatment rate in Chongqing was only 7.2 percent at the end of 2001. To achieve a treatment rate of 80 percent in urban areas by 2005, two municipal wastewater treatment plants are under construction (Jiguanshi Wastewater Treatment Plant, at 600,000 cubic meters per day, and the Tangjiatuo Wastewater Treatment Plant, at 300,000 cubic meters per day). Four (Jingkou, Zhongliangshan, Qiezixi, and Lijiatuo) wastewater treatment plants are in the planning stage.

Chengdu, Sichuan Province. From 2003 to 2005, Chengdu plans to construct 16 municipal wastewater treatment plants, which are listed in Table 2.10.

Wastewater Reclamation

China's pending water shortage crisis is drawing the attention of decision-makers and prompting major incentives to promote wastewater reclamation. Water scarcity is prevalent throughout China, especially in the north, northeast, northwest, and coastal areas. Of the 660 cities in China, more than 420 are encountering water supply scarcity issues, and in 110 of these cities, the water shortages are severe.

The rapid development of municipal wastewater treatment throughout China will create more plentiful water sources for wastewater reclamation in the next few years and will provide a powerful incentive to develop more wastewater reclamation projects to alleviate some of the pressure from existing water shortages. Some large cities, such as Beijing, Tianjin, Xi'an, and Dalian, are already taking action, and wastewater reclamation is expected to accelerate in China.

Beijing. The capital of China, Beijing, has always used surface water from water reservoirs and groundwater as water resources. Recently, continuous drought plunged Beijing into a serious water shortage. Annual water shortages are estimated to reach 0.79 billion to 1.65 billion cubic meters in 2005 and 1.18 billion to 2.0 billion cubic meters by 2010.

To mitigate water shortages, the Beijing government constructed centralized wastewater reclamation projects and supported a number of discrete gray water reuse projects. Table 2.11 highlights the current gray water reuse projects in Beijing.

The volume of reclaimed wastewater in Beijing is currently over 147 million cubic meters per year and is planned to increase to 600 million cubic meters per year by 2008. Once achieved, the wastewater reclamation rate will increase from the current 20 percent to 50 percent of the total amount of municipal wastewater discharged.

Tianjin. Tianjin's main water sources are groundwater and surface water from the Luan River. These resources are currently stressed, and water shortage is a long-term problem that threatens to hinder Tianjin's social and economic development. Water shortage is estimated to reach 3.6 billion cubic meters per year in 2005 and 4 billion cubic meters per year by 2010. Table 2.12 shows

Table 2.10
Planned Municipal Wastewater Treatment Plants in Chengdu from 2003 to 2005

Name of Plant	Capacity (1,000 m³/day)	Investment ($ million)
Central	300	96.14
Longquanyi	40	6.76
Qingbaijiang	100	16.91
Dujiangyan	40	6.76
Pengzhou City	40	6.76
Gonglai City	40	6.76
Chongzhou City	35	5.92
Jintang County	30	5.07
Shuangliu Dongsheng	40	6.76
Shuangliu Huayang	40	6.76
Wenjiang County	30	5.07
Pi County	40	6.76
Xindu County	50	8.45
Dayi County	30	5.07
Pujiang County	20	8.45
Xinjin	20	3.38
Total	895	196.75

Source: PRC, Ministry of Construction, "The Progress on the Treatment of Municipal Wastewater and Wastes in Chengdu City" (report of the Chengdu Environmental Protection Bureau, June 2002); Chinese text available at www.cin.gov.cn/indus/exp/2002092314.htm.

established and planned wastewater reclamation projects in Tianjin. The planned amount of reused water will be 813,000 cubic meters per day by 2010, with a reuse rate exceeding 50 percent.

Xi'an, Shanxi Province. In Xi'an, the main water sources are surface water from the Hei River and groundwater. The estimated water shortage for the city will be 1.2 billion cubic meters per year in 2010. Table 2.13 shows the established or planned wastewater reclamation projects in Xi'an. The planned amount of reused water will be 460,000 cubic meters per day by 2010.

Dalian, Liaoning Province. The current amount of reused water in Dalian is 50,000 cubic meters per day, including 10,000 cubic meters from the Chunliuhe Wastewater Treatment Plant and 40,000 cubic meters from the Malanhe Wastewater Treatment Plant. By 2005, the planned total amount of reused water should reach 240,000 cubic meters per day.

Environmental Service

China now faces huge demands on its water supply and wastewater treatment facilities and piping systems. This demand represents a correspondingly large potential market for design, engineering construction, equipment production, information networking, facility operation, and professional training. Because this market is still forming, the service entities and enterprises in China are relatively small compared with large, established international organizations. The following new enterprises are being established to meet market demand:

- **Comprehensive water corporations.** This type of group usually forms out of a merger between water supply companies and wastewater collection and treatment companies, often established by a city or an area. In addition to providing better service, these groups seek to be a monopoly supplier to the water market in an area or even in a large watershed. Although establishing these

Table 2.11
Current Gray Water Reuse Projects in Beijing

Project	Scale (1,000 m^3/day)	Current Status
Gray water reuse project of Gaobeidian Municipal Wastewater Treatment Plant	300	In use
Jiuxianqiao gray water reuse project	60	Under construction
Fangzhuang gray water reuse project	20	Under preparation
More than 200 gray water reuse facilities in buildings	24	In use

Source: Beijing Municipal City Planning Management Committee, "Wastewater Reclamation and Utilization in Beijing" (October 18, 2003); Chinese text available at www.h2o-china.com/paper/viewpaper.asp?id=3480.

groups seems popular in China, they tend to be underfinanced or lack working capital.

- **Environmental service companies.** These groups tend to supply services in design, engineering construction, equipment fabrication, and facility operations. They usually form from mergers and acquisitions among institutes, engineering companies, and manufacturers. Most of these groups are small or not well established, but several large groups in the water sector are expected to emerge in China.

In addition, water-related Web sites are far more active lately. These Web sites mainly provide environmental information services, such as water news, government policies, technical exchanges, advertisements, and a platform to discuss water affairs. Water enterprises fund many of these Web sites.

Best Sales Prospects

Water Supply and Wastewater Treatment Project and Plant or System Operation

As discussed previously, the water market is growing because of the huge water demands placed on weak infrastructure systems that are unable to meet the growing need. A large number of water supply and wastewater treatment projects will be implemented in China to strengthen the existing water infrastructures.

According to the National Towns and Villages Water Supply Development Plan, from now until 2010 China needs to spend $29 billion to increase by 20 percent its capability to provide drinking water. (Prior to 2005, China spent $14.5 billion to $15.7 billion to build municipal wastewater treatment plants.) In addition, China must extend and renew the existing water supply and wastewater collection piping systems.

The government's inability to invest and to fulfill the huge capital demand creates opportunities to involve non-state-owned or foreign investment. The Chinese government has stipulated relevant policies to encourage non-state-owned and foreign investment participation. These policies include preferential tax policies for the industries and projects listed in the Foreign Investment Industry Guideline.[5] Guided by the state's policies, local governments established relevant policies applicable to local areas. Companies can obtain details on these policies from the local governments and taxation bureaus.

Forming a private and public partnership (P3) is a common method for non-state-owned and foreign participants in the water supply and wastewater treatment sector. For specific projects, build-operate-transfer (BOT), and design-build-operate (DBO) schemes are often used. Because the concept of P3 is a new one in China, the Chinese government has not set specific regulations or guidelines regarding P3, BOT, and DBO schemes. Foreign companies and investors are likely to encounter a dilemma in assessing the opportuni-

Table 2.12
Wastewater Reclamation Projects in Tianjin

Project	Scale (1,000 m^3/day)	Current Status
Wastewater reclamation project of Xianyanglu Municipal Wastewater Treatment Plant	50	Planned
Wastewater reclamation project of Jizhuangzi Municipal Wastewater Treatment Plant (Phase I)	50	In use
Wastewater reclamation project of Jizhuangzi Municipal Wastewater Treatment Plant (Phase II)	100	Planned

Source: Tianjin Construction Committee, "The Utilization of Reclaimed Water Resource in Tianjin" (October 28, 2003); Chinese text available at www.h2o-china.com/paper/viewpaper/asp?id=3480.

ties and challenges for participation and the accompanying financial risks.

Water Supply and Wastewater Treatment Technology and Equipment

The construction of new water and wastewater treatment plants and piping systems, as well as the reconstruction of outdated water and wastewater treatment plants and piping systems, creates a large market demand for relevant technology and equipment.

Water and Wastewater Treatment Technology and Equipment. High-efficiency treatment technologies are needed in both the water supply and wastewater treatment sectors. In the water treatment sector, pollution of surface water and groundwater creates demand for deep treatment technologies. In the municipal wastewater treatment sector, nitrogen and phosphate removal technologies are needed. In the industrial wastewater treatment sector, technologies that can efficiently remove non-biodegradable organics are needed in various sectors, including the pulp and paper, textile, chemical, and petrochemical industries. The following specific technologies and equipment represent the best market potential in China:

Municipal wastewater treatment

- Standardized water and wastewater treatment equipment
- Biological denitrification and phosphorus-removal technology with high-efficiency and energy-saving technologies
- Manufacturing technology of anaerobic biological reactors such as upward-flow anaerobic sludge bed reactors, anaerobic filters, anaerobic attached-film expanded beds, and anaerobic fluidized bed reactors
- Immobilized microbe technology
- Membrane manufacture technology
- Low-speed and variable-speed multi-pole centrifugal blower
- Sludge treatment and disposal equipment
- Packaged thickening and dewater belt presses
- Horizontal screw centrifugal dewatering
- Methane electric generators
- Automatic control equipment for water treatment

Industry wastewater treatment

- High-concentration organic wastewater treatment technology and equipment
- Membrane separation technologies, such as reverse osmosis, nanofiltration, ultrafiltration, microfiltration, and ion exchange
- Wastewater deep treatment and reuse technology and equipment in industry sectors, such as surface treatment, coal and mining, pulp and paper, metallurgy, petroleum

Table 2.13
Wastewater Reclamation Projects in Xi'an

Project	Scale (1,000 m^3/day)	Current Status
Beishiqiao wastewater reclamation project	50	In use
Wastewater reclamation project of Dengjiacun Municipal Wastewater Treatment Plant	60	Under construction

Source: Xi'an City Planning Management Committee, "Municipal Wastewater Reclamation and Utilization in Xi'an" (October 18, 2003); Chinese text available at www.h2o-china.com/paper/viewpaper/asp?id=3479.

exploitation, electronics, machining, and chemical sectors

- High-efficiency ozone generators and chlorine dioxide generators
- High-efficiency ultraviolet disinfection devices

Water conservation

- Water-saving technologies and equipment for the power and energy, textile, metallurgy, petroleum, and chemistry sectors
- Miscellaneous water-saving devices or apparatus
- Usage and desalinization technologies and equipment for seawater and brackish water
- High-efficiency air-cooling technology and waterless production technology

Natural water body

- Organic pollution and eutrophication natural water body pollution control and rehabilitation technologies
- Natural water body substrate sludge disposal technology
- Algae control technology
- Scenic water quality maintenance

Monitoring instruments:

- Pollution source on-line monitoring instrumentation
- Portable monitoring instruments
- Intelligent auto-sampling, data collection, treatment, and remote control systems with high reliability and precision
- City water monitoring networks

Water treatment agents

- Water treatment biological and enzyme agents
- High-efficiency flocculation and coagulation agent
- Pollution-free bactericide

Services:

- Integrated engineering project services, including financing, design, equipment supply, construction, installation, and operation
- Operation and maintenance of professional water treatment facilities
- Water market information services

Water and Wastewater Piping Network Operation and Maintenance Technology. The piping network operation and maintenance technologies, such as dispatching and monitoring of the water supply piping network and scouring and maintenance of the wastewater collection piping system, have been developed and applied in China. The use level, however, is low, particularly in small and medium-sized cities.

Wastewater Reclamation

Wastewater reclamation is a new market feature that is emerging from China's water scarcity problems. Reused water is priced in some cities and

provides a market for wastewater reclamation. Some successful cases of environmental enterprises or companies' participation in investing and operating wastewater reclamation projects include a Dalian company, which invested $1.21 million to construct a wastewater reclamation project with production capacity of 5,000 cubic meters per day, and a Qingdao company, which invested $590,000 in a similar project. Non-state-owned and foreign investors should find good investment opportunities in this sector.

Wastewater reclamation requires advanced treatment technologies and equipment, such as membrane separation devices. Municipal wastewater reclamation demands large-scale treatment technologies, while buildings and residential areas need small- to medium-scale treatment technologies and equipment. In general, technology and equipment with high efficiency, low cost, and convenient operation and maintenance have the greatest sales potential in China.

Water Projects Requiring Foreign Investment

The major water and wastewater treatment projects requiring investment and business cooperation are detailed in Appendix A. These projects are distributed in both the water supply and wastewater sectors, and most are linked to municipal infrastructure construction or reconstruction projects. Water supply projects include construction of new water plants and piping systems, and reconstruction of old water supply piping systems. Wastewater treatment projects include construction of facilities and piping systems. Both investment and equipment are required, and the main participation requirements include BOT, joint venture, or cooperative.

Notably, the Chinese government maintains the supervisory authority for all the municipal water and wastewater projects because public water infrastructure is so important. Market mechanisms in the water sector are helping the government attract non-state-owned and foreign investment and improve water supply and wastewater treatment capabilities. Furthermore, the Chinese government anticipates that foreign investors will bring advanced technology and management experience to positively influence the long-term development of China's water and wastewater treatment sector.

As the decision-maker, the government sets basic requirements or expectations for authorized companies. First, the water supply enterprises must have the technical and financial capability to provide a rational project schedule, good work quality, and good water and wastewater treatment quality. The companies must ensure that the treated water meets relevant standards, and they must provide quality services for end users. In addition, BOT project participants should ensure that the fixed assets are well maintained so that the facilities and piping systems will be in good condition after they are transferred to the government or a new enterprise.

NOTES

5. PRC, State Planning Commission, *Guidelines for Foreign Investment by Industry* (Beijing, December 31, 1997). The guidelines went into effect on April 1, 2002, and supersede guidelines that were published in 1995. They were issued jointly by the State Planning Commission, the State Economic and Trade Commission, and the Ministry of Foreign Trade and Economic Cooperation.

CHAPTER 3

Competitive Situation

Domestic Production

The production industry for China's environmental protection equipment is mostly located in developed regions, such as the coastal areas in Eastern China and areas along major rivers. Eighty percent of China's environmental protection enterprises are medium-sized or small enterprises with comparatively low technical capabilities. Recently, several large enterprises, with registered capital of $12.1 million have been established in China's market. Their services include technology development, equipment fabrication, and environmental engineering services.

Water Supply Technology

China's municipal water supply infrastructure is more than 120 years old, with the first water supply facility built in 1879. In 1949, 60 municipal water supply facilities provided 1.86 million cubic meters per day. By 2000, the daily water supply capacity of all cities reached 2.2 billion cubic meters. From the early 1990s to the present, China's water supply enterprises grew rapidly. Currently, about 300 institutes engage in water supply research and engineering design, wastewater collection, and wastewater treatment projects. Several hundred factories produce water supply and wastewater treatment equipment and materials. China possesses mature technology and experience in equipment production, plant design, construction, operation, and management.

Conventional Water Treatment Technology. China's conventional water treatment technologies include coagulation, sedimentation, clarification, filtration, and disinfection technologies. On the basis of conventional processes, new process types and high-efficiency treatment technologies were developed and applied in China. Alternatives to conventional horizontal sedimentation tanks, such as inclined-tube, lamella, side-flow inclined-plate, labyrinth inclined-plate, and longitudinal water collection inclined-plate sedimentation tanks, are widely used. The main clarification processes are mechanical, hydraulic cycle, and pulse clarifiers. The most widely used filtration processes are rapid, siphon, valveless, movable hood backwashing, pressure, multimedia layer, and V-type filters. Chlorination is the main method of drinking water disinfection used in China. To avoid the by-products of disinfection by chlorination, some water plants are using chlorine dioxide to disinfect, and a trial application of ozone disinfection technology is under way.

Pretreatment and Deep Treatment Technology. Water pollution in China has damaged the quality of raw water for water supply. Biological treatment, ozone oxidation, and activated carbon treatment are used in China to remove ammonia and organic pollutants in the raw water or to improve the water quality of treated water. The Shenzhen Water Plant uses biological oxidation in the pretreatment process. Beijing's Ninth Water Plant and the Tiancunshan Water Plant apply activated carbon adsorption and ozone-activated carbon treatment. Pretreatment and advanced treatment technologies for polluted water are expected to develop significantly in the future.

Membrane Filtration Technology. Membrane filtration technologies include ultrafiltration membrane technology and reverse osmosis membrane

technology. Membrane technology produces pure water for industrial use, but there is no application in China's large-scale municipal water supply plants. Some Chinese companies can produce various types of membrane materials, but the quality of domestic membranes cannot compete with imported products. High-efficiency membrane technology is expected to increasingly develop for use in the water treatment sector.

Other Special Water Treatment Technology. China developed water treatment technologies applicable to different types of polluted water, including high- and low-turbidity, low-temperature, and saline water, as well as water containing iron and flourine. Although algae removal technology has developed in China, it achieves only low levels of efficiency.

Water Plant Auto-Control Technology. Recently, many existing and all newly built water plants were equipped with advanced equipment and automatic control systems. Automatic control systems, including monitoring, executive, and management systems, are used widely in large or medium-sized water plants and occasionally in small water plants. However, the quality of applied technology systems and equipment is low. The Shanghai Water Supply Company is setting up a water supply operation and control system, a geographic water supply information system, and a water supply network model with the support of a World Bank loan. Beijing's Ninth Water Plant implemented an auto-control system to monitor the plant's water purification process.

Water Treatment Equipment

Most of China's more than 2,100 large and medium-sized municipal water plants use domestically produced equipment. Domestic manufacturers provide almost all of the main water supply piping system. China's domestic technology is mature in producing the following common plant equipment:

- Pumps
- Valves
- Mixing, reaction, sedimentation, and filtration equipment
- Coagulant dosing devices
- Disinfectant dosing devices
- Regular apparatus and testing devices
- Electrodialysis and reverse osmosis equipment
- Pure water equipment
- Chlorine dosing facilities
- Metering pumps and anti-corrosion diaphragm pumps
- Ozone generators and sodium hypochlorous generators
- Electronic and control equipment

The quality of the majority of domestic equipment lags far behind that of foreign products from the United States and Europe. Domestically manufactured automatic control and dosing systems often do not operate effectively.

Water Treatment Agents

The primary water treatment agents used in China's market include scale and corrosion inhibition agents, biocides, and inorganic and organic flocculants. Almost 80 percent of these domestic agents are produced domestically by township enterprises. A fairly comprehensive suite of water treatment agents has developed to cover the entire water treatment spectrum. Table 3.1 lists the main agents produced in China.

China's domestically produced organic macromolecular coagulant compares unfavorably in molecular weight, toxicity, and solubility to advanced products from the United States and Europe. A variety of organic macromolecular coagulants is also scarce because producers only make polyacrylamide, polyacrylate sodium, and polyamines. In addition, the development of cationic macromolecular coagulants in China is far behind those of more industrial countries.

The market for recycled cooling water treatment agents is well developed in China, including scale and corrosion inhibition agents and biocides. The quality of many domestic products is equal to or outperforms products from developed countries. Newer types of water-soluble copolymers, phosphine carboxylic acids, oxidation bactericide types, and brominated bactericides, however, are not well developed in China.

