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Huai River Water Pollution Control Project
Environmental Assessment

Summary

September 2000

Anhui Provincial PMO
Shandong Provincial PMO

with assistance from

Mott MacDonald/ERM

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Currency Equivalents

(Exchange Rate Effective October 1999)

Currency Name: Renminbi

Currency Unit: RMB

RMB 8.3 = US$1.00

US$0.12 = RMB 1.0

Abbreviations and Acronyms

AC Advisory Consultant
AIC Average Incremental Cost
AP Action Plan for IDP
ATP Ability to Pay
BOD Biochemical Oxygen Demand
COD Chemical Oxygen Demand
DHV DHV Consult. BV/D&J Eng Consult. Co
DO Dissolved Oxygen
DRICSI 9th Design & Research Institute for China Shipbuilding Industry
DWF Dry Weather Flow (sewage)
EA Environmental Assessment
EIRR Economic Internal Rate of Return
EMP Environmental Management Plan
EPB Environmental Protection Bureau
ERM Environmental Resource Management
FIRR Financial Internal Rate of Return
FSR Feasibility Study Report
HRBC Huai River Basin Commission
HRWPCP Huai River Water Pollution Control Project
IDC Interest During Construction
IDP Institutional Development Plan
IST Institutional Strengthening and Training
JMEDI Jinan Municipal Engineering Design Institute
LG Leading Group
l/c/d Litres per capita per day
LIBOR London Inter-bank Borrowing Rate
MLG Municipal Local Government
MoF State Ministry of Finance
NCMEDI North China Mun Eng Design Institute
OD Oxygen Demand
PAD Project Appraisal Document (WB)
PAP Project Affected Person
PIP Project Implementation Plan
PIU Project Implementation Unit (Municipal)
PMO Project Management Office (Provincial)
PPP Project Procurement Plan
PRC People's Republic of China
PS Pumping Station
PV Present Value
RAP Resettlement Action Plan
RMC Resident Mission in China
RMDI Rizhao Municipal Design Institute
SDPC State Development and Planning Commission
SEPA State Environmental Planning Agency
SLIDI Shandong Light Industry Design Institute
SS Suspended Solids
SUCDRI Shandong Urban Construction Design Research Institute
TVE Town and Village Enterprise
WB World Bank (International Bank for Reconstruction and Development)
WRB Water Resources Bureau
WSC Water Supply Company
WTP Willingness to Pay
WTW Water Treatment Works
WWC Wastewater Enterprise
WwTW Wastewater Treatment Works

NB: SI units of measurement have been used throughout this report

1 OVERVIEW

This report provides a brief summary of the major findings in the two Provincial Environmental Assessment (EA) Reports produced for Anhui and Shandong Provinces, under the Huai River Water Pollution Control Project (HRWPCP). The Provincial EA for Anhui Province was conducted by the Hefei Design Institute (HDI), under the Ministry of Coal Industry. The Provincial EA for Shandong Province was conducted by the Shandong Scientific Research and Design Institute of Environmental Protection (SIEP), under the Shandong Provincial Environmental Protection Bureau (EPB) in Jinan. Both of the English versions of these EA reports were prepared with the assistance of the AC (Mott MacDonald and ERM International).

The full Provincial EA reports cover the assessment of the environment impacts of the project components to be undertaken under the HRWPCP in each Provinces. The EA reports were prepared as Category B, as directed by the World Bank (WB). Full Resettlement Action Plans (RAPs) were prepared in each Province and the findings incorporated into the EA reports.

The EA reports were prepared in both Chinese and English versions. The Chinese versions of these EAs were submitted to the Chinese State Environmental Protection Agency (SEPA) for approval. Both the Anhui Provincial EA and Shandong Provincial EA were approved by SEPA in September 2000. The final English versions of the provincial EAs were submitted to the WB in August 2000.

2 HUAI RIVER BASIN

2.1 General

The Huai River Basin lies across four provinces in the centre of China, covering an area of 270,000 km^2 between the Yangtze and Yellow Rivers and the Yellow Sea. The Basin is divided into two major systems: (1) The Huai River System (190,000 km^2), originating from Mt.Tongbo in Henan Province and about 1,000 km long with 120 tributaries, flows east through Anhui Province to Hongze Lake, through Jiangsu Province and discharges into the Yangtze River. (2) The Yi-Shu-Si River System (80,000 km^2) originates in Shandong, flows south to Jiangsu Province and discharges into the Yellow Sea. The Grand Canal in the east connects the Huai River and Yi-Shu-Si systems as well as the Yangtze and Yellow Rivers.