Table 3.1

Domestically Produced Water Treatment Agents in China

Agent	Type	Species
Biocide	Oxidation-type	• Chlorine (Cl_2) • Sodium hypochlorite (NaOCl) • Calcium hypochlorite ($Ca(OCl)_2$) • Chlorine dioxide (ClO_2) • Chloramine • ozone
	Non-oxidation type	• Quaternary ammonium • glutaraldehyde • bisulfide-cyano-methane
Inorganic coagulant	Mineral salt	• Aluminum sulphate ($AlSO_4$) • Ferrous sulphate ($FeSO_4$) • Ferric chloride ($FeCl_3$)
	Macromolecular coagulant	• Poly aluminum chloride (PAC) • Polymeric ferric sulfate (PFS) • Poly aluminum sulfate
	Composite inorganic macromolecular coagulant	Anion compounds including: • PAC combining with sulphate (SO_4^{2-}) • PFS combining with chloride (Cl^-) • Cation compounds including PAC combining with ferric ion (Fe^{3+}) Multi-ion compounds including: • Complex of ferric ion • Sulfate radical • Chloride Inorganic-organic complex compounds including: • Complex of PAC and polyacrylamide (PAM) • Poly chlorinated ferric sulphate • Poly aluminium silicon • Poly aluminium phosphorus • Poly aluminium ferrous
Organic coagulant	Synthetic macromolecular coagulant	PAM and its ramifications
	Natural macromolecular coagulant	Amylum, cellulose, mucus of plant, amylose, protein and their ramifications

Wastewater Treatment Technology

Since the 1990s, China's wastewater treatment industry developed various technologies and equipment through its increased investment in water pollution treatment systems.

Municipal Wastewater Treatment Technology. According to the National Technical Policy for Municipal Wastewater Treatment and Pollution Prevention, conventional activated sludge (CAS), anaerobic-aerobic activated sludge process (A/O), and anaerobic-anoxic-aerobic activated sludge process (A/A/O) are the priority processes recommended for large and medium-sized municipal wastewater treatment plants. The CAS process was widely used in municipal wastewater treatment plants constructed before 1994. From 1995, the commonly used technologies included the following:

- Oxidation ditch process, including almost all the derivative technologies developed by other countries.
- Sequencing batch reactor (SBR) activated sludge process, including almost all the derivative technologies developed by other countries, such as intermittent cyclic extended aeration system (ICEAS), cyclic activated sludge system (CASS), cyclic activated sludge technology (CAST), and demand aeration tank–intermittent aeration tank (DAT–IAT).
- Other processes, such as absorption-biodegrading (AB) process; the University of Cape Town (UCT) process, biological aeration filter (BAF) process, and biological membrane process. From 1995 to 2000, 70 percent of more than 100 newly built wastewater treatment plants employed oxidation ditch, and from 1998 to 2000, at least 20 plants applied SBR process. In addition, the BAF, biological membrane, and hydrolysis-acidification and aerobic processes have also been applied in small municipal wastewater treatment plants.

In the future, various SBR processes are expected to be used widely. Biological membrane, physical-chemical treatment, and biological treatment processes with good nitrogen and phosphate removal attributes are also expected to develop in China.

Industrial Wastewater Treatment Technology. Physical-chemical and biological processes are widely used to treat industrial wastewater, including coagulation-sedimentation, coagulation-flotation, high-efficiency filtration, catalytic oxidation, anaerobic and aerobic activated sludge, and biological membrane contact oxidation processes.

High-efficiency anaerobic or aerobic reactors are used throughout different industrial sectors and include the use of aerobic inner circulation fluidized beds, pressure biological reactors, membrane bioreactors, upflow anaerobic sludge beds, inner circulation anaerobic reactors, and complex anaerobic biological filters.

High-efficiency and low-cost wastewater treatment technologies, automatic control systems, and wastewater treatment agents will be extensively developed in China in the near future.

Other Wastewater Treatment Technology. In water purification treatment, industrial water treatment, and wastewater reclamation, various physical-chemical separation technologies are widely used, including filtration, coagulation-sedimentation, adsorption, and membrane separation technology. Wastewater reclamation needs in China can be expected to drive a new field of development in membrane technology and membrane materials applications. Oxidized disinfection technologies are also developing quickly in China. With the exception of chlorine dioxide (ClO_2), disinfection technologies using ozone, ultraviolet, and combined ultraviolet-ozone have also been applied in organic pollutant degradation and sterilization.

Wastewater Treatment Equipment

Most of the environmental protection products associated with the above wastewater treatment technologies are produced in China, including general and specialized machines, equipment, wastewater treatment agents and materials, and monitoring devices and equipment. Unfortunately, product quality and production capabilities are low.

Physical Treatment Equipment. China's physical treatment equipment includes devices for sed-

imentation, clarification, flotation, centrifugal separation, magnetic separation, screen separation, filtration, and micropore filtration. Some domestic environmental protection companies manufacture quality products; however, microtechnology and related equipment product quality is low. Centrifugal separation machines, micromesh microstrainers, fine rack separation units, magnetic separation machines, and high-precision micropore filtration materials are of inadequate quality. The product quality is also low for sludge dewatering machines made in China, primarily plate, frame, and belt filter presses.

Chemical Treatment Equipment. China's chemical treatment equipment includes neutralization, chemical sedimentation, oxidation and reduction, and sterilization and disinfection equipment. Most of the domestic chemical treatment equipment is of low quality and uses outdated technology. Problems frequently occur because of comparatively low automation levels and substandard reliability. Sterilization and disinfection devices are developing rapidly. Almost every type of disinfection device is produced in China, including small scale ozone and ultraviolet technologies.

Physical-Chemical Treatment Equipment. China's physical-chemical treatment equipment includes extraction, adsorption, ion exchange, and common membrane separation devices. With regard to general technology and materials, there are no obvious differences between domestic and imported equipment; however, compatibility, auto-controls, and life expectancy of domestically produced equipment compares poorly with equipment from developed countries. China has increased development of new membrane technologies and membrane materials in recent years, but many membranes are still imported.

Biological Treatment Equipment. Biological treatment equipment is widely used in municipal and industrial wastewater treatment. Domestic biological treatment equipment in China includes devices in aerobic treatment, anaerobic treatment, sludge digesting, comprehensive biogas utilization, and anaerobic-aerobic treatment. The basic technical principle of these devices is the same as it is in developed countries. Low prices offset the low quality of these products.

Aeration devices have developed rapidly in the past five years in China. China now produces almost every kind of aeration device available, including microfine bubbles and middle porous diffusers; screw, jet, vertical and horizontal surface, submerged, and floating aerators; and aerators used in oxidation ditches. The quality of these devices is always problematical. The products produced by joint venture companies are of much better quality but usually cost more. The variety and amount of decanters increased considerably because of SBR technology applications. For sludge digesting processes, the key domestic products include heat exchange and stirring devices. Currently, no domestic comprehensive biogas device is used in China.

General Wastewater Treatment Device. Domestic wastewater treatment devices include blowers, pumps, valves, and auto-control devices. The blower designs include centrifugal and roots types. Compared with advanced international technology, the capability to produce large-capacity, low- and variable-speed multi-pole centrifugal blowers is poor. Roots blowers have weak efficiency, fabrication, and machining precision. Valves include butterfly, gate, check, and motorized types. Some domestic manufacturers can produce valves according to international standards, such as the DIN German standard and American Water Works Association (AWWA) standard, and some firms obtain international certificates. Many products achieve an internationally advanced quality level and are exported to other countries with competitive pricing. The pumps include single-suction single- and multi-stage, double-suction single-stage, non-blocking wastewater, and screw types. Domestic pumps can fulfill the basic domestic market demand; however, working efficiency, quality, and fabrication precision issues require further improvement.

Wastewater Treatment Reagent and Material. The key wastewater treatment agents made in China are inorganic coagulants, germicides, and algaecides. Wastewater treatment materials include fillings, filtration materials, and resins. Domestic production of wastewater treatment reagents and materials meets domestic demand, but there is a crucial gap in product quality, performance, and variety between the domestic and imported prod-

ucts. China's ability to produce high-technology wastewater treatment agents lags behind developed countries.

Operation Monitoring Device and Apparatus. China produces continuous monitoring, portable monitoring, and large laboratory facilities, but monitoring devices and equipment are not well developed in China. China imports high-quality analytical devices, special monitoring devices, and auto-monitoring systems. Although the variety of domestic monitoring devices is quite limited, they still command a very high market share in China because of their low prices.

Environmental Services

Environmental services directly related to water and wastewater treatment include research, design, information collection and presentation, water engineering construction, water pollution treatment facility operation, and water monitoring and analysis.

Before 1990 the environmental protection service served as a kind of commonwealth, or welfare, sector. Almost all the service organizations were public and directed by the government. Development of the environmental service industry was very slow because of the very low payment for these services and the small market demand. Since 1990 and the establishment of an environmental protection market in China, the environmental services sector has developed rapidly. China formed a basic environmental service framework and network consisting of universities; research, application, and design institutes; information services; monitoring companies; and engineering equipment integration contractors. The environmental services sector remains underdeveloped in terms of service volume, technical level, capability, and service scope. In developed countries, production value of environmental services accounts for 50 percent of the total environmental market. In China, services account for less than 40 percent. Water treatment services hold an important position in the environmental market in developed countries, while in China the development of the water treatment sector is new and not fully mature.

Environmental Engineering Design and Construction. Environmental engineering design and construction are showing strength in China's environmental service market. China has good design and construction capabilities in municipal wastewater treatment, industrial wastewater treatment, and wastewater reclamation projects. As a result of the old planning institutions, each province has its own design and construction system. The state-owned institutes or enterprises usually undertake the large water or wastewater treatment projects. Institutes or companies interested in entering China's design and construction industry need to obtain qualified certification from the government.

Mergers and acquisitions are expected to occur in the engineering design and construction sector for domestic wastewater treatment. This sector is expected to grow and develop rapidly in the next couple of years because the Chinese government identified improved water pollution treatment as a long-term goal throughout the country.

Environmental Pollution Treatment Facility Operation. To gain authority to operate municipal and industrial wastewater treatment facilities in China, companies must obtain an environmental pollution treatment facility operation certificate from the local administration (local water bureau or city construction management bureau). Primarily, wastewater treatment enterprises, industrial plants, and environmental engineering companies have authority to operate in this field.

The operation service sector for wastewater treatment facilities is not yet developed in China. However, many companies can operate wastewater treatment facilities. Increasing water tariffs and wastewater treatment fees are expected to prompt many companies to enter into the operation service market.

Environmental Monitoring and Analysis. Environmental monitoring and analysis refers to tests performed while water and wastewater treatment facilities operate and test on products. Although Chinese environmental research and monitoring institutes, environmental monitoring stations, and environmental protection companies can provide these services, their equipment, devices, and instruments cannot match the quality of those from developed countries. Currently, most of the water quality monitoring is conducted by

state-owned environmental monitoring stations, which are authorized by the government and are located in each province, city, and county in China. Although other companies have monitoring capability, they are not allowed to provide the monitoring services because they lack government authorization. This subsector is expected to grow, with new companies entering the field in response to market mechanisms in monitoring demands, strengthened public opinion, and possible co-supervision with monitoring stations.

Third-Country Competition

Since the 1990s, more than 100 internationally well-known enterprises entered China's environmental industry and capital market. From 1991 to 2000, about 90 percent of the equipment in large or medium-sized wastewater treatment plants was imported. Some companies invested directly in China's water market, participating in the construction and operation of water and wastewater treatment plants through BOT and other cooperation modes. Other foreign companies established joint ventures or wholly owned subsidiaries in China. Foreign companies are present in almost all facets of China's water and wastewater treatment market.

Water Market Investment

Multinational water companies have worked on water supply projects in China since the late 1970s, when the Chinese government began reconstructing water supply facilities with the support of loans from international organizations. China's recent adoption of a market-based approach to water and wastewater treatment has moved the market into an intensive development stage. Two French companies, Suez and Véolia Water (previously Vivendi Water), and a U.K. company, Thames Water, are the best-known foreign companies that have participated in this market growth.

Ondeo, a water division of Suez, was the first foreign water company to enter China. Ondeo contributed work on more than 125 drinking and wastewater plants, supplying about 20 percent of the urban population in China (400 million people). Ondeo won nearly 20 long-term water contracts in China and invested a total of $210 million in China. These contracts are located in the provinces of Shandong (Qingdao); Shanghai (Shanghai Spark Industrial Development Zone and Shanghai Chemical Industry Park); Guangdong (Tanzhou, Dongguan, Zhongshan, and Lian jiang); Liaoning (Shenyang, Panjin, and Changtu); Jilin (Siping); Henan (Zhengzhou); Hainan (Sanya); Hubei (Baoding); Jiangxi (Nanchang); Zhejiang (Xinchang); Tianjin; Xichuan (Chengdu and Chongqing); and Jiangxi (Nanchang).

Véolia Water has 15 years and $1 billion investment in China's water market, and has succeeded in joining or establishing 84 water supply and wastewater treatment plants. Véolia's most notable achievements also represent milestones in China's water market development. In 1998, Véolia Water won the first formal BOT project in China's water market to construct and operate the Sixth Chengdu Water Plant, and in 2002, Véolia acquired 50 percent of the assets of the Shanghai Pudong Water Supply Company. In the Shanghai project, Véolia Water became the first foreign company to be granted authority to participate in network construction and provide water supply to end users. Véolia Water is also active in China's wastewater treatment market. Véolia Water and the Beijing Municipal Drainage Co., Ltd., signed a BOT contract for the Beijing Lugouqiao wastewater treatment plant.

Thames Water won its first water treatment BOT contract (20-year term) in Shanghai, with a total investment of $68 million in 1995. In 2002, Thames Water strategically invested $70 million to purchase 48.9 percent of the shares of a water company registered in Hong Kong so that it could win water projects in seven Chinese cities, including Shenyang, Shaoxing, and Taixing.

Berlin Water, Germany's largest water company, holds a commanding market presence in China. Entering China's water market in 1998, Berlin Water has participated in the construction and operation of water supply and wastewater treatment plants in Tianjin, Xi'an, Chongqing, Shanghai, Nanchang, and Xiamen. Recently, Berlin Water invested in the construction of the Qingshanhu Wastewater Treatment Plant in Nanchang, Jiangxi Province. The treatment capac-

ity of this project is 1 million cubic meters per day, and the total investment for Phase I is $36.2 million. In May 2003, Berlin Water established a joint venture water company in the Tianjin Economic Development Area. The joint venture company plans to invest $100 million to construct wastewater treatment facilities.

In addition to the above-mentioned companies, other international water companies have established niche positions in China's water market. A British company, Anglian Water International invested $12.1 million in Taizhou Water Plants. Singapore RB Environmental Protection Ltd. Co. won authorization to construct and operate municipal wastewater treatment plants. The total project investment includes three parts: $13.2 million to purchase an existing wastewater treatment plant, $22.9 million for the Phase II construction, and $20.4 million to construct piping networks.

Water and Wastewater Treatment Technology and Equipment Supply

China started importing water and wastewater treatment technologies and equipment upon receiving multilateral or bilateral loans for China's public utility sector. For the multilateral loan projects, the imported product suppliers are subject to international bidding for the award of contracts. In contrast, the contract conditions for bilateral loans are "tied," and require the project to purchase the needed technology and equipment from the country providing the loan. Canada, Denmark, Germany, Japan, the Netherlands, Norway, Spain, Sweden, and the United Kingdom effectively used bilateral loans to increase their technology and product exports to China.

Imported technologies and equipment are extensively used throughout China, especially in many large-scale municipal water and wastewater treatment plants, such as Beijing's Gaobeidian Municipal Wastewater Treatment Plant. Complete sets of technology and equipment—that is, the technology and equipment that can provide the whole spectrum service for a complete water treatment project—have the best sales record.

Many foreign companies have established branches, representative offices, or wholly owned subsidiaries in China to gain a strong competitive position in China's water and wastewater treatment markets. For example, a U.K.-based company opened a wholly owned water treatment subsidiary and won more than 40 contracts in China over the past six years in municipal water supply, wastewater treatment, and other industrial sectors. Bilateral loans were the primary financing mechanism for these projects and served as a strong incentive to award the contracts.

The poor quality and performance of most domestic water and wastewater treatment technologies and products give foreign advanced products an advantage for successful entry into the Chinese market. Foreign companies that specialize in producing robust quality products achieve excellent sales in China. Imported equipment with a solid reputation and good market share in China include the following:

- German metering devices and pumps
- Japanese integrated water or wastewater treatment equipment and membranes
- French wastewater treatment technology and water supply technology and related equipment
- Canadian small, turnkey wastewater treatment facilities
- Australian filtration equipment, including sand filtration equipment
- Israeli water-saving equipment and other sorts of filtration equipment

Market shares of different countries in China's water and wastewater treatment sector in the past three years are as follows: Australia, 4 percent; Canada, 6 percent; Japan, 10 to 20 percent; and the United States, 15 percent. The European Union has a 50 percent market share.

Japan was the largest bilateral provider of loans in the environmental sector to China over the past six years. For environmental protection, the loans provided by Japan accounted for about 30 percent of total loans to China by all bilateral and multilateral lenders from 1996 to 2000. However, Japan's export market share for water and wastewater treatment products was only 10 to 20 percent. Japanese companies now mainly provide

their services to Japanese-related projects in China and avoid the high cost of open competition with Chinese companies. Relatively few Japanese companies expanded their services to non-Japanese-related projects to increase their market share.

Germany is the second largest bilateral loan provider in the environmental sector to China. Germany's export market share in the water and wastewater treatment sector was estimated at 10 to 17 percent from 1996 to 2000. German exports to China improved, with market share increasing to 15 to 22 percent in the past three years. From January to June 2003, the German mechanical products exported to China increased by 36 percent over the previous year. China became the third largest country to receive mechanical product exports from Germany, just behind the United States and France.

France is a large bilateral loan provider to China. France not only supplies technology and equipment, but also provides large-scale investment and operation services in the Chinese water supply and wastewater treatment sector.

U.S. Market Position

In China's water and wastewater treatment market, U.S. companies are actively involved in investment, technology and equipment supply, and engineering services. U.S. companies' share in China's water market is generally less than the combined market share of French, U.K., and German water companies; however, U.S. companies have established their own strategic positions in this field.

More than 15 large U.S. investment groups or companies are active in the Chinese water market. One U.S. company established an office in Beijing, invested $400 million in Qingdao and Shanghai, and plans to invest $18.2 billion in China's public infrastructure and environmental protection. Another U.S. company invested $60 million in water and wastewater treatment since entering China in 1997. The company plans to invest $30 million to $50 million in infrastructure projects every year, including water and wastewater treatment projects.

In water and wastewater treatment projects, six large companies won projects in the industrial and municipal sectors. In 2000, a U.S. company won the first wastewater treatment BOT project in the Beijing area to build a municipal wastewater treatment plant with a capacity of 100,000 cubic meters per day in an economic development zone. The total investment was $24.2 million.

Other U.S. water and wastewater treatment BOT projects under way include the following:

- **Li County Water Plant.** The total investment for this plant is $14 million, total water supply capacity is 100,000 cubic meters per day, and the authorized operation period is 30 years.
- **Jieyuan Water Plant Renovation.** This plant provides drinking water for 1.2 million citizens. The total investment of this project is $46 million, the total water supply capacity of the plant is 500,000 cubic meters per day, and the authorized operation period is 20 years.
- **Xilang Wastewater Treatment Project.** This project includes a wastewater treatment plant with a capacity of 200,000 cubic meters per day. The total investment of this project is $120 million, and the authorized operation period is 20 years.
- **Tongzhou District Wastewater Treatment Plant.** The total investment amount is $20.5 million, and the treatment capacity of this plant is 100,000 cubic meters per day.

Besides BOT, international cooperation is another entry method for entering the Chinese water and wastewater treatment market. One U.S. company cooperated with a local firm, and in September 2003 won a $3.25 million contract for the Zhengzhou Wulongkou Wastewater Treatment Plant.

U.S. companies participated in water and wastewater treatment projects in more than 300 cities by supplying equipment and technology or serving as subcontractors for special engineering sections, including more than 100 medium-sized and large water and wastewater treatment projects. This underlines the fact that many of China's water supply and wastewater treatment plants utilized

imported equipment. For example, between 1991 and 2000, about 90 percent of the equipment used in large or medium-sized wastewater treatment plants was imported. From 1996 to 2000, U.S. exported products may have accounted for more than 26 percent of the imported market share in the Chinese water and wastewater treatment sector.

During the last three years, however, the U.S. share of the Chinese market for water and wastewater treatment equipment has decreased. Estimates place this decreased share at less than 15 percent. This may be due to:

- Large quantities of the imported U.S. equipment are supplied through projects won in international public bidding.
- Loans to China from the World Bank related to urban construction, environment, and water supply decreased from an average $381.9 million per year during the 1996–2000 period to $135.17 million per year during the 2001–2003 period.

In China's water and wastewater treatment market, U.S.-made products are primarily instrumentation, electrical equipment, auto-control devices, and pumps. The United States recently exported numerous types of industrial wastewater treatment equipment and technologies into China. U.S. technology and equipment enjoy a good reputation in China, and the U.S. market share of technology and equipment exports could increase as more U.S. companies decide to enter the Chinese water market.

End User Analysis

Municipal End Users

Municipal Water and Wastewater Treatment End Users. Municipal water supply end users in China include private citizens, industry, commerce, educational and other institutions, and the government. Municipal wastewater treatment end users include private citizens, industry, commerce, educational and other institutions, the government, and farmers.

Chinese citizens expect high water quality and low water tariffs and wastewater discharge fees. Before the 1990s, when water was not treated as a commodity, water tariffs were extremely low, and there were no wastewater discharge fees. People were more concerned with water quality than with the price and quantity they used. Because of rising water prices, citizens now pay close attention to water consumption costs as well as to water quality. They expect higher prices to accompany water quality improvements. Most citizens understand why water tariffs and levies for wastewater discharges are rising, and they can afford the current water prices. Water tariffs in many cities are expected to rise in concert with citizens' ability to pay. Some people with higher incomes are even willing to pay more for high water quality that meets the "direct from the tap" potable standard. Poorer citizens, however, may find that water consumption costs account for a large portion (more than 20 percent) of their incomes. These citizens will try to reduce their water consumption and will prefer a supply system in which the water price is very low.

Citizens' awareness of environmental protection is much higher than 10 years ago. Chinese citizens know that the wastewater they produce needs to be treated and that they need to pay for the treatment cost. They do not mind who provides the water plant investment and the technology used as long as the water supply is safe and as long as the price and quality are reasonable.

The commerce, education, and government sectors make up a major proportion of water consumers in China, primarily using water to drink, wash, clean, and cook in hotels and restaurants. These consumers have a similar attitude to water supply and wastewater treatment as citizens, although the commerce sector pays higher fees than citizens. Therefore, some commercial organizations with large water consumption are very price sensitive. They have taken measures to conserve water or increase their service fees to customers while acknowledging that water prices may continue to rise.

The government position, except when it is a water consumer, considers economic development, efficient water resource usage, social stability, and environmental protection to be the most important issues aside from price. The government's overall objective is to achieve a proper balance

among water price, citizens' expectations, a prosperous water market, and further economic development.

New water tariff reforms and pricing systems will definitely bring changes to the social and economic life of end users. Already water prices have increased several times, and authorities have started to levy wastewater treatment fees in all cities.

The public's attitude toward water resources is expected to shift toward water conservation measures and is reflected in the actions of all citizens. Understandably, the public wants the best service at the lowest possible price.

Reused Water End Users. The construction of large and medium-sized municipal wastewater reclamation projects and small-scale gray water treatment and reuse projects in buildings and residential areas means a larger volume of reusable water will be available in the future. Municipal wastewater reclamation end users target groups are industry, municipal departments, and farmers. For industrial users, reused water can be used as cooling and production water. For municipal departments, reused water can be used for lawn irrigation and dust control. In residential buildings, reused water can be used for toilets. Citizens are potentially the largest group of end users. However, the basic requirements for all of these end users are low price, proper quality, and sanitation.

At present, municipal reused water is priced in only a few cities. The price of reused water varies from $0.12, $0.13, and $0.14 per cubic meter in Beijing, Tianjin, and Xi'an, respectively. In all cases, the price is lower than that of fresh water. The current price of fresh domestic water in Beijing is $0.35 per cubic meter and is expected to increase to $0.56 per cubic meter in the near future. The price of fresh water for industrial users is even higher. The obvious price gap between fresh and reused water should make reused water more appealing for end users.

Sanitation will be the primary concern for most end users. Although the existing technologies can ensure that treated wastewater meets relevant sanitary standards, consumers will still have some hesitation about using reused water for household needs and even for crop irrigation. To expand the reused water market, wastewater reclamation projects must offer reasonable guarantees to end users.

State-Owned Enterprises and Government-Owned Corporations

Water Supply. State-owned companies can be small, medium-sized, or large enterprises and municipal water supply facilities. Either the municipal water supply system or their own water plants provide the water used by companies. All the water supply facilities are state-owned property, but companies are authorized to conduct their own operation and maintenance. All companies take water supply very seriously, because it directly influences product quality. Typically, water quality and quantity demands depend on the company's production processes. Some companies can use municipal water directly, while some do not require high quality and can use treated surface water. Firms that use surface water usually need special water treatment technology and equipment. Some firms, such as those in the electronic and food industries, require high-quality water treatment technology and equipment to produce pure water.

Many large companies have their own water treatment plants, similar in scale to some municipal water plants, allowing them to control the water quality to meet production requirements. These companies may need municipal water only for sanitation purposes. Some firms are located far from urban centers and must build their own water supply plants. These enterprises treat their water supply plant as a factory or workshop and require a wide array of water treatment technologies and equipment to help them maintain treatment standards and efficiency.

Large and medium-sized companies that use municipal water supply take many measures to reduce water consumption because of the projected water price increases. These firms seek water-saving technologies and equipment to upgrade their production methods to achieve this goal. Unfortunately, many small firms are poor economic performers and lack the financial ability to upgrade production methods to achieve water savings.

Municipal water supply companies aim to treat raw water to meet the Chinese national standard and supply this water to their end users. These firms face many challenges to develop their businesses because of the water tariff reforms, the overall market approach of this sector, and an extremely large water demand in the country. All these challenges simultaneously represent excellent opportunities for these firms to rapidly expand and realize a good financial return. Factors challenging these opportunities for domestic companies include limited capital; worn-out water supply facilities, including piping networks; inefficient management and operation systems; low-quality domestic equipment; and the entry of very large international water groups into China's water market. U.S. companies can increase their market share by helping municipal water supply firms meet these challenges by assuming a cooperative and win–win business strategy.

Wastewater Treatment. Chinese law requires industrial wastewater to be treated in the factory before it is discharged into the municipal sewage system. Pollution prevention projects are also required to be implemented simultaneously with the construction of main projects. In principle, enterprises that discharge pollutants must have wastewater treatment plants.

Most state-owned enterprises are large or medium-sized. They generally take the relevant environmental regulations seriously. Some enterprises in good financial standing are willing to invest in wastewater treatment facilities and take every effort to keep the facilities in good condition. These enterprises are generally the main consumers of industrial water and wastewater treatment technology and equipment. Technology and equipment with high efficiency, low cost, high quality, and convenient operation will be of interest to them.

As previously discussed, municipal wastewater treatment represents an area of large growth potential in China. The existing municipal wastewater treatment companies are inadequate to meet the demand, and they face similar challenges and opportunities as the municipal water supply firms in growing and developing their business. Water tariff reforms, market reforms, and increasingly large wastewater treatment demand provide excellent opportunities for fast growth and good investment returns. Limited capital, low-technology facilities, inefficient management and operation systems, poor quality domestic equipment, and the entry of large international water groups into China's water market represent large challenges for domestic firms. U.S. companies should find opportunities to increase their market share in this sector by assuming a cooperative business strategy with existing municipal wastewater treatment firms in China. Given the current domestic market situation, municipal wastewater treatment firms are poised to be in high demand of capital, technology, and equipment to overcome these challenges.

Water Reuse. At present, industrial water reuse consists mainly of cooling water recycling. In some cities, reused water from municipal wastewater reclamation plants is distributed as industrial water (see Table 2.11). According to the current water pricing system, fresh industrial water is priced higher than domestic water (that is, municipally produced potable water for domestic use). Given its lower price, reused water is expected to play a major role in the development of state-owned industries in China. Power plants and steel plants, which have large water consumption demands, represent the largest potential market for reused water.

Private Enterprises

Water Supply. Private enterprises tend to be small and medium-sized operations in China. Like state-owned enterprises, either municipal piping systems or enterprise-owned water plants provide their water. Water supply facilities are owned by the enterprises.

Private enterprises also take water supply seriously when considering product quality and company profits. Many private enterprises now have good sales performance and, therefore, have some financial ability to upgrade the production process to conserve water. These companies are beginning to demand all kinds of water-saving technologies and equipment and are potential buyers of new industrial water treatment equipment.

Wastewater Treatment. Private firms are also required to construct wastewater treatment facilities; however, private firms often ignore applicable

environmental regulatory standards. In addition, many private firms are small operations with insufficient capital to construct adequate wastewater treatment facilities. These companies are scattered across China, and in some regions they are the heaviest polluters.

Water Reuse. For private enterprises, the water reuse issue is similar to that for state-owned enterprises.

Agricultural End Users

Most households in rural areas still use private wells or water supply systems; however, small village water supply projects have been constructed in some areas. Some of these projects are demonstration projects supported by the World Bank. Small water purification facilities and equipment are needed to service these areas.

Rural areas do not have sewage systems, and almost all of the domestic wastewater and runoff are discharged directly to the surface water. This situation has led to serious non-point pollution in many areas. The absence of infrastructure creates demand for small-scale wastewater treatment facilities; however, the demand exists only at a very low level. Some household stock farms need wastewater treatment and biogas collection and usage systems.

Conclusion

Advanced technologies and management skills that can ensure good quality service and lower production costs offer the biggest advantages in China's new competitive market environment. Currently, foreign investment, technology, and equipment have performed robustly in China's water and wastewater treatment sectors. Foreign company involvement in the market is now well accepted by both the public and the government.

CHAPTER 4

Market Access

Import Climate

China's Accession to the World Trade Organization

After China's World Trade Organization (WTO) accession in 2002, the preferential fields in the environmental sector that are opening to international competition are (a) environmental services and (b) environmental protection investment and financing. China's commitment on the market entry and civil treatment in the environmental services sector is conditional, as detailed in Table 4.1.

In the environmental protection investment and financing markets, the Chinese government has generally opened the water supply and wastewater treatment infrastructure market to international competition.

The water supply and wastewater collection piping system remains a restricted investment sector. It is mandatory for a Chinese company to hold the joint-stock company that conducts construction and operation of the water supply and wastewater collection piping network.

According to China's commitment on imported commodities, the customs duties on most environmental protection products are decreasing in 2004. The degree of reduction depends on the type of product. For instance, the tariff on water treatment separation machinery is decreasing from 12 percent to 10 percent.

Following China's WTO accession and some government policy changes, there is a notable change in the environmental investment and financing market in the country. Foreign participation in the investment, construction, and operation of the water market is now very active.

Unlike the environmental investment and financing market, WTO accession has not had an immediate and obvious influence on China's environmental protection equipment industry. Very low product prices and lower service prices still offer continuing advantages to use domestic products rather than imported products. Also, domestic technology and products have improved over the past 10 years, further strengthening their position. Despite local advantages, however, some technologies and equipment from developed countries have been imported and distributed in China.

Government Policies that Encourage or Restrict Imports

The Chinese government enacted the following three policies in 2002 to promote foreign capital involvement in China's water and wastewater treatment sector:

1. **Decisions on Accelerating the Market Conversion of Municipal Public Utilities,** enacted December 2002 by the Ministry of Construction. In this decision, the Chinese government encourages social and foreign capital to participate in the construction and operation of municipal public utilities through wholly foreign-owned enterprises, joint venture company, or cooperation agreements.

Table 4.1
China's World Trade Organization Commitment on Environmental Services

Environmental Service	Service Content	Restriction of Market Entry	Restriction of Civil Treatment
Delivery across frontiers	Service is provided across frontiers from one member country to another member country	Limited only in environmental consultation services	No restriction
Consumption from abroad	The consumer of one member country purchases the service in another member country	No restriction	No restriction
Commerce establishment	The external service supplier establishes a business organization such as a branch, agent, or subsidiary holding company and operates the business	Allowed only if the foreign service supplier provides the environment service in the form of a joint venture company; majority shareholding by the foreign company allowed	No restriction
Movement of foreign nations	A nation from one member country provides services in the other member country	No commitments other than horizontal commitments	No commitments other than horizontal commitments

Source: China Association of Environmental Protection Industry, Guidebook on the Market Supply and Demand of China Environmental Industry (Beijing, December 2002), page 255.

2. **Notice on Accelerating the Industrialization of Municipal Wastewater and Wastes Treatment,** enacted September 2002 by the former National Planning and Development Committee, Ministry of Construction, and State Environmental Protection Administration. In this notice, the state supports the registered leading corporation of municipal wastewater treatment projects in absorbing foreign capital, including foreign loans. The government will provide a transparent and equitable market environment for domestic and foreign investors who intend to invest in and operate wastewater treatment facilities.
3. **Foreign Investment Industry Guideline,** effective April 2002, enacted by the former National Planning and Development Committee, the former State Economy and Trade Committee, and the former Ministry of Foreign Trade and Economic Cooperation.

The third policy, the guideline for foreign investors, lists encouraged water and wastewater treatment industries, as follows:

Production and manufacturing:

- Water treatment agent
- The control and distribution system, including equipment fabrication for long-distance water diversion project
- Municipal wastewater treatment equipment with a capacity of 80,000 cubic meters per day and above, industrial wastewater membrane treatment equipment, upflow anaerobic fluidized bed equipment, and other biological wastewater treatment equipment
- In-line water quality monitoring device fabrication and water-saving irrigation technology and equipment fabrication

Water production and supply:

- Municipal water plant construction and operation

Social service:

- Wastewater treatment facility construction and operation
- Environmental information consultation and service

Research and technology development:

- Seawater desalination and use

The main restriction, in the social service sector, applies to the construction and operation of water supply and wastewater collection network in large and medium-sized cities, unless the Chinese partner holds the joint-stock company.

Notably, the construction of municipal water supply networks, which was previously restricted to foreign investment, is now open with certain restrictions. Foreign investment can be involved in the entire process of water production, distribution, and sales. Through constructing new piping systems or retrofitting aging ones, foreign investors can more effectively control overall production and operation costs that lay a foundation for better financial returns.

Business Practices and Options

U.S. companies can choose to enter China's water and wastewater treatment market in several ways.

Water Market Investment

Three arrangements are possible for water market investment:

1. **Build-operate-transfer method.** At present, the build-operate-transfer (BOT) method is the most popular investment method in China's water and wastewater treatment market. Through the BOT investment mode, the Chinese government intends to absorb foreign capital and advanced technology and equipment into the construction of new wastewater plants and the retrofitting of old water and wastewater treatment facilities. The most significant issue for BOT project negotiations is investment return. Previously, the government promised a fixed, relatively high payback, which ensured stability. However, because of an increasingly mature financial market, the government can no longer agree to fixed paybacks. Flexible negotiation strategies need to be applied to secure BOT projects.
2. **Joint venture.** Joint ventures are very common in China's water market. Foreign investors acting alone are not permitted to hold complete control of municipal water and wastewater treatment plants. Under most situations, a Chinese partner is required to control the operation and facilities, making a joint venture a suitable option for public water infrastructures. Local water companies are normally good partners, because they usually have good relationships with local administrative authorities, such as the environmental protection bureau, and they are familiar with the Chinese market. Recently, large domestic water companies were established in Beijing (Beijing Jingcheng Water Co., Ltd., with the registered capital of $490 million); Shanghai (Shanghai Water Affairs Capital Management Co., Ltd., with the registered capital of $1.09 billion); and Shenzhen (Shenzhen Water Company, with the registered capital of $720 million). Cooperation with local water companies undoubtedly increases the ability of foreign companies to compete in the Chinese market.
3. **Cooperation.** Others partnership arrangements are also possible, depending on local conditions.

Water and Wastewater Treatment Technology and Equipment Sales

Several strategies are possible for water and wastewater treatment technology and equipment sales:

- **Technology and equipment export.** The export of technology and equipment is the most readily acceptable and accessible investment strategy for foreign companies to

undertake. Risk is low and long term. Most export opportunities result from the international bidding of multilateral loan projects or appointed purchasers of bilateral loan projects. U.S. companies are active in international bidding and have won some of these contracts in China.

- **Trading companies.** Generally, foreign companies are not permitted to directly engage in trading in China. The exception is the direct marketing of a portion of the products manufactured in China or the establishment of wholly owned foreign trading companies in some free trade zones, with limited access to markets outside these zones. Accordingly, U.S. exporters need to set up a joint venture trading company in which the U.S. exporter can hold the majority shareholding. Alternatively, they may use a domestic Chinese agent to both import into China and market within China. Such trading companies must be authorized by the central or provincial government to handle exports and imports and to sign import and export contracts.
- **Local agents.** In addition to trading companies, many local sales agents handle internal distribution and marketing. Most of these firms do not have import–export authorization, and they are the next link down the distribution chain, buying imported products from those that do have import–export authorization. The local sales agents may be representative offices of foreign trading companies or domestic Chinese firms with regional or partial national networks. Beijing, Shanghai, and Guangzhou could be chosen as basic entry points, given their geographic position and significant roles in China's economic development.
- **Representative offices.** Representative offices are the easiest type of offices for foreign firms to set up in China; however, they can perform only limited tasks, such as liaison activities, according to Chinese law. As such, they cannot sign sales contracts, directly bill customers, or supply parts and after-sales services for a fee. Most representative offices, however, perform these activities in the name of their parent companies. Establishing a representative office gives a company increased control over its sales and permits greater use of its specialized technical expertise.
- **Chinese subsidiaries.** A locally incorporated equity or cooperative joint venture with one or more Chinese partners or a wholly foreign-owned enterprise may be the next step in developing markets for a company's products. With local production, companies can avoid import restrictions, including tariffs, and can obtain greater control over both intellectual property and marketing.