The economic and environmental impacts of water pollution on the Huai River Basin area are widespread and acute. In 1994, severe water pollution caused temporary production stoppage at many factories and drinking water problems for many inhabitants in the Huai River Basin. The 1994 Huai River pollution incident was caused by the discharge of polluted wastewater from many straw pulp factories, paper mills, and tanneries in Henan Province and Anhui Province located in the upstream portion of the Ying He River. These industries discharged a great quantity of polluted wastewater during the dry season when river control gates were often closed; 60-70 % of the annual river flow occurs during May-August time period, the gates are closed during the dry season for storage purposes. During the flood season the river control gates were opened releasing the concentrated stored pollution. This sudden increase in pollution of downstream sections of the Ying He River caused power station malfunction and consequently major impacts on the Hua Dong power network. Furthermore, fishery resources were destroyed and agricultural and industrial damages were widespread. Urban water sources were also affected resulting in significant shortages for the

inhabitants of the downstream cities. Direct economic damages were estimated at over one billion yuan.

Consequently the State Council authorised various actions to combat water pollution and prevent future pollution disasters in the Huai River Basin. The central government approved the "Ninth Five-Year Plan (1996-2000) of Water Pollution Control" (WPCP) in June of 1996. The WPCP defined targets for the Huai River Basin as follows:

- By 1997, all the wastewater discharges from industrial pollution sources should meet standards for effluent and the total Basin COD should be reduced from 1.5 million tons in 1993 to 0.89 million tons (including 0.207 million tons from Anhui Province and 0.264 million tons from Shandong Province);
- By 2000, the total Basin COD should be reduced to 0.368 million tons (including 77,000 tons from Anhui Province and 64,700 tons from Shandong Province);
- By 2000, the Huai River mainstream, main tributaries, and rivers that are sources for urban water supplies, should reach the Class III of the National Surface Water Standard.

As part of the efforts of the State Council and the four Huai basin provinces (i.e. Henan, Anhui, Jiangsu and Shandong) to meet water pollution control targets, the Huai River Water Pollution Control Project (HRWPCP) is currently being prepared for Anhui and Shandong Provinces. At the request of the PRC, the WB has listed the proposed project in the lending programme for WB fiscal year 2001. Water pollution control in Henan and Jiangsu is being dealt with under separate programmes.

As described below, despite significant efforts, including the closure of a large number of polluting industries, the targets listed above are far from being achieved, with provision of municipal wastewater control facilities in particular lagging far behind programme. This project will thus be a significant step towards achieving the proposed pollution reduction targets and, through the associated technical assistance activities, will help to provide the necessary skills and experience to execute further projects within the plan.

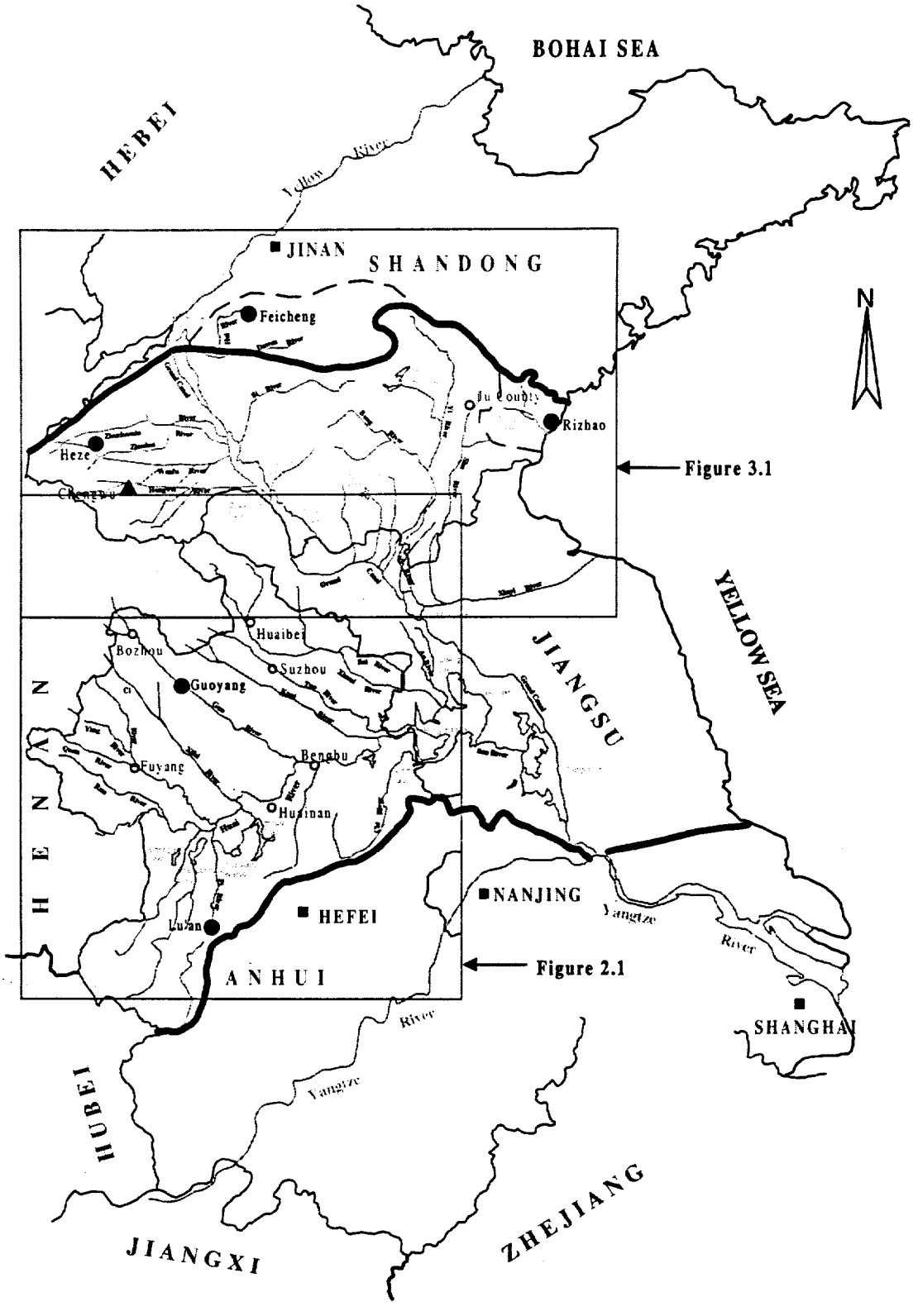
2.2 Anhui Province

Anhui Province extends over the centre of the Huai River Basin. The Huai River mainstream flows through the centre of Anhui Province with major tributaries located both north and south. See **Figure S-1** for the locations of the Huai River mainstream and major tributaries in Anhui and Shandong Provinces. (Note, all figures are located at the end of this Summary). The length of the mainstream of the Huai River in the province is 420 km and the length of the tributaries is 1,580 km.

River pollution is mainly organic, with sections in urban reaches being more polluted than rural reaches, and pollution in tributaries being more serious than in the mainstream reaches.

Anhui Province is approximately 139,400 km^2, of which 66,940 km^2 is located within the Huai River Basin (24.8% of the total basin area). The total 1998 population of Anhui Province was 61.3 million, with 11.2 million in urban areas, of this, 34.7 million were within the Huai River Basin including 4.6 million in urban areas.

Figure S-1
Location of Project Sub-components



○ CITY WITH SEWERAGE PROJECT
● CITY WITH SEWERAGE AND WwTW PROJECT
▲ INDUSTRIAL POLLUTION CONTROL PROJECT
■ PROVINCIAL CAPITAL
COASTLINE
PRINCIPAL RIVER
PROVINCIAL BOUNDARY
HUAI RIVER BASIN (PLANNING BOUNDARY)
HUAI RIVER BASIN (NATURAL DRAINAGE BOUNDARY

2.3 Shandong Province

Shandong Province includes most of the Yi-Shu-Si System of the Huai River Basin. This system is hydrologically connected to the Huai River via the Grand Canal but actually flows directly to the Yellow Sea. Pollution is mainly organic, with sections in urban reaches being more polluted than rural reaches.

Shandong Province is approximately 156,700 km^2, of which 47,100 km^2 is located within the Huai River Basin (17.4% of the total basin area). The total 1998 population of Shandong Province was 86.10 million, with 23 million in urban areas. Of this, about 30 million were within the Huai River Basin including 1.2 million in urban areas.

3 HRWPCP PROJECT GOALS AND OBJECTIVES

In order to fully solve the pollution problems in the two provinces, major pollution control schemes will need to be developed for most cities. It is not possible to finance all necessary works in one step. It is therefore foreseen that further phases of the HRWPCP will be needed over the coming years.