Environmental Service in the Water Sector

A joint venture is a good option for providing engineering design, construction, and operation services for water and wastewater treatment in China. Foreign companies gain access to a lower-priced labor source, and the license to perform design, construction, and operation can also be easily obtained. At present, this type of license is not awarded directly to wholly foreign-owned companies. Cooperation with local institutes or engineering companies is a good way to enter this market and also facilitates business development in local areas.

Foreign Private-Sector Involvement in Water Treatment and Supply

All of the investment, product sales, and service modes described earlier in this chapter are suitable for foreign private companies. The best mode is technology and equipment export to China, considering potential investment risk. Projects supported by multilateral or bilateral loans are the main business opportunities.

The active water and wastewater treatment market in China provides major investment opportunities for U.S. companies; however, the issue of investment risk is notable. In China's water market, the biggest risk may come from the gov-

ernment's intervention and policy decisions. Variation in water prices is a major factor to be considered. The levels of water fees and tariffs are the main drivers of financial returns, and the government could decide to cap water pricing to maintain social stability. This possibility will increase if there is a perceived conflict between public affordability and business ambitions to accelerate an increase in prices. A BOT investment has similar risks. At present, no special government-enacted BOT regulations or policies exist. The government's commitment, therefore, becomes the critical factor in weighing the total investment risk. In this scenario, private investors are advised to pay close attention to the contract conditions, including water pricing in BOT negotiations.

Financing

U.S. Government Resources

U.S. firms can choose from several U.S. government sources to develop their business opportunities in China:

Export–Import Bank of the United States. The Export–Import Bank (Ex–Im Bank) facilitates the export of U.S. goods and services by providing loans, guarantees, and insurance for export sales. The major features of the program are (a) a short-term environmental export insurance policy to provide enhanced short-term support for small business exporters and (b) enhanced medium- and long-term support for environmental projects, products, and services. The Ex–Im Bank now accepts guarantees from three Chinese financial institutions: the Bank of China, the People's Construction Bank of China, and the Industrial and Commercial Bank of China. The Ex–Im Bank can be contacted at:

Export-Import Bank of the United States
811 Vermont Avenue, NW
Washington, DC 20571
Phone: (202) 565-3946 or (800) 565-3946

U.S. Trade and Development Agency. The U.S. Trade and Development Agency (TDA), an independent U.S. government agency, provides grant funding for studies to determine the technical, economic, and financial feasibility of major infrastructure and industrial projects in developing and middle-income countries. TDA funds feasibility studies, conducted by U.S. companies, to get the U.S. private sector in on the ground floor of projects that have the potential to generate significant exports of U.S. goods and services. By providing assistance in project planning, TDA promotes economic development while helping the U.S. private sector get involved in projects that offer significant U.S. export opportunities.

Water pollution is one of TDA's priorities for China. From 2002 to the present, TDA-funded projects related to water and wastewater treatment include a Beijing water reuse conference, a World Bank Shanghai urban environmental project, feasibility studies for Changzhou and Chongqing wastewater treatment plant projects, and plans for a Jiangsu environmental monitoring system.

TDA can be contacted as follows:

U.S. Trade and Development Agency
1000 Wilson Boulevard, Suite 1600
Arlington, VA 22209
Phone: (703) 875-4357
Fax: (703) 875-4009
E-mail: *info@tda.gov*

U.S. Small Business Administration. The small business program encourages private lenders to make loans of up to $750,000 to borrowers who could not borrow on reasonable terms without government help. The U.S. Small Business Administration's Web site is *www.sba.gov/ak/index.html*.

Multilateral and Bilateral Lending Programs

Financial assistance in the form of investment loans from the World Bank (WB), the Asian Development Bank (ADB), and the Japan Bank for International Cooperation (JBIC) traditionally accounted for about 80 percent to 90 percent of total official international financial flows in recent years. Apart from these three major loan channels, loans from other international organizations or countries—such as the United Nations (UN), the Global Environment Facility (GEF), the United

Kingdom, Germany, and Canada—have also contributed to China's development.

The environmental protection sector is the long-term priority of all the providers of multilateral and bilateral loans or grants. From 1987 to 2001, 45 environmental protection projects, with a total investment sum of $5.55 billion, were funded proportionally by the WB (49.7 percent), the ADB (23.9 percent) and the JBIC (26.4 percent), respectively. Urbanization and environmental issues will be the major targets for foreign loans and grants in the next couple of years, as is consistent with China's state development strategy.

World Bank. China is the WB's largest borrower, with loans funding China's pollution prevention and control totaling $2.0 billion. From 2002 to 2004, an annual lending program of about $1.2 billion to $1.3 billion is anticipated. Urban projects focused on environmental mitigation (water, sanitation, and air pollution) account for 24 percent of the 2002–2004 lending program. During the 2003 fiscal year, the urban development projects of Tianjin, Shanghai, and Liaoning were awarded $460 million. During the 2004 fiscal year, the urban development projects of Zhejiang and Hunan, plus the Tai Lake water quality project, will receive $400 million. During 2005, $500 million will go toward Chongqing's small cities urbanization and environmental protection, Shanghai's urban management, and Henan's water supply projects for medium-sized cities.

Asian Development Bank. According to its operational strategy for China, the ADB is paying increased attention to China's urban development, including providing an adequate supply of clean water and reducing water pollution. The 2004 loans will be awarded to the Henan Hai River wastewater treatment ($100 million) and the Fuzhou environmental treatment improvement ($100 million) projects. In 2005, loans will be awarded for water supply and sewerage system development projects in Jilin Province ($100 million) and for the Shandong Haihe water pollution treatment project ($100 million). Loans in 2006 will be awarded for the Guangxi Nanjing urban infrastructure development project ($100 million) and the Anhui Hefei urban environment improvement project ($150 million).

Japan Bank for International Cooperation. The JBIC is the executive institute for Japan's government development aid. China is the Japanese loan's largest borrower. The priority sectors for China include environmental protection, agriculture, medical care, and intellectual training. Before 1998, Japanese loans had funded approximately 40 percent of the total wastewater treatment capacity of 11 million cubic meters per day. An April 2003 agreement contracted a $1.1 billion loan to be mainly used for six environmental protection projects in the provinces of Anhui, Hunan, Hubei, Gansu, Guangxi, and Inner Mongolia.

United Nations. The United Nations Industrial Development Organization (UNDIP) will invest $30 billion in wastewater treatment for Chinese cities over the next 10 years. More detailed plan or project information is not available at present.

Global Environment Facility. The Global Environment Facility (GEF) is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. In the 2004, a GEF lending program of about $17 million is focused on Hai River basin pollution control in China.

Other Bilateral Loan Programs. Many other countries, including Australia, Canada, Denmark, Germany, Norway, Sweden, and the United Kingdom, provide loans and grants to China for water and wastewater treatment projects. This aid is intended to help their own domestic firms enter the Chinese market and is not accessible to investors from other countries.

Domestic Financing Resources

Domestic financing channels are available for domestic companies and enterprises. Foreign investors and foreign companies can access domestic loans through joint ventures. The primary domestic financing channels include state bonds, State Development Bank loans, commercial loans, and listed stock companies.

State Bonds. State bonds are awarded to key state projects with a total investment that exceeds $12.1 million. Large municipal infrastructure construction is a priority market for state bonds. Both

water supply and wastewater treatment plants have been funded by state bonds; however, large wastewater treatment plants in key state pollution control areas or key cities offer the best opportunity to access state bonds. The construction of 19 wastewater treatment plants located in the Three Gorges area attracted $180 million, accounting for 65 percent of the total investment. State bonds also funded the ongoing construction of three wastewater treatment plants in Beijing.

State Development Bank. Different from a commercial bank, the State Development Bank (SDB) is a policy bank that provides long-term, large-sum loans at low interest rates. The total amount of an SDB loan may reach $1 billion. The priority sectors are state infrastructure and fundamental industries. SDB loans have been awarded to construct municipal water supply and wastewater treatment facilities.

Commercial Bank Loans. The four major commercial banks in China are the People's Construction Bank of China, the Industrial and Commercial Bank of China, the Bank of China, and the Agriculture Bank of China. These commercial banks provide loans to construct water supply and wastewater treatment facilities. Several examples of significant loans are listed below.

- The People's Construction Bank of China loaned a total $240 million to the Beijing Municipal Drainage Co., Ltd., before 2008 to build municipal wastewater treatment plants in Beijing.
- The Agriculture Bank of China, in cooperation with the Ministry of Construction, is lending $3.62 billion over the next 10 years for infrastructure construction in small cities, including water supply, wastewater collection, and wastewater treatment.
- The Bank of China and the Industrial and Commercial Bank of China are providing a $13.18 million loan for a wastewater treatment project in Hebei Province.

The Stock Market. The stock market is another effective financing source for water projects in China. Nearly 20 companies in China's stock market have participated in water market investment. In 2002, of the five companies whose core business is in the water sector, their earnings per share were 1.75 times that of the whole stock market, and their profit margin reached 57.92 percent. This indicates a potential realizable return of water sector investment through the stock market and suggests that the stock market represents a major potential source of financing.

Foreign investors still encounter some practical difficulties in directly entering China's stock market. Although foreign-owned companies are permitted to enter domestic stock markets according to China's policy, there are no such cases at present. Some foreign companies have found it feasible to purchase partial shareholdings of Chinese listed companies.

CHAPTER 5

Trade Promotion Opportunities

Trade Shows and Exhibitions in China

Every year numerous international environmental protection exhibitions are hosted in China, mainly in Beijing, Shanghai, Tianjin, and Guangzhou. The most important exhibition is the China International Environmental Protection Exhibition and Conference (CIEPEC) that is held regularly in Beijing and attracts worldwide interest. Detailed information about CIEPEC and some international exhibitions to be held in China in 2004 are described below.

China International Environmental Protection Exhibition and Conference

CIEPEC originated in 1986 and is sponsored by the China State Environmental Protection Administration (SEPA). It is the largest professional environmental protection exhibition in China, with the longest history and best quality. It has been successfully hosted on seven occasions.

CIEPEC attracts the mainstay environmental enterprises in China and reflects the overall technology level and development situation of China's environmental protection industry. Recently, more foreign environmental enterprises with advanced technologies and equipment have been participating in this significant exhibition.

Through CIEPEC, the foreign exhibitors gain a further understanding of Chinese environmental policies and measures on environment quality management and sustainable development. They also learn about key environmental projects and investment fields, as well as make contact with Chinese counterparts to find suitable partners and opportunities to enter China's market.

CIEPEC provides a forum for international exchange and communication among environmental enterprises and organizations in China and from abroad. CIEPEC, as a channel to the Chinese environmental market, can open opportunities for foreign environmental companies.

The Eighth China International Environmental Protection Exhibition and Conference was held Dec. 15–18, 2003, in Beijing. The profile covered municipal domestic wastewater treatment technology and equipment, industrial wastewater treatment technology and equipment, environmental monitoring and analysis, ecological rehabilitation and protection, environmental management and service, energy efficiency, and cleaner production.

CIEPEC 2003 attracted the support of many foreign governments and organizations. According to the organizers' news release, more than 10 foreign government agencies organized opportunities for environmental protection companies in their own countries to exhibit at CIEPEC 2003. Those agencies included the U.S. Department of Commerce, Trade Partners U.K. and the U.K. Embassy, Industry Canada and the Canadian Embassy, the Japan Society of Industrial Machinery Manufacturers, the Korea Environmental Industry Association, UBI France and the French Embassy, the German Federal Environmental Agency, the Spanish Embassy, the Italian Ministry of Environment and Territory and Italian Trade Commission, FINPRO and the Finnish Embassy, and the Polish Embassy. Approximately 160 inter-

national companies registered to exhibit including, among others, 16 Canadian companies, 6 Finnish companies, 22 French companies, 10 German companies, 7 Hong Kong companies, 18 Korean companies, 14 U.K. companies, and 8 U.S. companies. In addition to these international companies, 272 domestic companies and manufacturers registered for the exhibition. The list of international companies is shown in Box 5.1.

For more detailed information concerning CIEPEC, contact :

Mr. Su Fan
Phone: +86-10-68393245, 68393827
Fax: +86-10-68393748
Website:*www.chinaenvironment.com/ciepec2003/*
E-mail: *ciepec@163.net*

Regional Opportunities and Projects in China

China continues to implement a policy of intensive development. The major resource-driven regions in China are described below, and key projects are listed in Appendix A.

National Western Development

Great Western Region covers the provinces of Xinjiang, Inner Mongolia, Tibet, Qinghai, Ningxia, Gansu, Shaanxi, Sichuang, Yunnan, Guizhou, and Guangxi, as well as Chongqing Municipality. The economic status in these regions is generally undeveloped. To improve China's economic and social development level, the central government stipulated the National Western Development Strategy and offers preferential policies for the development of this area. Consistent with China's policy, the Western Region is also regarded as a priority region by international organizations, such as the World Bank and the Asian Development Bank. Both water supply and wastewater treatment infrastructures are badly needed to fulfill key features of the development goals. Detailed project information is described in Chapter 2.

The institution responsible for implementing the National Western Development Strategy is the Office of the Leading Group for Western Region Development of the State Council. More detailed information is available at: *www.chinawest.gov.cn.*

South-to-North Water Diversion Project

The construction of the South-to-North Water Diversion Project creates a large water supply and wastewater treatment market. In the water destination areas, including Beijing, Tianjin, Hebei, Henan, Shandong, and Jiangsu, the construction or expansion of water plants and piping systems offers market opportunities valued at $6.09 billion and $5.92 billion, respectively. In addition, water pollution control is a major part of the eastern route project, and an investment of $1.93 billion is planned for the construction of municipal wastewater treatment plants. These projects are located in Jiangsu, Shandong, Hebei, Tianjin, Anhui, and Henan provinces. Projects with investment value greater than $12 million are highlighted in Appendix A.

Three Gorges Watershed Area

The Three Gorges area is located in Yichang, Hubei Province. To maintain the acceptable water quality levels, wastewater treatment projects are to be implemented in Hubei, Sichuan, Guizhou, Yunnan provinces and Chongqing Municipality. From 2003–2005, 77 projects with $860 million total investment will be constructed, and from 2006–2010, China plans another 146 projects with a total budget of $930 million. Detailed project information is not available at present, although Chongqing Municipality is constructing the following four wastewater treatment plants before 2005: Jingkou, Zhongliangshan, Qiezixi, and Lijiatuo.

Beijing 2008 Olympic Games and Jing-Jin-Tang Economic Delta. Jing-Jin-Tang Economic Delta covers Beijing, Tianjin, Tangshan, Qinhuangdao, and Tanggu in Hebei Province. The future prosperity and development of this area relies on the significant position of Beijing, China's national political and cultural center. In 2002, Beijing's gross domestic product (GDP) was $37.8 billion, and the per capita GDP was $3.35. Economic prosperity has brought rapid development of municipal infrastructure construction.

Box 5.1

CIEPEC 2003 International Exhibitors

Australia	Measurement Analysis China
Canada	Canadian Government Pavilion
	CanTech Plus (Hong Kong) Ltd.
	Ecolo Odor
	EcoSmart
	Hatch
	Hydroclave
	Jacques Whitford Environmental Ltd.
	JR Labs
	Metafix
	New East Consulting
	Ozomax
	Reap Canada
	Resources Future International (RFI)
	Richway
	TIR Systems Ltd.
	Zenon
Denmark	Novozymes Biotechnology Co., Ltd.
Finland	Ekokem Oy
	Finnchain Oy
	Finn Katalyt Oy
	Ideachip Oy
	Proventia Automotion Oy
	Proventia Solutions
France	Addes
	Ademe
	CDEE
	Dhesdin S.A.
	Faure Equip
	Fluides & Automation
	Galicier
	Groupe ATI
	INSA
	Lyon Chamber of Commerce and Industry
	Masterflex
	Millennium Chemicals
	Millennium Shanghai Chemicals Trading Ltd.
	Mixel S.A.
	Oriam/Ducamp Group
	Paris Ile de France—Beijing Jo
	Shanghai Michelin Warrior Tire Co., Ltd.
	TECESM
	Tecofi S.A.
	UBI France
	Véolia Environment
	Vichem
Germany	BENE Separa
	EnviroSystems Engineering & Technology Co., Ltd.
	Federal Environmental Agency
	GDW-Brocoo
	HAMMEL Recycling GmbH
	KWH Katalysatoren GmbH
	Lodige Maschinenbau GmbH
	Netzsch (Lanzhou) Pumps Co., Ltd.
	Seeper GmbH and Co. Shanghai Representative Office
	SICK MAIHAK (Beijing) Co., Ltd.
Greece	Shanghai HiTeC Plastic Co., Ltd.
Hong Kong	Element-Flash (Hong Kong) Ltd.
	Euro-Tech (China) Ltd.
	Jenbacher East Asia Ltd.
	Keppel Fels China Ltd.
	New Star Environmental
	Shinnichi Mechanical & Electrical Equipment (S.Z.) Co., Ltd.
	Sino-German Countertrade Ltd.
Malaysia	Guolene Plastic Films Sdn. Bhd.
Netherlands	CN-NL Waste Solution Co., Ltd.
Poland	Economic and Commercial Section, Embassy of Poland
Russia	NPO LIT
South Korea	Bluebird Co., Ltd.
	Bogo Global Corporation
	Daewoo Engineering & Construction Co., Ltd.
	Environmental Vision 21 Ltd.
	ENVIROTECH Co., Ltd.
	Greensys Co., Ltd.
	H2L Co., Ltd.
	Halla Energy & Environment
	Hansung Cleartech Co., Ltd.
	Jesagi Hankook Ltd.
	Kenvitech
	KOCAT Inc.
	Korea–China Environmental Industry Center
	Korea E.P. Co., Ltd.
	Korea Power Engineering Co., Inc.

Continued on page 54

Box 5.1—*continued*

	Korea Resources Recovery and Reutilization Corporation
	Sambo EN-Tec Co., Ltd.
	TASET Inc.
Sweden	PURAC
Switzerland	Result Technology A.G.
United Kingdom	Business Link North Manchester
	Cambridge Environmental Research Consultants Ltd.
	Department of Trade and Industry
	Environlink Northwest
	Ecosecurities Ltd.
	Garrad Hassan and Partners Ltd.
	Gill Instruments
	Micorbac Ltd.
	Millenniumpore Ltd.
	Mono Pumps Limited
	National Physical Laboratory
	Technogen U.K. Ltd.
	U.K. Trade and Investment, Joint Environmental Markets Unit Renewable, U.K.
	Wastegen (U.K.) Ltd.
United States	Asia Pacific Environmental Technology Inc.
	BGI Instruments
	Earth Tech Inc.
	JWC Environmental
	LightStream Technologies
	Lincolne Scott Inc.
	Met-Pro Corporation
	NAICC Co., Ltd.
	State of Hawaii, Department of Business, Economic Development, and Tourism
	U.S. Embassy-Commercial Service
Other	Ample Technology Instruments Co., Ltd.
	Bene Abwassertechik GmbH
	Environmental Technology (Publications) Ltd.
	HiTeC Plastic Co., Inc.
	Hongyuan Zhongsheng Technology Co., Ltd.
	JCE Environmental Technology Co., Ltd.
	KWH
	Naichi Pumps
	North American Apparatus

Beijing, as the host city for the 2008 Olympic Games, has ambitious plans to develop its wastewater treatment infrastructure from now to 2008. According to the Beijing City Planning Department, nine wastewater treatment plants, 1,000 kilometers of wastewater main pipelines, nine wastewater reclamation and reuse facilities, and four sludge digesting facilities will be completed. The total investment will be $1.45 billion.

As the main water receiving areas of the South-to-North Water Diversion project (middle route), Beijing, Tianjin, and Hebei must construct or expand water plants with a total investment of $2.19 billion, and construct piping systems with a total investment of $2.07 billion. The detailed project information is not available at present.

Shanghai–Yangtze Economic Delta. The Shanghai–Yangtze Economic Delta, covering Shanghai, Jiangsu, and Zhejiang provinces and 100,000 square kilometers, accounts for 2.2 percent of China's total area. Although the population of this area accounts for only 10.6 percent of China's total population, the GDP is almost 20 percent of the national GDP. The next five years will bring rapid urbanization, with a huge demand for municipal infrastructure.

Shanghai, the famous economic center in China, now plans to increase its municipal wastewater treatment rate from the current 55 percent to 70 percent in 2005 and 80 percent in 2010. A total investment of $3.62 billion is estimated to achieve the 2010 target. Recently, Shanghai started the preparations for a Phase III wastewater treatment project, with $580 million total investment. The main facilities include the following:

- 197 kilometers of sewage pipeline
- 83 kilometers of storm-water collection pipeline
- 10 storm-water pumping stations
- 13 sewage pumping stations
- 1 wastewater treatment plant with a capacity of 500,000 cubic meters per day

Pearl River Economic Delta. With Hong Kong and Shenzhen as contiguous economic areas, the Pearl River Economic Delta covers the cities of Guangzhou, Dongguan, Foshan, Jiangmen, Zhongshan, Huizhou, and Gaozhou. It was the first area opened to outside investment in the early 1980s and has made a significant contribution to national economic development. In 2001, the GDP of $110.6 billion was created in the Pearl River basin area of Guangdong Province, accounting for 86.8 percent of Guangdong Province's total GDP and 9.5 percent of the GDP throughout China. Economic prosperity led to severe pollution in the Pearl River, especially in the sections near cities and towns. Worse than Class V water standard occurred in the Dongguan Canal, Guangzhou River Section, Shenzhen River, and Foshan Watercourse.

According to the Guangdong Pearl River Water Environment Comprehensive Pollution Control Plan, the municipal wastewater treatment rate in 2001 was 18.7 percent. For cities in the Pearl River Economic Delta, the planned treatment rate is to reach 50 percent in 2005 and 70 percent in 2010. The total planned investment from 2003 to 2010 is about $5.43 billion for all the pollution control projects. Guangzhou's projects include the following:

- The expansion project of Datansha Wastewater Treatment Plant (220,000 cubic meters per day)
- The expansion project of Liede Wastewater Treatment Plant (220,000 cubic meters per day)
- The Li'an Wastewater Treatment Plant expansion (200,000 cubic meters per day)
- The Xilang Wastewater Treatment Plant expansion (200,000 cubic meters per day)
- 19 new sewage pumping stations
- 209 kilometers of new sewage pipeline

Industry Reconstruction in the Three Provinces of Northeastern China

In August 2003, the central government formally started the reconstruction in three provinces in Northeast China: Liaoning, Jilin, and Heilongjiang provinces. These three provinces are the traditional large industrial manufacturing zones in China, and they contributed greatly to China's industrialization and development in the 1950s and 1960s. Recently, inefficient industry structures and aging technology and equipment have significantly slowed the development of these provinces, resulting in the poor condition of both industrial and municipal infrastructures. The planned industry reconstruction offers opportunities to renovate or construct industrial water supply and wastewater treatment facilities and encourages the development of municipal water supply and wastewater treatment infrastructure.

Harbin, the capital of Heilongjiang Province, did not have a municipal wastewater treatment plant until the Wenchang Wastewater Treatment Plant was put into operation in 2003. Current active projects here include the following:

- The Taiping Wastewater Treatment Plant (325,000 cubic meters per day, with a biological secondary treatment process)
- The expansion of Wenzhang Wastewater Treatment Plant (165,000 cubic meters per day, with a biological secondary treatment process)
- The Hejiagou Qunli Wastewater Treatment Plant (200,000 cubic meters per day, with a biological secondary treatment process)

The Harbin Water Supply and Sewage Group is responsible for these projects. Market mechanisms, such as build-operate-transfer, are being introduced to construct and operate these projects.

CHAPTER 6

Case Studies of Successful Projects with Foreign Participation

The construction and rebuilding of municipal infrastructures in China is developing rapidly, particularly in the water supply and wastewater treatment sectors. The problem of an acute shortage of capital has been encountered throughout China, even in relatively economically developed areas, such as Beijing and Shanghai. Despite financing difficulties, advanced foreign technologies and management experience are badly needed in China. The Chinese government's water reform policy is intended to encourage foreign investors to participate in China's water market by expanding foreign investors' opportunities and by creating favorable conditions for investors and the economic and social development of China.

In China's water market transformation process, the preferred method of foreign investment is build-operate-transfer (BOT). In a BOT arrangement, the government awards operational authority for the project to companies or investment agencies. The authorized party is responsible for the financing, design, construction, operation, maintenance, and management of the project during the contracted period. The BOT investment must simultaneously achieve return and profit during the operation period. At the end of the contracted operation period, the facility is returned in good condition and working order (as prescribed in the contract) to the government.

Another method of operation used in China's water market is a partial merger and acquisition (M&A). Foreign investors purchase a part of the stock of a water plant and then participate in the rebuilding and operation of the plant. The two parties in the joint-stock company share the operations, risks, and profits.

Since the BOT method was first adopted for the Chengdu Water Supply Project in 1999, it has been widely used in many water supply and wastewater treatment projects. M&As in the water sector have also been actively applied during that time. Two successful cases, one a wastewater treatment BOT project, and the other a water plant acquisitions project, are described below.

Beijing Economic and Technological Development Zone Sewage Treatment Plant Project

Beijing Golden State Engineering & Technology Co., Ltd., a subsidiary company of a U.S. corporation, was awarded China's first municipal wastewater treatment BOT project in 2000. This municipal wastewater treatment plant is located in the Beijing Economic and Technological Development Zone.

The Beijing Economic and Technological Development Zone (BET Development Zone) is the sole state-level economic and technological development zone in Beijing, covering 6.8 square kilometers. The key industrial sectors include biological technology and medicine, digital technology and electronic information, electronic technology and photoelectric-machine integration, material technology, and new energy. A financial center, trading center, commercial center, gym, hospital, and other public facilities, along with the industrial

and residential areas, are also located in the BET Development Zone.

In 2000, the BET Development Zone Management Committee prepared to construct its first wastewater treatment plant. The decision-makers intended to attract investment and advanced technology through market competition. BOT was selected as the preferred construction and operation method for this project. Eventually, the Beijing Golden State Engineering & Technology Co., Ltd. (BJET) won the contract because of its advantages in treatment processes and its long-term solid reputation in China's domestic water engineering market.

According to the contract, a joint venture company formed between the BET Development Zone and BJET became the operator of the wastewater treatment plant. The treatment capacity of this plant is 20,000 cubic meters per day, with a total investment of $3.86 million. As agreed, BJET invested $3.14 million, while the BET Development Zone contributed the land-use right of the occupied land, worth $720,000. Both parties have the right to share profits from the project.

The contracted operation period for this project is 20 years. During the operation period, the profits derive from levying wastewater treatment fees in the BET Development Zone. When the operation period terminates, the capital assets and management authority will be transferred to the BET Development Zone Management Committee.

The contract was signed in September 2000. One year later, the construction of the wastewater treatment plant was completed, and it was put into test run in December 2001. On March 29, 2002, the project passed inspection and obtained approval to operate from the local environmental protection administrative authorities. The wastewater treatment fee was priced at $10.3 per cubic meter. Capital investment is to be recouped within 10 years.

This project represents a successful BOT case in the wastewater treatment sector. Through this project, the BET Development Zone introduced foreign capital, advanced technology, and management experience into the infrastructure construction and operation, thus effectively solving the problems of scarce capital and environmental pollution. BJET is expected to make a good financial return from this investment.

The relatively high wastewater treatment fee is the notable factor for generating profits in this case study. The wastewater in the BET Development Zone is mainly industrial wastewater discharged from the enterprises located in the BET De velopment Zone. These enterprises are generally good business performers, making the wastewater treatment fees affordable for them. Thus, the BET Development Zone Management Committee priced the fee at $0.13 per cubic meter, much higher than the typical $0.04 per cubic meter for domestic water consumers as dictated by Beijing policies. The higher price provides the basis for a sound return on the company's investment.

The director of BJET stated that it would take a long time to recover the investment for environmental infrastructure type projects, and the profit margin was not high; however, the investment risk was lower than investments in other sectors.

From this case, it is clear that success in BOT-type wastewater treatment projects will mainly depend on wastewater treatment fees. A rational and higher price leads to successful business operations. The collection of wastewater treatment fees can be guaranteed only in areas with good economic success. A cautious approach should be taken for BOT investment projects in undeveloped areas.

Shanghai Pudong Water Supply Plant Acquisitions Project

In May 2002, only one month after the government opened the municipal water distribution sector to foreign investors, Vivendi Water, a subsidiary of Vivendi Environment, won the acquisition of the Shanghai Pudong Water Plant through an international tender competition.

Pudong, already one of the leading business and financial centers in Asia, has approximately 1.71 million residents now, and forecasts indicate that the population will increase to 5 million in the future. The service area of the Pudong Water Plant covers many commercial buildings and residential complexes, the new Shanghai international airport,

and numerous business parks located in the Pudong area.

Vivendi Environment began working on water supply projects in China in the 1980s. Vivendi Environment, through its subsidiary company Vivendi Water, successfully built and operated water plants in Tianjin, Chengdu, and many other cities, while establishing a good working relationship with the Chinese government and a good reputation in China's water market. These factors, together with Vivendi Water's powerful technical and financial capabilities, are the key factors that helped Vivendi Water successfully tender bids.

Vivendi Water paid about $240 million to purchase 50 percent of the government-owned stock of the Shanghai Pudong Water Co. to establish an equal-share joint venture water plant, named Shanghai Pudong-Vivendi Water Corporation Ltd. The contract term is 50 years. During the contract term, Vivendi Water is authorized to operate and manage Pudong's water supply services. The joint venture currently has six subsidiary companies: Pudong Water Plant, Linjiang Water Plant, Lingqiao Water Plant, a customer service center, a pumping station management center, and Pumao Engineering Company. The staff total is 1,205, the water production capacity is 1.27 million cubic meters per day, and the water supply service area is 319 square kilometers. Through this project, Vivendi became the first foreign company with authority to provide full services, including drinking water production, network distribution, and customer services. This accomplishment represents a milestone in China's water market development. For Vivendi, it represents a long-term profitable business opportunity.

According to a Vivendi expert, the profit in the operation of the water network distribution is more attractive than the limited profit in the water plant operation. The water leakage loss rate of China's water supply network is estimated to be at least 30 percent. If the water leakage loss rate is reduced by 1 percent, the profit will proportionally increase. Foreign investors who are interested in the operation of China's water supply network should consider these important factors.

The Shanghai government transferred the entire Pudong water supply operation to the Vivendi joint venture company without any profit margin guarantees. The profit margin depends entirely on the efficient operation of the joint venture company and the development of the Pudong area. In addition, the price of water to consumers is a major risk for Vivendi. The government sets pricing; however, reasonable costs and profits are the government's long-term principles when establishing water prices. This policy is reinforced in the relevant regulations enacted by the former National Planning and Development Committee and the Ministry of Construction. Therefore, if Vivendi can operate the water supply system effectively and efficiently, and if the Pudong economy grows, this water pricing policy risk may not be detrimental to Vivendi over the long term.

Conclusion

Financial rewards in the Chinese water sector will only come from strategic long-term investment and business performance, and investors with strong investment and management experience and skills will be able to grasp the opportunities and avoid potential risks to achieve success in China.

APPENDIX A

Key Projects Seeking Foreign Investment and Cooperation

Water Supply Projects

No. 1:	**Reconstruction of Baicheng Water Supply Piping System**
Location:	Baicheng City, Jilin Province
Status:	Under engineering design stage
Total investment:	$1,380,000
Funding source:	State bond ($460,000), city financial department ($460,000), other sources (460,000)
Cooperation form:	Joint venture, cooperation, or build-operate-transfer (BOT)
Brief description:	The water supply piping system, with the total length of 92.37 kilometers, will be reconstructed to serve the water supply capacity of 80,000 cubic meters per day.
Comment:	The construction of this project will start in 2004 and finish in 2006.
Contact:	Urban Construction Bureau of Baicheng City Person in charge: Leng Youchun Phone: +86-436-3242966 Fax: +86-436-3240684 Postal code: 137000 E-mail: *lengyouchun@hotmail.com*

No. 2:	**Reconstruction of Xinxiang Water Supply Piping System**
Location:	Xinxiang City, Henan Province
Status:	Feasibility study report submitted for approval
Total investment:	$1,730,000
Funding source:	Commercial bank loan (840,000), other sources (890,000)
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The project includes the reconstruction of a 64.5-kilometer piping system, of which 15.5 kilometers will use DN1000 pipe.
Comment:	The construction of this project will start in 2003 and finish in 2005.
Contact:	Rural Construction Bureau of Xinxiang City Person in charge: Mr. Deng Sen Phone: +86-373-2075266 Fax: +86-373-2052202 Postal code: 453000

No. 3:	**Reconstruction of Qionghai Water Supply Plant**
Location:	Qionghai City, Hainan Province
Status:	Feasibility study report submitted for approval
Total investment:	$1,760,000
Funding source:	State aid ($970,000), commercial bank loan ($500,000), other sources ($300,000)
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of the planned project is 50,000 cubic meters per day. This project has requirements for pumps, valves, metering devices, a chlorine dosing facility, and automatic control devices.
Comment:	The construction of this project starts in 2003 and finishes in 2005. It is estimated that the investment will be returned in 10 years.
Contact:	People's Government of Qionghai City Person in charge: Guo Xing Phone: +86-898-62830230 Fax: +86-898-62838440 Address: Qionghai Water Supply Corporation, Qionghai City, Hainan Province Postal code: 571400

No. 4:	**Wenchang City Water Supply Plant Expansion Project**
Location:	Wenchang City, Hainan Province
Status:	Under design stage
Total investment:	$1,450,000
Funding source:	State bond ($1,000,000), other sources ($450,000)
Cooperation form:	Joint venture or cooperation
Brief description:	The capacity of this expansion project is 50,000 cubic meters per day. This project will purchase pumps, valves, metering devices, a chlorine dosing facility, and control equipment.
Comment:	It is estimated that the construction term will be three years, and the profit margin will be 8.01 percent.
Contact:	Water Supply Company of Wenchang City Person in charge: Yun Yaqing Phone: +86-898-63222702 Fax: +86-898-63222702 Postal code: 571300

No. 5:	**Jinan Donghu Water Supply Project**
Location:	Jinan City, Shandong Province
Status:	Information not available
Total investment:	$96,500,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	This is a project related to the South-to-North Water Diversion Project (eastern route). This project is to supply industrial and domestic water to the eastern suburb of Jinan City, with the capacity of 83 million cubic meters per year. This project consists of five subprojects: water diversion, water reservoir, water conveyance, water purification, and water distribution. The water purification plant has the capacity of 300,000 cubic meters per day.

Contact:	Jinan Donghu Water Supply Project Management Office Person in charge: Zhu Dantong Phone: +86-531-8909066 Fax: +86-531-8909366 Address: 40 Honglou South Road, Jinan City, Shandong Province Postal code: 250100

No. 6:	**Beijiao Water Supply Plant**
Location:	Taierzhuang District, Zaozhuang City, Shandong Province
Status:	Information not available
Total investment:	$6,700,000
Funding source:	Information not available
Cooperation form:	Joint venture
Brief description:	The capacity of this project is 50,000 cubic meters per day, with groundwater as the water source. This project includes the development of 7–10 wells with a depth of 150 meters and the production capacity of 5,000–7,000 cubic meters per day. Equipment includes a pressure pumping station, two clear water tanks with the capacity of 4,000 cubic meters, a chlorine treatment facility, and an analysis center. A 10,050 meter piping system (950 meter using 800 millimeter cast iron pipe and 9,100 meter using 200 millimeter cast iron pipe) will be installed.
Contact:	Taierzhuang Water Supply Plant, Zaozhuang City Person in charge: Cao Fengzhong Phone: +86-632-6611956 Address: Yanhe South Road, Taierzhuang District, Zaozhuang City, Shandong Province Postal code: 277400

No. 7:	**Anqiu City Shibei Water Supply Project**
Location:	Anqiu City, Shandong Province
Status:	Information not available
Total investment:	$8,300,000
Funding source:	Information not available
Cooperation form:	Cooperation
Brief description:	The capacity of the planned plant is 80,000 cubic meters per day. The project mainly includes the construction of a 10-kilometer water supply piping system, two sedimentation systems, two clarifier systems, one filtration system, and other purifying facilities.
Comment:	The construction term will be two years. Annual operation revenue will be $965,000. The return period of the investment is expected to be about 10 years.
Contact:	Anqiu Water Supply Plant Person in charge: Liu Yongchun Phone: +86-536-4221637 Address: 14 Xiangyang Road, Anqiu City, Shandong Province Postal code: 262100

No. 8:	**Second Xintai Water Supply Plant**
Location:	Xintai City, Shandong Province
Status:	Information not available
Total investment:	$7,000,000
Funding source:	Information not available
Cooperation form:	Cooperation
Brief description:	The capacity of the planned water supply plant is 50,000 cubic meters per day. The water treatment process includes clarification, filtration, and sterilization.
Comment:	The construction term is two years. Annual operation revenue will be $2,500,000. The return term of the investment is planned to be five years.
Contact:	Xintai Water Supply Plant Person in charge: Qiao Fangtao Phone: +86-538-7222575 Fax: +86-538-7222575 Address: 9 Yuanlin Road, Xintai City, Shandong Province Postal code: 271200

No. 9:	**Taian Huangqian Water Supply Plant Expansion Project**
Location:	Taian City, Shandong Province
Status:	Information not available
Total investment:	$4,820,000
Funding source:	Information not available
Cooperation form:	Joint venture or cooperation
Brief description:	The project is mainly to construct a water-conveying pipeline from the Huangqian to the Sanhe Water Supply Plant. The pipeline is 1,000 millimeters in diameter and 18 kilometers in length. The capacity of the existing water supply plant will be expanded from the current 50,000 cubic meters per day to 100,000 cubic meters per day.
Comment:	After the expansion project is completed, the annual sales revenue will be increased by $2,386,000, and the annual profit will be increased by $145,000.
Contact:	Taian Water Supply Plant Person in charge: Zheng Guangping Phone: +86-538-6993516 Fax: +86-538-6993533 Address: 157 Dongyue Street West Section, Taian City, Shandong Province Postal code: 271000

No. 10:	**Binzhou West Suburb Water Resources and Water Supply Project**
Location:	Binzhou City, Shandong Province
Status:	Information not available
Total investment:	$19,300,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The planned water supply project is to supply 60,000 cubic meters per day of industrial water and 40,000 cubic meters per day of domestic water. The project mainly includes the construction of an inlet gate and channel, a one-stage pump station, a sedimentation system, a double-valve filtration system, a clean water basin, a two-stage pump station, and a water-conveying pipeline.
Contact:	Binzhou Water Supply Plant

	Person in charge: Song Jianhua Phone: +86-543-3262594 Fax: +86-543-3262594 Postal code: 256600
No. 11:	**Fuyang Water Supply Plant**
Location:	Hengshui City, Hebei Province
Status:	Most parts of the project finished
Total investment:	$15,463,000
Funding source:	Chinese side ($2,410,000), foreign side ($9,640,000), commercial bank loan ($3,413,000)
Cooperation form:	Cooperation and joint venture
Brief description:	The capacity of the planned project is 100,000 cubic meters per day, including three main parts: a water inlet, water transmission, and water purification.
Contact:	Fuyang Water Supply Plant Persons in charge: Jia Bingkun and Liu Junhua Phone: +86-318-2315961 Fax: +86-318-2315961 Address: 310 Xinya'Mansion, Renmin Road, Hengshui City, Hebei Province Postal code: 0530001
No. 12:	**Linzhang County Water Supply Plant Expansion Project**
Location:	Linzhang County, Hebei Province
Status:	Provincial planning commission approved the feasibility report
Total investment:	$10,952,200
Funding source:	County government ($4,900,000), foreign fund ($6,000,000), other sources
Cooperation form:	Information not available
Brief description:	The capacity of the expansion project is 50,000 cubic meters per day. The project includes the development of 29 deep wells with depths between 350 meters and 500 meters, the construction of four clean water tanks with the capacity of 2,000 cubic meters, the installation of sterilization equipment, and the construction of a water inlet well and 65,800 meter pipelines DN200–DN1000).
Contact:	Municipal Administration of Linzhang County Person in charge: Du Yufeng Phone: +86-310-7865729 Address: Ximen Street, Linzhang County, Hebei Province Postal code: 056600

Wastewater Treatment Projects

No. 1:	**Luohe City Wastewater Treatment Plant**
Location:	Luohe City, Henan Province
Status:	Under feasibility study stage
Total investment:	$1,090,000
Funding source:	City financial department ($360,000), other sources ($720,000)
Cooperation form:	BOT

Brief description:	The capacity of the planned wastewater treatment plant is 80,000 cubic meters per day. Wastewater treatment equipment, such as various types of screens, is needed.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Environmental Protection Bureau of Luohe City Person in charge: Mr. Guo Liansheng Phone: +86-395-2123267 Fax: +86-359-2124024 Postal Code: 462000

No. 2:	**Baicheng Wastewater Treatment Plant**
Location:	Baicheng City, Jilin Province
Status:	Under feasibility study stage
Total investment:	$2,310,000
Funding source:	City financial department ($1,220,000), commercial bank loan ($1,090,000)
Cooperation form:	Information not available
Brief description:	The capacity of the planned wastewater treatment plant will be 50,000 cubic meters per day; oxidation ditch treatment will be used in this project. Key equipment will be imported.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Urban Construction Bureau of Baicheng City Person in charge: Leng Youchun Phone: +86-436-3242966 Fax: +86-436-3240684 Postal code: 137000 E-mail: *lengyouchun@hotmail.com*

No. 3:	**Binhu and Chengbei Wastewater Treatment Plants in Wuxi City**
Location:	Wuxi City, Jiangsu Province
Status:	Bid invitation
Total investment:	Information not available
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of the planned Binhu Wastewater Treatment Plant is 50,000 cubic meters per day. The Chengbei Wastewater Treatment Plant project is an expansion project with the capacity of 50,000 cubic meters per day.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Wuxi Municipal Public Utility Group Co., Ltd. Persons in charge: Ms. Lijing and Mr. Wang Shuyi Phone: +86-21-62950006 Fax: +86-21-62786543 Address: Building 22, 322 Xianxia Road, Wuxi City, Jiangsu Province Postal code: 200336

No. 4:	**Jiaonan City Wastewater Treatment Plant**
Location:	Jiaonan City, Shandong Province
Status:	Feasibility study report submitted for approval
Total investment:	$1,420,000

Funding source:	City financial department ($220,000), commercial bank loan ($700,000), other sources
Cooperation form:	Joint venture, cooperation
Brief description:	The project includes two phases, and the Phase I project has a capacity of 60,000 cubic meters per day. An anaerobic-aerobic activated sludge nitrogen removal process will be applied in this project.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Urban and Rural Construction Bureau of Jiaonan City Person in charge: Mr. Xu Gongnong Phone: +86-532-6175180 Fax: +86-532-6175180 Address: Shandong Jiaonan Wastewater Treatment Plant, Jiaonan City, Shandong Province Project Management Department Postal code: 266400

No. 5:	**Piping System of Shangqiu Wastewater Treatment Plant**
Location:	Shangqiu City, Henan Province
Status:	Under design stage
Total investment:	$1,450,000
Funding source:	Information not available
Cooperation form:	Information not available
Brief description:	The total length of the pipeline is nearly 33 kilometers. Four pumping stations will be constructed simultaneously.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Shangqiu City Wastewater Treatment Plant Person in charge: Liu Min Phone: +86-370-3218769 Fax: +86-370-3225800 Postal code: 476100

No. 6:	**Reconstruction of Xinxiang Wastewater Discharge Piping System**
Location:	Xinxiang City, Henan Province
Status:	Under feasible study stage
Total investment:	$18,383,000
Funding source:	City financial department ($1,130,000), commercial bank loan ($1,090,000), other sources
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	Reconstruction of a 141.2-kilometer piping system, and construction of pumping stations with the capacity of 52,000 cubic meters per day.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Rural Construction Bureau of Xinxiang City Person in charge: Mr. Zhang Weicheng Phone: +86-373-3356887 Fax: +86-373-3356887 Address: 56 Laodong Northern Road, Xinxiang City, Henan Province Postal code: 453000

No. 7:	**Xinxiang Wastewater Treatment Plant Expansion Project**
Location:	Xinxiang City, Henan Province
Status:	Under design stage
Total investment:	$1,980,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of 150,000 cubic meters per day will be expanded in Xinxiang Wastewater Treatment Plant. Simultaneously, a 10.4-kilometer piping system will be constructed. An anaerobic-anoxic-aerobic activated sludge process will be applied in the expansion project.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Rural Construction Bureau of Xinxiang City Person in charge: Mr. Zhang Weicheng Phone: +86-373-3356887 Fax: +86-373-3356887 Address: 56 Laodong Northern Road, Xinxiang City, Henan Province Postal code: 453000

No. 8:	**Xinxiang Wastewater Treatment Pipeline Network Project**
Location:	Xinxiang City, Henan Province
Status:	Under design stage
Total investment:	$2,330,000
Funding source:	City financial department ($1,170,000), commercial bank loan ($1,090,000), other sources
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	This project includes the construction of two wastewater pumping stations with the capacity of 11.4 cubic meters per day, two storm-water pumping stations with the capacity of 45 cubic meters per second, a wastewater pipeline network 23.26 kilometers in length, and a storm-water pipeline network 38.81 kilometers in length.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Rural Construction Bureau of Xinxiang City Person in charge: Mr. Zhang Weicheng Phone: +86-373-3356887 Fax: +86-373-3356887 Address: 56 Laodong Northern Road, Xinxiang City, Henan Province Postal code: 453000

No. 9:	**Baoan District Wastewater Treatment Plant**
Location:	Baoan District, Shenzhen City, Guangdong Province
Status:	Feasibility study report submitted for approval
Total investment:	$2,720,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of the planned plant is 150,000 cubic meters per day. Secondary treatment will be applied with the modified anaerobic-anoxic-aerobic activated sludge process as the main process.
Comment:	The construction will start in 2005 and finish in 2007.

Contact:	Environmental Protection Bureau of Baoan District, Shenzhen City Person in charge: Wu Lanping Phone: +86-755-27875819 Fax: +86-755-27875826 Address: Environmental Protection Bureau of Baoan District, Shenzhen City, Guangdong Province Postal code: 518101

No. 10:	**Guiyang City Wastewater Treatment Plant**
Location:	Guiyang City, Guizhou Province
Status:	Proposal submitted for approval
Total investment:	$1,000,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of the planned plant is 250,000 cubic meters per day.
Comment:	The construction will start in 2005 and finish in 2008. This project has requirements for pumps, an auto-control system, aerators, screens, and centrifugal machines. Key equipment will be imported.
Contact:	Construction Bureau of Guiyang City Person in charge: Huangjun, Zhou Huaizhi Phone: +86-851-5848376, 5824990 Postal code: 550004

No. 11:	**Pingxiang Wastewater Treatment Plant**
Location:	Pingxiang, Jiangxi Province
Status:	Under design stage
Total investment:	$1,430,000
Funding source:	Commercial bank loan ($600,000), city financial department ($830,000)
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of the planned plant is 160,000 cubic meters per day.
Comment:	The construction will start in 2003 and finish in 2005. According to the feasiblity study report, the return term of the whole investment is planned to be 7.5 years.
Contact:	Water Resource Bureau of Pingxiang City, Jiangxi Province Person in charge: Yuan Kaiguo Phone: +86-799-6782812 Postal code: 337000

No. 12:	**Qinhuangdao Shanhaiguan Wastewater Treatment Plant**
Location:	Shanhaiguan District, Qinhuangdao, Hebei Province
Status:	Under design stage
Total investment:	$11,875,000
Funding source:	Commercial bank loan ($600,000), other sources ($830,000), other sources
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The planned capacity of the plant's 60,000 cubic meters per day. Oxidation ditch technology will be applied, and the effluent can be reused as agriculture irrigation water and industrial water.

Comment:	The construction will start in 2004 and finish in 2008. Key equipment will be imported.
Contact:	Construction Bureau of Shanhaiguan District, Qinhuangdao Person in charge: Zhang Yue Phone: +86-335-5051588 Fax: +86-335-5165740 Postal code: 066000

No. 13:	**Quanzhou City Wastewater Treatment Plant Project (Phase II)**
Location:	Quanzhou City, Fujian Province
Status:	Bid invitation
Total investment:	$730,000
Funding source:	Investment
Cooperation form:	BOT
Brief description:	The capacity of the Phase II project is 100,000 cubic meters per day.
Comment:	The BOT model is to be applied in this project. The authorized operation period will be 25 years. The investors will be responsible for financing and construction.
Contact:	Water Purification Center of Quanzhou City Person in charge: Wan Dingfang Phone: +86-595-2553883 Fax: +86-595-2553883 Postal code: 350001

No. 14:	**Jingbian County Wastewater Treatment Plant**
Location:	Jingbian County, Shaanxi Province
Status:	Proposal submitted for approval
Total investment:	$1,090,000
Funding source:	Information not available
Cooperation form:	Joint venture or cooperation
Brief description:	The capacity of the planned plant is 45,000 cubic meters per day. Aerators, auto-control system, and pressure filtration machines are needed.
Comment:	The construction will start in 2003 and finish in 2007. It is estimated the financial return term will be 10 years.
Contact:	Environmental Protection Bureau of Jingbian County Person in charge: Sun Zhihe Phone: +86-912-4627762 Fax: +86-912-4622650 Postal code: 718500

No. 15:	**Xinyuan County Wastewater Treatment Plant**
Location:	Xinyuan City, Xinjiang Uighur Autonomous Region
Status:	Feasibility study report submitted for approval
Total investment:	$420,000
Funding source:	Information not available
Cooperation form:	Joint venture or cooperation
Brief description:	The capacity of the planned plant is 20,000 cubic meters per day and the total length of the planned piping system is 26.426 kilometers. In the treatment process, there are various screens, a pump room, a sedimentation tank, an

	aeration tank, a settling tank, a sludge concentration tank, a dewatering facility, and some auxiliary pipeline networks.
Comment:	The construction will start in 2003 and finish in 2005. The return term of the investment is planned to be six years.
Contact:	Xinyuan County Water Supply and Heating Company Phone: +86-999-5020598 Fax: +86-999-5020598 Postal code: 835800

No. 16:	**Ji'an City Wastewater Treatment Plant**
Location:	Ji'an City, Jiangxi Province
Status:	Under design stage
Total investment:	$1,760,000
Funding source:	Commercial bank loan ($840,000), other sources
Cooperation form:	Joint venture or cooperation
Brief description:	Oxidation ditch system will be applied as the treatment process. Other information is not available.
Comment:	According to the feasibility study report, the return term of the investment will be 13.27 years, with a stable return rate of 4.95 percent.
Contact:	Water Supply Company of Ji'an City, Jiangxi Province Person in charge: Liu Feng Phone: +86-796-8222739 Fax: +86-796-8222738 Postal code: 343100

No. 17:	**Yining City Wastewater Treatment Plant**
Location:	Yining City, Xinjiang Uighur Autonomous Region
Status:	Under design stage
Total investment:	$501,000
Funding source:	Information not available
Cooperation form:	Joint venture or cooperation
Brief description:	The capacity of the planned plant is 50,000 cubic meters per day. Oxidation ditch technology will be applied.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Yining City Frontier Economic Cooperation Company Person in charge: Chen Baodi Phone: +86-999-8141176 Fax: +86-999-8128184 Postal code: 835000

No. 18:	**Tianshui City Wastewater Treatment Plant**
Location:	Tianshui City, Gansu Province
Status:	Under feasibility study stage
Total investment:	$1,740,000
Funding source:	Information not available
Cooperation form:	Joint venture or cooperation
Brief description:	Cyclic activated sludge system (CASS) technology will be applied in the treatment process that includes various screens, a pump station, a sedimen-

	tation tank, a CASS tank, a settling tank, a sludge concentration tank, and a dewatering facility.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Construction Bureau of Beidao District, Tianshui City Person in charge: Ma Yanguang Phone: +86-938-2736749 Address: Tianshui City Wastewater Treatment Plant, Construction Management Office, Tianshui City, Gansu Province Postal code: 741020

No. 19:	**Changle City Wastewater Treatment Plant**
Location:	Changle City, Fujian Province
Status:	Under feasibility study stage
Total investment:	$554,000
Funding source:	Information not available
Cooperation form:	BOT
Brief description:	The capacity of the planned plant is 50,000 cubic meters per day.
Comment:	The construction started in 2003 and finish in 2005.
Contact:	Construction Bureau of Changle City Person in charge: Gao Xiaojian Phone: +86-591-3316804 Fax: +86-591-3375115 Address: Municipal Engineering Co., Ltd., Gongye Road 29, Fujian Province Postal code: 350004

No. 20:	**Ganyu County Wastewater Treatment Plant**
Location:	Ganyu County, Jiangsu Province
Status:	Under feasibility study stage
Total investment:	$676,000
Funding source:	Information not available
Cooperation form:	BOT
Brief description:	The capacity of the planned plant is 20,000 cubic meters per day. In the treatment process, the following equipment or facilities will be included: various screens, a pump station, a sedimentation tank, an oxidation ditch, a settling tank, a sludge concentration tank, and a dewatering facility. The key equipent will be imported.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Construction Bureau of Ganyu County Person in charge: Tian Qingbin Phone: +86-578-6212331 Address: Municipal Company, Ganyu County, Jiangsu Province Postal code: 222100

No. 21:	**Wuxi City Wastewater Treatment Plant**
Location:	Wuxi City, Jiangsu Province
Status:	Under design stage
Total investment:	$2,320,000
Funding source:	Information not available

Cooperation form:	Joint venture or BOT
Brief description:	The capacity of the planned plant is 100,000 cubic meters per day.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Environmental Protection Bureau of Huishan District, Wuxi City, Jiangsu Province Person in charge: Li Guangping Phone: +86-510-2459258 Fax: +86-510-2408647 Postal code: 214101

No. 22:	**Haikou City Wastewater Treatment and Piping System Project**
Location:	Haikou City, Hainan Province
Status:	Feasibility study report submitted for approval
Total investment:	$1,510,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	Market mechanisms will be introduced into this project. The planned piping system is 42.86 kilometers.
Comment:	The construction will start in 2003 and finish in 2005.
Contact:	Construction Bureau of Haikou City Person in charge: Wu Qingxiong Phone: +86-898-66264643 Fax: +86-898-66261470 Address: Wastewater Treatment Corporation, Renmin Street 89, Haikou City, Hainan Province Postal code: 570208

No. 23:	**Jieyang City Wastewater Treatment Plant**
Location:	Jieyang City, Guangdong Province
Status:	Design work in progress
Total investment:	$1,930,000
Funding source:	Information not available
Cooperation form:	Joint venture
Brief description:	The capacity of the planned plant is 21.9 million cubic meters per year.
Comment:	The construction will start in 2003 and finish in 2005. The return term of the investment is planned to be 16.73 years, with a stable return rate of 4.27 percent.
Contact:	Environmental Protection Bureau of Jieyang City Person in charge: Lin Dawei Phone: +86-663-8768584 Fax: +86-663-8768572 Postal code: 522000

No. 24:	**Xixia County Wastewater Treatment Plant**
Location:	Xixia County, Henan Province
Status:	Information not available
Total investment:	$728,000 (Phase I), $2,290,000 (Phase II)
Funding source:	Foreign investment of $480,000 is needed for Phase I project

Cooperation form:	Information not available
Brief description:	According to the plan for South-to-North Water Diversion Project, a wastewater treatment plant will be constructed in Xixia County. The capacity of the planned plant is 100,000 cubic meters per day. The capacity of Phase I project is 40,000 cubic meters per day.
Contact:	The Construction Administration Bureau of Xixia County Person in charge: Ye Xinxian Phone: +86-377-4663692

No. 25:	**First Jinan Wastewater Treatment Plant (Phase II)**
Location:	Jinan City, Shandong Province
Status:	Information not available
Total investment:	$54,000,000
Funding source:	Foreign investment of $12,000,000 needed
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The existing Phase I wastewater treatment facility, with the capacity of 220,000 cubic meters per day, needs renovation. A new secondary wastewater treatment system with the capacity of 360,000 cubic meters per day (Phase II project) will be constructed.
Contact:	Urban Construction Administration Bureau of Jinan City Person in charge: Zhang Hongkui Phone: +86-531-2059980 Fax: +86-531-2059962 Address: Jianshe Road 16, Jinan City, Shandong Province Postal code: 250021

No. 26:	**Loushanhe Wastewater Treatment Plant, Qingdao City**
Location:	Qingdao City, Shandong Province
Status:	Information not available
Total investment:	$61,000,000
Funding source:	Information not available
Cooperation form:	Cooperation or BOT
Brief description:	The capacity of the planned plant is 200,000 cubic meters per day. Both biological and chemical treatment will be applied in the process.
Contact:	Urban Administration Department of Qingdao City Person in Charge: Li Zhipeng Phone: +86-532-2865829 Fax: +86-532-2667751 Address: Yishui Road 7, Qingdao City, Shandong Province Postal code: 266071

No. 27:	**Jiaonan Wastewater Treatment Plant**
Location:	Jiaonan City, Shandong Province
Status:	Under feasibility study stage
Total investment:	$14,500,000
Funding source:	Foreign investment of $14,500,000 needed
Cooperation form:	Joint venture, cooperation, sole investment, or BOT
Brief description:	The capacity of the planned plant is 100,000 cubic meters per day. Secondary biological treatment will be applied. The project will construct a pump sta-

tion, a wastewater treatment system, a sludge disposal system, a treated water recycling system, and a water distribution network and wastewater collection system (1,200 meters long and 1,200 millimeters in diameter). All equipment and devices will be imported.

Comment: The construction and return terms of this project will be 2 and 12 years, respectively.

Contact: Urban and Rural Construction Bureau of Jiaonan City
Persons in charge: Lin Zhaode and Chi Yanzhi
Phone: +86-532-6163515, 5183217
Fax: +86-532-5181522
Address: Zhuhai Road 34, Jiaonan City, Shandong Province
Postal code: 266400

No. 28: **Zichuan Wastewater Treatment Project Engineering**

Location: Zibo City, Shandong Province
Status: Information not available
Total investment: $12,000,000
Funding source: Information not available
Cooperation form: Joint venture
Brief description: The project will be built up at the lower reach of Xiaofu River in Zichuan District, covering an area of 6 hectares. The capacity of the planned plant is 60,000 cubic meters per day. This project will construct or install various screens, pump station, sedimentation tank, aeration tank, settling tank, sludge concentration tank, dewatering facility, and some auxiliary pipelines.
Comment: It is expected that the construction term will be two years.
Contact: Urban Asset Management Company of Zichuan District, Zibo City
Person in charge: Li Jianmei
Phone: +86-533-5284150
Fax: +86-533-5281184
Address: Songlingdong Road 49, Zichuan District, Zibo City, Shandong Province
Postal code: 255100

No. 29: **Taoziwan Wastewater Treatment Plant**

Location: Yantai City, Shandong Province
Status: Information not available
Total investment: $57,300,000
Funding source: Foreign investment of $57,300,000 needed
Cooperation form: Joint venture, cooperation, or sole investment
Brief description: The capacity of the planned plant is 250,000 cubic meters per day: 210,000 cubic meters per day will be treated using a primary treatment process, and 40,000 cubic meters per day will be treated using a secondary treatment process. The effluent from the secondary treatment process will be reused in industrial sectors.
Contact: Urban Administration Bureau of Yantai City
Person in charge: Zhao Lijing
Phone: +86-535-6151758
Fax: +86-535-6151700

Address: Huanshan Road 88, Yantai City, Shandong Province
Postal code: 264001

No. 30: **Laishan Wastewater Treatment Project**
Location: Yantai City, Shandong Province
Status: Information not available
Total investment: $10,700,000
Funding source: Foreign investment of $10,700,000 needed
Cooperation form: Joint venture, cooperation, or sole investment
Brief description: The capacity of the planned plant is 40,000 cubic meters per day. In the treatment process, there are various screens, a pump station, a sedimentation tank, an aeration tank, a settling tank, a sludge concentration tank, a dewatering facility, and some auxiliary pipelines. This project is approved by the government of Shandong Province as a new project and is listed in the Wastewater Control Program around Bohai Gulf.
Contact: Construction Administration Bureau of Yantai City
Person in charge: Zhang Yuyan
Phone: +86-535-6905988
Fax: +86-535-6905999
Address: Dongfang Street 23, Laishan District, Yantai City, Shandong Province
Postal code: 264003

No. 31: **Laizhou City Wastewater Treatment Expansion Project**
Location: Laizhou City, Shandong Province
Status: Information not available
Total investment: $9,600,000
Funding source: Information not available
Cooperation form: Joint venture or cooperation
Brief description: The expansion project has a capacity of 50,000 cubic meters per day. In the treatment process, there are various screens, a pump station, an anaerobic tank, an oxidation ditch, a sludge concentration tank, a dewatering facility, and an auxiliary pipeline network with a total length of five kilometers.
Comment: It is estimated that the return term of the total investment will be 15 years.
Contact: Laizhou Wastewater Treatment Plant
Person in charge: Sun Yonghui
Phone: +86-535-2480149
Fax: +86-535-2211432
Address: Wenchangnan Road 50, Laizhou City, Shandong Province
Postal code: 261400

No. 32: **Haiyang City Wastewater Treatment Plant**
Location: Haiyang City, Shandong Province
Status: Information not available
Total investment: $7,800,000
Funding source: Information not available
Cooperation form: Joint venture, cooperation, or BOT
Brief description: The capacity of the planned plant is 50,000 cubic meters per day. In the treatment process, there are various screens, a pump station, a sedimentation tank,

	an aeration tank, a settling tank, a sludge concentration tank, a dewatering facility, and related piping systems.
Comment:	If the wastewater treatment fee is priced at $0.11 per cubic meter, it is estimated that the return term of the investment will be 12 years, with an internal return rate of 4.24 percent.
Contact:	Planning and Construction Administration Bureau of Haiyang City Person in charge: Qu Wenping Phone: +86-535-3221150 Fax: +86-535-3223009 Address: Hushan Road 994, Haiyang City, Shandong Province Postal code: 265100

No. 33:	**Zhucheng City Wastewater Treatment Expansion Project**
Location:	Zhucheng City, Shandong Province
Status:	Information not available
Total investment:	$15,000,000
Funding source:	Information not available
Cooperation form:	Joint venture
Brief description:	The capacity of the existing wastewater treatment plant will be expanded to 100,000 cubic meters per day.
Comment:	The construction term of this project will be three years, and the investment will be returned by collection of wastewater treatment fees and reclamation of wastewater as industrial water.
Contact:	Wastewater Treatment Administration Department of Zhucheng City Person in charge: Li Fashan Phone: +86-536-6118605 Fax: +86-536-6118657 Address: Wulipu Village, Misu Street, Zhucheng City, Shandong Province Postal code: 262200

No. 34:	**Gaomi City Wastewater Treatment Project (Phase II and III)**
Location:	Gaomi City, Shandong Province
Status:	Under feasibility study stage
Total investment:	$11,500,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The capacity of the existing plant will be expanded to 70,000 cubic meters per day. The Phase II project that will expand the current capacity to 20,000 cubic meters per day needs an investment of $3.1 million. The main treatment process includes various screens, a pump station, a sedimentation tank, an aeration tank, an oxidation ditch, a sludge concentration tank, a dewatering facility, and some auxiliary pipelines. The Phase III project with the capacity of 50,000 cubic meters per day needs $8.4 million and mainly includes a water collection pipeline, a pump station, various screens, a sedimentation tank, an aeration tank, an oxidation ditch, a sludge concentration tank, a dewatering facility, and some auxiliary pipe work.
Contact:	Gaomi City Water Supply Company Person in charge: Shan Jigang Phone: +86-536-2323435

Fax: +86-536-2323435
Address: Renmin Street 177, Gaomi City, Shandong Province
Postal code: 261500

No. 35: **Anqiu City Wastewater Treatment Plant**
Location: Anqiu City, Shandong Province
Status: Under feasibility study stage
Total investment: $13,550,000
Funding source: Foreign investment of $13,550,000 needed
Cooperation form: Joint venture, cooperation, sole investment, or BOT
Brief description: The capacity of the planned plant is 60,000 cubic meters per day. The treatment process mainly includes a screen, a pump station, a sedimentation tank, an aeration tank, an oxidation ditch, a settling tank, a dewatering facility, and some auxiliary pipelines.
Contact: Construction Administration Bureau of Anqiu City
Person in charge: Zhou Shouqing
Phone: +86-536-4321617
Fax: +86-536-4368009
Address: Middle Part of Jian'an Road, Anqiu City, Shandong Province
Postal code: 262100

No. 36: **Xinwen Wastewater Treatment Plant**
Location: Xintai City, Shandong Province
Status: Information not available
Total investment: $13,670,000
Funding source: Foreign investment of $13,670,000 needed
Cooperation form: Joint venture, cooperation, sole investment, or BOT
Brief description: The capacity of this planned plant is 50,000 cubic meters per day. The oxidation ditch system will be applied in the treatment process. This project has been listed in the pollution control program of the South-to-North Water Diversion Project (eastern route).
Comment: The construction term of this project will be four years. It is estimated the total investment will be returned in 15 years with an annual sales income of $2,217,000 and an internal return rate of 4.54 percent.
Contact: Xinwen Wastewater Treatment Plant Construction Management Office
Person in charge: Zhao Tianzeng
Phone: +86-538-7073257
Fax: +86-538-7073257
Address: Guoyuan Village, Subdistrict Office of Qing Street, Xintai City, Shandong Province
Postal code: 271200
E-mail: *Xtchzhm@263.net*

No. 37: **Liaocheng City Wastewater Treatment Plant (Phase II)**
Location: Liaocheng City, Shandong Province
Status: Information not available
Total investment: $9,800,000
Funding source: Foreign investment of $9,800,000 needed

Cooperation form:	Joint venture, cooperation, or sole investment
Brief description:	The capacity of the Phase II project is 50,000 cubic meters per day. A wastewater treatment system, a sludge treatment system, auxiliary facilities, and a pipeline network will be constructed. This project has been listed in the pollution control program of the South-to-North Water Diversion Project (eastern route).
Comment:	It is estimated that there will a return of $500,000 every year. The effluent will be reused as irrigation water.
Contact:	Construction Committee of Liaocheng City Person in charge: Jiang Yushang Phone: +86-635-8311421 Fax: +86-635-8311386 Address: Jiankang Road 46, Liaocheng City, Shandong Province Postal code: 252000

No. 38:	**First and Second Weihai City Wastewater Treatment Plant Renovation Project**
Location:	Weihai City, Shandong Province
Status:	Information not available
Total investment:	$15,660,000
Funding source:	Information not available
Cooperation form:	Joint venture, cooperation, or BOT
Brief description:	The first plant will be developed with a capacity of 45,000 cubic meters per day, out of which 30,000 cubic meters per day will be treated to meet the requirements for reuse. The second plant will be renovated to produce 20,000 cubic meters per day of reused water, and a secondary treatment process will be applied.
Comment:	The whole project will be completed in one year. It is estimated that this project will obtain an annual sales income of $2.1 million
Contact:	Construction Committee of Weihai City Person in charge: Liu Maode Phone: +86-631-5233204 Fax: +86-631-5231183 Address: Guangming Road 149, Weihai City, Shandong Province Postal code: 264200

No. 39:	**Dengzhou City Wastewater Treatment Plant**
Location:	Dengzhou City, Henan Province
Status:	Information not available
Total investment:	$1,250,000
Funding source:	Information not available
Cooperation form:	Joint venture
Brief description:	The capacity of the planned plant is 60,000 cubic meters per day.
Comment:	It is estimated that the return term of this project will be 15.48 years with an annual sales income of $2.28 million.
Contact:	Dengzhou City Wastewater Treatment Plant Phone: +86-377-2124623 Fax: +86-377-2124335

Address: Xinhua Middle Road 100, Dengzhou City, Henan Province
Postal Code: 474100
E-mail: *DZJW@public.nyppt.ha.cn*
Web site: *http://Dengzhou.gv.cn*

No. 40: **Neixiang County Wastewater Treatment Plant**
Location: Neixiang County, Henan Province
Status: Information not available
Total investment: $690,000
Funding source: Information not available
Cooperation form: Information not available
Brief description: The capacity of the planned plant will be 30,000 cubic meters per day.
Contact: Planning Committee of Neixiang County, Water Resource Bureau of Neixiang County

No. 41: **Xichuan County Wastewater Treatment Plant**
Location: Xichuan County, Henan Province
Status: Information not available
Total investment: $167,000
Funding source: Information not available
Cooperation form: Information not available
Brief description: The capacity of the planned plant is 100,000 cubic meters per day. The oxidation ditch system will be applied in the treatment process.
Contact: Xichuan County Wastewater Treatment Co., Ltd.
Person in charge: Zhang Tingcai
Phone: +86-377-4222112
Fax: +86-377-4212103
Address: Environmental Protection Bureau of Xichuan County, Xichuan County, Henan Province
Postal code: 474450

No. 42: **Jingziguan Wastewater Treatment Plant**
Location: Xichuan County, Henan Province
Status: Information not available
Total investment: $600,000
Funding source: Foreign investment of $600,000 needed
Cooperation form: Joint venture, cooperation, or sole investment
Brief description: The project includes a wastewater treatment plant and auxiliary pipeline networks outside the plant.
Contact: Environmental Protection Bureau of Xichuan County
Person in charge: Wei Rongkui
Phone: +86-377-4222112
Fax: +86-377-4212103
Address: Danjiang Road, Chengguan Town, Xichuan County, Henan Province
Postal code: 474450

No. 43: **Handan East Wastewater Treatment Plant Expansion Project**
Location: Handan City, Hebei Province
Status: Information not available

Total investment:	$36,630,000
Funding source:	Information not available
Cooperation form:	Joint venture or cooperation
Brief description:	The project will expand the wastewater treatment capacity from the current 100,000 cubic meters per day to 200,000 cubic meters per day; the project also includes the construction of a sludge dewatering system and a wastewater reclamation system and the renovation of a sewage collection system.
Comment:	It is estimated that this project will create $360,000 profit each year. By producing fertilizer with the sludge, it will create $720,000 of benefits annually.
Contact:	Handan Wastewater Treatment Co., Ltd. Persons in charge: Gao Song, Li Yutian, Zhang Guowang Phone: +86-310-3080012 Fax: +86-310-3080012 Address: 24 Chaoyang Road, Handan City, Hebei Province Postal code: 056001

No. 44:	**Xingtai City Wastewater Treatment Plant**
Location:	Xingtai City, Hebei Province
Status:	Proposal report prepared
Total investment:	$30,000,000
Funding source:	Information not available
Cooperation form:	Information not available
Brief description:	The total capacity is 165,000 cubic meters per day. Three subprojects are included: the Shahe Wastewater Treatment Plant (50,000 cubic meters per day), the Ningjin Wastewater Treatment Plant (50,000 cubic meters per day), and the Qinghe Wastewater Treatment Plant (65,000 cubic meters per day).
Contact:	Construction Committee of Xingtai City Person in charge: Zhao Jianping Phone: +86-319-2023390 Fax: +86-319-2023390 Address: 17 Zhongxing Road, Xingtai City, Hebei Province Postal code: 054000

No. 45:	**Wastewater Treatment Plant in Bada Industrial Park**
Location:	Baoding City, Hebei Province
Status:	Information not available
Total investment:	$18,070,000
Funding source:	Foreign investment of $9,000,000 needed
Cooperation form:	Joint venture, cooperation, and sole investment
Brief description:	The capacity of the planned plant will be 80,000 cubic meters per day.
Contact:	Baoding Bada Industrial Development Co., Ltd. Person in charge: Mr. Yang Senlin Phone: +86-312-3215005 Fax: +86-321-3212185 Address: Bada Industrial Park, Baoding National High-Tech Industrial Development Zone, JiangCheng Road, Baoding City, Hebei Province Postal code: 071051

No. 46:	**Cangzhou City Wastewater Treatment Plant**
Location:	Cangzhou City, Hebei Province
Status:	Ongoing
Total investment:	$20,480,000
Funding source:	Foreign investment of $10,000,000 needed
Cooperation form:	Cooperation
Brief description:	The capacity of the planned project is 100,000 cubic meters per day.
Comment:	The construction period for the project will be two years. The return term of the investment is estimated to be 18 years.
Contact:	Urban Construction Department of Cangzhou Construction Committee Person in charge: Zhang Yimin, Director Phone: +86-317-2024887-8115 Fax: +86-317-2024159 Postal code: 061000

No. 47:	**Sanhe City Wastewater Treatment Plant**
Location:	Sanhe City, Hebei Province
Status:	Key project; feasibility study completed
Total investment:	$14,830,000
Funding source:	Foreign investment of $7,000,000 needed
Cooperation form:	Joint venture or cooperation
Brief description:	This project has the capacity of 80,000 cubic meters per day. An oxidation ditch is to be used as the main treatment process.
Contact:	Sanhe City Planning and Construction Bureau Person in charge: Mr. Maying, Director Phone: +86-316-3221113 Fax: +86-316-3221113 Address: South to Jingha Road (No. 102 Highway), Sanhe City, Hebei Province Postal code: 065200

No. 48:	**Haikou City Wastewater Supply Plant Expansion Project**
Location:	Haikou City, Hainan Province
Status:	Feasibility study report submitted for approval
Total investment:	$945,000
Funding source:	Information not available
Cooperation form:	Information not available
Brief description:	The capacity of the expansion project is 100,000 cubic meters per day. The project will construct an aerated sedimentation tank, an aeration tank, a sedimentation tank, and a sludge dewatering system. Key equipment will be imported.
Comment:	The construction of this project will start in 2003 and finish in 2005.
Contact:	Construction Bureau of Haikou City Person in charge: Wu Qingxiong Phone: +86-898-66264643 Fax: +86-898-66261470 Address: Sewage Treatment Corporation, Renmin Street 89, Haikou City, Hainan Province Postal code: 570208

Wastewater Reclamation Projects

No. 1:	**Fuxin Mining Wastewater Reclamation Project**
Location:	Fuxin City, Liaoning Province
Status:	Feasibility study report submitted for approval
Total investment:	$920,000
Funding source:	Fuxin Mining (Group) Co., Ltd. ($220,000), commercial bank loan ($700,000)
Cooperation form:	Joint venture, cooperation
Brief description:	There are nine mines in Fuxin diggings, and the amount of groundwater from the well has reached 22 million to 28 million cubic meters per year. The groundwater can be used as industrial or domestic water after proper treatment. It is planned that eight water treatment plants will be constructed in these diggings, and the total capacity will be 51,400 cubic meters per day. The operation period of these plants will be 30 years. The key equipment needed includes ion exchange, microfiltration, ultra filtration, and reverse osmosis technology.
Comment:	The whole project will be constructed from 2003 to 2005, and it may achieve an annual sales income of $3,500,000. The return term of the total investment is estimated to be 6.4 years.
Contact:	Fuxin Mining (Group) Co., Ltd. Person in charge: Wang Kun Phone: +86-418-6558203 Fax: +86-418-2820063 Address: Liaoning Fuxin Jiulong Water Supply Co., Ltd., Fuxin City, Liaoning Province Postal code: 123000

No. 2:	**Dezhou City Wastewater Treatment Plant Wastewater Reclamation Project**
Location:	Dezhou City, Shandong Province
Status:	Feasibility study report approved
Total investment:	$7,300,000
Funding source:	Foreign investment of $7,300,000 needed
Cooperation form:	Joint venture, cooperation, or sole investment
Brief description:	The capacity of the wastewater reclamation project is 60,000 cubic meters per day. The treated water will be reused as industrial water.
Comment:	It is anticipated that the whole project will be completed in two years, and the total investment will be returned in 23 years.
Contact:	Sewage Treatment Plant of Dezhou City Person in charge: Xie Shuning Phone: +86-534-2315088 Fax: +86-534-2315088 Address: Pingguoyuan 2, Decheng District, Dezhou City, Shandong Province Postal code: 253000

APPENDIX B

U.S. Government Contacts in China

U.S. Department of Commerce Offices in China

Beijing
31st Floor, North Tower
Beijing Kerry Center, No. 1 Guanghua Lu
Beijing 100020, China
Tel: +86-108-529-6655
Fax: +86-108-529-6558/9
Web site: *www.buyusa.gov/china/en/beijing.html*
E-mail: *Beijing.Office.Box@mail.doc.gov*

Shanghai
Shanghai Center, Suite 631
1376 Nanjing West Road
Shanghai 200040, China
Tel: +86-216-279-7630
Fax: +86-216-279-7639
Web site: *www.buyusa.gov/china/en/shanghai.html*
E-mail: *Shanghai.Office.Box@mail.doc.gov*

Guangzhou
14/F China Hotel Office Tower, Room 1461
Liu Hua Road
Guangzhou 510015, China
Tel: +86-208-667-4011
Fax: +86-208-666-6409
Web site: *www.buyusa.gov/china/en/guangzhou.html*
E-mail: *Guangzhou.Office.Box@mail.doc.gov*

Chengdu
4 Lingshiguan Lu, Renmin Nanlu Section 4
Chengdu, Sichuan 610041, China
Tel: +86-288-558-3992/9642
Fax: +86-288-558-9221/3520

Web site: *www.buyusa.gov/china/en/chengdu.html*
E-mail: *Chengdu.Office.Box@mail.doc.gov*

Shenyang
52 Shi Si Wei Road, Heping District
Shenyang, Liaoning 110003, China
Tel: +86-242-322-1198
Fax: +86-242-322-2206
Web site: *www.buyusa.gov/china/en/shenyang.html*
E-mail: *Shenyang.Office.Box@mail.doc.gov*

Hong Kong
26 Garden Road, Hong Kong
Tel: +85-22-521-1467
Fax: +85-22-845-9800
Web site: *www.buyusa.gov/hongkong*
E-mail: *Hong.Kong.Office@mail.doc.gov*

Other Key U.S. Government Contacts

U.S. Department of Commerce, International Trade Administration, U.S. and Foreign Commercial Service

Beijing
David Gossack: +86-108-529-6655, x807
Yi Wang: +86-108-529-6655, x837
Mobile: +86-139-0103-0885
Wan Xiaolei (U.S. Trade and Development Agency): +86-108-529-6655, x839

Shanghai
Eric Hsu: +86-216-279-7055
Mobile: +86-138-0180-0302
Stellar Chu: +86-216-279-7930, x6225
Mobile: +86-130-0211-5681

Guangzhou
Mike Murphy: +86-208-667-4011
Diana Liu: +86-208-667-4011, x19

Chengdu
Denny Barnes: +86-288-558-3992, x6961
Chen Ling: +86-288-558-3992, x6967
Mobile: +86-136-0808-3670

Shenyang
Liu Yang: +86-242-322-1198

Hong Kong
Stewart Ballard: +85-22-521-5752
Olevia Yim: +85-22-521-6166
Mobile: +85-29-436-4300

U.S. Department of Commerce, International Trade Administration

Washington, D.C.
- Energy and Environmental Industries
  Susan Simon: +1 (202) 482-0713
- Advocacy Center
  Roza Pace: +1 (202) 482-0679
- Market Access and Compliance
  Elise Owen: +1 (202) 482-1983

Manila, Philippines
- Asia Development Bank, U.S. and Foreign Commercial Service Liaison
  Frank Foster: +1 (632) 887-1345

U.S. Environmental Protection Agency

Washington, D.C.
Suzanne Giannini-Spohn: +1 (202) 564-3907
Dan Thompson: +1 (202) 564-6418

Export–Import Bank of the United States

Washington, D.C.
Craig O'Connor: +1 (202) 565-3939
Talaat Rahman: +1 (202) 565-3911

U.S. Department of State

Beijing
Environment Science and Technology
Debbie Seligsohn: +86-106-532-3831, x6609
Karen Pongonis: +86-106-532-3831

Washington, D.C.
Mike Finnegan: +1 (202) 647-7628

U.S. Trade and Development Agency

Washington, D.C.
Geoff Jackson: +1 (202) 875-4357
Tom Hardy: +1 (202) 875-4357

U.S. Department of Energy

Germantown, Maryland
Office of Coal/Power; Import/Export Activities; Fossil Energy
Peter Rozelle: +1 (301) 903-2338
Mobile: +1 (570) 881-2605

U.S. Department of Agriculture

Washington, D.C.
Sylvana Li: +1 (202) 690-2868

APPENDIX C

In-Country Contacts

Ministries and Agencies

China Development Bank
29 Fuwaidajie, Xicheng District
Beijing 100037, China
Phone: +86-10-68307304
Fax: +86-10-68311517
Web site: *www.cdb.com.cn*
E-mail: *Zhaopin@cdb.com.cn*

Ministry of Commerce
2 Dongchanganjie
Beijing 100731, China
Phone: +86-10-65121919
Fax: +86-10-65198173
Web site: *www.mofcom.gov.cn*

Ministry of Construction
9 Sanlihe Road
Beijing 100835, China
Phone: +86-10-68394114
Web site: *www.cin.gov.cn*
E-mail: *cin@mail.cin.gov.cn*

Ministry of Science and Technology
15 (Yi) Fuxing Road, Haidian District
Beijing 100862, China
Phone: +86-10-68515544
Web site: *www.most.gov.cn*
Department of International Cooperation
Director: Yu Ying
Phone: +86-10-68515048

Ministry of Water Resources
2 Baiguang Road, Ertiao
Beijing, China
Phone: +86-10-63202558, 63202557, 63202561
Fax: +86-10-63202556
Web site: *www.mwr.gov.cn*
E-mail: *webmaster@mwr.gov.cn*

Department of International Cooperation and Science and Technology
Director: Gao Bo

National Development and Reform Commission
Division of Environment Industry
38 Yuetannanjie
Beijing 100824, China
Phone: +86-10-68535653
Fax: +86-10-68535652
Web site: *www.sdpc.gov.cn*

State Environmental Protection Administration (SEPA)
115 Xizhimennei, Nanxiaojie
Beijing 100035, China
Web site: *www.zhb.gov.cn*
E-mail: *mailbox@zhb.gov.cn*

SEPA Department of International Cooperation
Phone: +86-10-67117091

State Tax Bureau
5 Yangfangdianxi Road, Haidian District
Beijing 100038, China
Phone: +86-10-63417572
Web site: *www.chinatax.gov.cn*
E-mail: *webmaster@chinatax.gov.cn*

Institutes and Associations

China Association of Environmental Protection Industry
9 Sanlihe Road, Haidian District
Beijing 100835, China
Phone: +86-10-65211883
Fax: +86-10-65211887
Web site: *www.cepi.com.cn*
E-mail: *cepi@vip.163.com*

China International Center for Economic and Technical Exchanges (CICETE)
18 Bei San Huan Zhong Lu
Beijing 100011, China
Phone: +86-10-62049988
Fax: +86-10-62011328
Web site: *www.cicete.org*
E-mail: *webmaster@cicete.org*

Chinese Research Academy of Environmental Sciences (CRAES)
8 Anwai Beiyuan, Dayangfang
Beijing 100012, China
Phone: +86-10-84915193
Web site: *www.craes.org.cn*
E-mail: *office@craes.org.cn*

Regional Environmental Protection Bureaus

Anhui Environmental Protection Bureau
85 Changjiangzhong Road
Hefei 230001, China
Phone: +86-551-2657677
Fax: +86-551-2672380
Web site: *www.aepb.gov.cn*
E-mail: *aheic_hb@mail.aepb.gov.cn*

Beijing Environmental Protection Bureau
14 West Chegongzhuang Street, Haidian District
Beijing, China
Phone: +86-10-68413817
Fax: +86-10-68413836
Web site: *www.bjepb.gov.cn*
E-mail: *webmaster@bjepb.gov.cn*

Chongqing Environmental Protection Bureau
212 Renmin Road, Yuzhong District
Chongqing 630015, China
Phone: +86-23-63868871
Fax: +86-23-63850021
Web site: *www.cepb.gov.cn*
E-mail: *einfo@cepb.gov.cn*

Fujian Environmental Protection Bureau
138 Fufei Road
Fuzhou 350003, China
Phone: +86-591-7840212
Fax: +86-591-7842211
Web site: *www.fjepb.gov.cn*
E-mail: *Fjepic@public.fz.fj.cn*

Gansu Environmental Protection Bureau
123 Gaolan Road, Chengguan District
Lanzhou 730030, China
Phone: +86-931-8418240, 8850189
Fax: +86-931-8418970
Web site: *www.gsep.gansu.gov.cn*
E-mail: *ghxqyt@public.lz.gs.cn*

Guangdong Provincial Environmental Protection Bureau
Fengze Mansion, 213 Loukou Xi Road, Tianhe District
Guangzhou 510630, China
Phone: +86-20-87532301, 87532295
Fax: +86-20-87531752
Web site: *www.gdepb.gov.cn*
E-mail: *webmaster@gdepb.gov.cn*

Guangxi Autonomous Region Environmental Protection Bureau
5 Jiaoyu Road

Nanning 530022, China
Phone: +86-771-2803997
Fax: +86-771-2849817
Web site: *http://gxepb.nn.gx.cn*
E-mail: *eiclyy@public.nn.gx.cn*

Guizhou Provincial Environmental Protection Bureau
Foreign Affairs Office
83 Zunyi Road
Guiyang 550002, China
Phone: +86-851-5867314
Fax: +86-851-5867314
Web site: *www.gzhjbh.gov.cn*
E-mail: *gzepbic@public.gz.cn*

Hainan Provincial Land Environment and Resources Department
59 Haifu Street
Haikou, China
Phone: +86-898-65338010
Fax: +86-898-65337757
Web site: *www.dloer.gov.cn*
E-mail: *hngzht@public.hk.hi.cn*

Hebei Provincial Environmental Protection Bureau
448 Xi Yuhua Road
Shijiazhuang 050051, China
Phone: +86-311-7908367
Fax: +86-311-7908549
Web site: *www.hb12369.net*
E-mail: *webmaster@epa.hebnet.gov.cn*

Helongjiang Provincial Environmental Protection Bureau
6 Hengshan Road, Xiangfang District
Harbin, China
Phone: +86-451-82331247
Fax: +86-451-82331747
Web site: *www.hljepb.gov.cn*
E-mail: *hljeic@mail.hl.cn*

Henan Provincial Environmental Protection Bureau
1 Shunhe Road
Zhengzhou, China
Phone: +86-371-6327929
Fax: +86-371-6320521
Web site: *www.whepb.gov.cn*
E-mail: *whepb@163.com*

Hubei Provincial Environmental Protection Bureau
13 Tianmendun, Hankou
Wuhan 430015, China
Phone: +86-27-87870675
Fax: +86-27-7861455
Web site: *www.whepb.gov.cn*
E-mail: *whepb@163.com*

Hunan Environmental Protection Bureau
75 East Chengnan Road
Changsha, China
Phone: +86-731-5464834, 5464857
Fax: +86-731-5464923
Web site: *http://grwy.online.ha.cn*

Inner Mongolia Autonomous Region Environmental Protection Bureau
6 South Yishuting Road, Xincheng District
Huhehaote City 010020, China
Phone: +86-471-6282001
Fax: +86-471-6281990
Web site: *www.nmhbj.com*
E-mail: *cht@public.hh.nm.cn*

Jiangsu Provincial Environmental Protection Bureau
241 West Fenghuang Road
Nanjing, China
Phone: +86-25-6517443, 6667306
Fax: +86-25-86631720
Web site: *www.jshb.gov.cn*
E-mail: *jseic@jshb.gov.cn*

Jiangxi Provincial Environmental Protection Bureau
16 South Hubin Road
Nanchang, China
Phone: +86-791-8592231, 8592565, 8592797
Fax: +86-791-8592797
Web site: *www.jxepb.gov.cn*
E-mail: *bgs@jxepb.gov.cn*

Jilin Provincial Environmental Protection Bureau
41 Hongqi Road
Changchun, China
Phone: +86-431-5942961
Fax: +86-431-2719168
Web site: *http://hbj.jl.gov.cn*
E-mail: *jleic@public.cc.jl.cn*

Liaoning Provincial Environmental Protection Bureau
34 East Chongshan Road, Yuhong District
Shenyang, China
Phone: +86-24-86625021
Fax: +86-24-86625033
Web site: *www.lnepb.gov.cn*
E-mail: *xxzx@lnepb.gov.cn*

Ningxia Hui Autonomous Region Environmental Protection Bureau
79 North Minzu Road
Yinchuan, China
Phone: +86-951-6030933
Fax: +86-951-6025596
Web site: *www.nxep.gov.cn*
E-mail: *lashjxx@public.yc.nx.cn*

Qinghai Provincial Environmental Protection Bureau
116 East Nanshan Road
Xining, China
Phone: +86-971-8176616
Fax: +86-971-8135112

Shaanxi Provincial Environmental Protection Bureau
Floor 10, Provincial Government Building Xincheng
Xi'an, China
Phone: +86-29-87291495/87292427
Fax: +86-29-87291327
Web site: *http://sxhbj.shaanxi.gov.cn*

Shandong Provincial Environmental Protection Bureau
12 Zhijinshi Road
Jinan, China
Phone: +86-531-6106112
Fax: +86-531-6921389
Web site: *www.sdein.gov.cn/*
E-mail: *sdepb@sdein.gov.cn*

Shanghai Environmental Protection Bureau
193 Hankou Road
Shanghai 200002, China
Phone: +86-21-63210957
Fax: +86-21-63233170
Web site: *www.sepb.gov.cn*
E-mail: *xinfang@sepb.gov.cn*

Shanxi Provincial Environmental Protection Bureau
21 West Binhe Road
Taiyuan, China
Phone: +86-351-6371141
Fax: +86-351-6371005
Web site: *www.sxhb.gov.cn*
E-mail: *sxeic@public.ty.sx.cn*

Sichuan Provincial Environmental Protection Bureau
31 Xiyu Road
Chengdu, China
Phone: +86-28-86112711, 86114531
Fax: +86-28-86119656, 86112143
Web site: *www.schj.gov.cn*
E-mail: *webmaster@schj.gov.cn*

Tianjin Environmental Protection Bureau
17 Fukang Road, Nankai District
Tianjin, China
Phone: +86-22-23051500, 23051597, 23051560
Fax: +86-22-23051596
Web site: *www.tjhb.gov.cn*

Tibet Autonomous Region Environmental Protection Bureau
61 Middle Jinzhu Road
Lhasa, China
Phone: +86-891-6811955
Fax: +86-891-6835242

Xinjiang Uighur Autonomous Region Environmental Protection Bureau
11 Jiangkang Road

Urumqi, China
Phone: +86-991-2826022, 2325087
Fax: +86-991-2819429
Web site: *www.xjepb.gov.cn*
E-mail: *xjeic@xj.cninfo.net*

Yunnan Provincial Environmental Protection Bureau
127 South Xiyuan Road
Kunming, China
Phone: +86-871-4102612
Fax: +86-871-4141645
Web site: *www.ynepb.gov.cn*

Zhejiang Provincial Environmental Protection Bureau
109 Tianmushan Road
Hangzhou, China
Phone: +86-571-87055404
Fax: +86-571-87054190
Web site: *www.zjepb.gov.cn*

Industry Organizations

Anhui Guozhen Environmental Protection Science and Technology Co., Ltd.
699 Changjing West Road, Hefei
Anhui 230031, China
Phone: +86-551-5319529, 5313412, 5319529
Fax: +86-551-5329201
Web site: *www.gzep.com.cn*
E-mail: *ahgzep@ahgze.com*

Beijing Capital Co., Ltd.
7th Floor, 8 Jingan Center, Bei San Huan Dong Lu
Beijing 100028, China
Phone: +86-10-84552266
Fax: +86-10-84552900
Web site: *www.beijingcapital.com.cn*
E-mail: *bjcapital@beijingcapital.com.cn*

Beijing Golden State Engineering and Technology Co., Ltd.
An Yuan Jia 8, An Hui Bei Li,
Chaoyang District
Beijing 100101, China
Phone: +86-10-64915588
Fax: +86-10-64979796
Web site: *www.gsgc.com*
E-mail: *goldenstate@gsgc.com*

Beijing Municipal Drainage Co., Ltd.
4 Longtanhubeiili, Chong Wen District
Beijing 100061, China
E-mail: *guimeng@bdcbeijing.com.cn*

CNECP Water Service Investment Co., Ltd.
F315 Yuanyang Mansion
158 Fuxingmennei Street, Xicheng District
Beijing 100031, China
Phone: +86-10-66410550
Fax: +86-10-66415028
Web site: *www.cnepc.com.cn/swt.htm*

Tsinghua Tongfang Water Engineering Corp.
10th Floor, Tower A, Tongfang Technology Plaza
1 Xiwangzhuang, Haidian District
Beijing 100083, China
Phone: +86-10-82390588
Fax: +86-10-82390586
E-mail: *tfwater@thtf.com.cn*

APPENDIX D

Information and Reference Resources

Web Sites

China's Official Web Sites

State Environmental Protection Administration (SEPA)
www.zhb.gov.cn

- News of national environmental protection
- Introduction of SEPA and SEPA affiliate units
- Environmental protection planning, reports, regulations, and standards in China made by SEPA and affiliate units
- Publication of environmental evaluation and the supervision and execution of environmental protection
- Introduction of international cooperation
- Links to Web sites of other related units and organizations

National Development and Reform Commission
www.sdpc.gov.cn

- Introduction of the compositions, frameworks, and functions of the National Development and Reform Commission and its affiliate units
- Introduction of provincial development and reform commissions and price bureaus
- Introduction of national development plans in energy, transportation, and social causes
- News and information of national planning, programming, policies, and public bidding
- Introduction of national debt investments
- Links to Web sites of other ministries and administrations

Ministry of Water Resources
www.mwr.gov.cn

Ministry of Construction
www.cin.gov.cn

Ministry of Commerce
www.mofom.gov.cn

China South-to-North Water Diversion Net
www.nsbd.mwr.gov.cn

China Western Development Net
www.chinawest.gov.cn

Three Gorges Online
www.sanxia.net.cn

China Water Resource Net
www.ewater.net.cn

- China's water resource bulletin
- Progress of water resource conservation
- Water resource planning

China City Construction Information Net
www.mpinvest.com.cn

- Business promotion and equipment purchase information
- Municipal works investment information
- Policy research report

China's Commercial Web Sites

China Environmental Protection Industry Online
www.cepiol.com
Sponsored by the China Association of Environmental Protection Industry

- News about environment protection and cleaner production
- Introduction to SEPA, the China Association of Environmental Protection Industry, and other related special committees
- Introduction to government documents, environmental certifications, and projects examination and approval
- Information about commercial activities, including new products, new companies, and environmental exhibitions
- Introduction to international environment protection technologies
- Special topic discussions
- Links to related Web sites

China Environmental Equipments Network
www.goepe.com

- Commercial information of environmental protection
- National and international activities of environmental protection
- Introduction to environmental companies and products
- Introduction to environmental protection technologies

H_2O-China.com
www.h20-china.com/english/index.htm

- Water and wastewater treatment project information (investment and equipment purchases)
- Latest news in the environmental industry
- Progress of environmental protection technologies

China Water Industry Net
www.c-water.com.cn

- Environmental protection exhibition information
- Project bidding invitation information
- Regulations and standards for environmental industries
- Water industry statistics

China Project Network
www.bhi.com.cn

- Introduction to engineering projects under planning and development, especially the major projects
- News about commercial activities
- Information on project investment policies, industry analysis reports, and special investigations
- Information about exhibitions
- Links to Web sites of related and cooperated units and organizations

China Economic Information Network
www.cei.gov.cn

- Directed by the State Information Center, providing economic information in China
- News, reports, analysis, policies, and regulations and statistics of the Chinese economy
- Special topics and forums on the Chinese economy
- Economic information for different industries
- Provincial economic information

China Investment Network
www.china-138.com

- Information about regional investment projects and enterprise investment invitation projects
- Introduction to developing zones in China
- Introduction to policies and procedures
- Focus analysis for invitations for outside investment
- Links to related Web sites of units and organizations and recommended commercial Web sites

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China Association of Environmental Protection Industry; Department of Science, Technology and Standards; and State Environment Protection Administration. *Guidebook on the Market Supply and Demand of China's Environmental Industry.* Beijing: China Environment Science Publishing House, 2002.

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