In accordance with the national WB policies and priorities, the Anhui and Shandong Provincial Governments have requested WB and bi-lateral donor support for the Huai River Water Pollution Control Project. The HRWPCP is also a key element of China's Agenda 21 programme. The sector-related goal for the project is:

- **Improve quality of water for the entire basin by providing environmental infrastructure operated in a sustainable manner**

The HRWPCP objectives are to:

1. Upgrade water quality in the Huai River (Class III target) and its tributaries (Class IV target) within the two provinces.
2. Establish performing and efficient wastewater agencies.
3. Consolidate water quality monitoring systems and procedures.

To accomplish this goal and objectives, the outputs for each project component are:

1. Increase in municipal wastewater collection.
2. Increase in quantity of wastewater treated.
3. Implementation of cost-recovery for wastewater operations.
4. Improved water quality monitoring systems and procedures.

4 NEED FOR THE PROJECT

According to the draft "3H Basins Action Program Study for Water Resources, Water Pollution Control" prepared in November 1999 for the Ministry of Water Resources and the WB (known as the '3H Study since it covers the Hai, Huai, and Huang rivers), the WPCP goals have not been met in the Huai River basin. This report indicates that significant additional resources are required to meet the Class III/IV river target standards of the WPCP, and that rural sources such as uncontrolled township and village enterprises (TVEs) and non-point source pollution (mainly polluted agricultural and urban surface water runoff) will remain a problem even after implementation of industrial controls and domestic wastewater treatment facilities.

Implementation of industrial and domestic wastewater treatment lags behind the WPCP implementation schedule due to funding problems. The main pollutants are unionised ammonia, BOD, COD and bacteria levels, and the problems are especially acute in the dry seasons when background flows are reduced to at or near zero levels. Environmental resources are minimal and the assimilative capacity of the surface waters during low-flow periods is virtually zero.

In summary, the water quality problems in the Huai River Basin remain severe, the implementation of municipal wastewater treatment facilities has been slow, and the HRWPCP is targeted to support a major need.

It is the national goal to have wastewater collection and secondary treatment facilities constructed in all cities within the Huai River Basin. A number of the cities in the basin have completed or are currently building wastewater collection and treatment facilities with international bi-lateral assistance. The HRWPCP is designed to help meet overall basin objectives by supplementing these ongoing efforts in the larger cities of Anhui and Shandong provinces that have not been addressed by other projects.

In 1999, the Chinese Research Academy of Environmental Sciences (CRAES) selected 45 major stations to investigate the current water quality of the Huai River Basin. Data from national environmental water quality reports between 1986 and 1993, 1994 for the Huai mainstream, 1995 to 1996 for trans-boundary assessments and some incomplete data from 1997 and 1998 were used by CRAES to determine the existing water quality of the river basin. CRAES (1999) reported that of the 45 sections, only 4 reached their designated beneficial use classification.

Pacific Consultants and the Danish Hydraulic Institute in 1999 estimated the total COD loading in Anhui Province as of 1997 at over 363,000 t/a. Data on year 2000 loading is difficult to obtain and verify, but it is likely closer to this 1997 estimate than to the WPCP goal for 2000 in Anhui Province of 77,000 t/a. The Anhui HRWPCP treatment facilities (Luan and Guoyang) will remove approximately 7,008 t/a of COD (ultimate WwTW sizing removes 11,498 t/a of COD), while the related bi-lateral treatment facilities will remove an additional 48,618 t/a of COD. This total ultimate COD removal of 60,116 t/a can be seen to be a good start for Anhui Province, but far short of the overall WPCP needs in the province.

It is undoubtedly true that the total COD loading in 1997 in Shandong Province also exceeds the WPCP goals, but verifiable data is not readily available. Although municipal and industrial wastewater loads were included in the plan goal for 1997, the WPCP did not account for the "other" sources of COD in the basin. In addition, the progress in achieving municipal and industrial pollution control since 1997 has lagged behind plan goals so that the year 2000 goals of 64,700 tons for Shandong province have not been met. SIEP estimates that the current year 2000 COD loading in Shandong Province is approximately 213,000 t/year, including TVEs and non-point source pollution. The HRWPCP projects will remove approximately 37,145 t/year of COD, leaving the overall Shandong loading well in excess of the target of 67,400 t/year.

5 THE PRIORITISATION OF SCHEMES

Provision of municipal wastewater collection and treatment facilities in the cities of the Huai River Basin is a priority action item in the WPCP, and a critical component shown in the 3H Rivers Action

Plan. The WPCP anticipated that much of the construction of wastewater collection and treatment facilities would be completed by the year 2000, but the programme is running well behind schedule.

Table S-1 provides a listing of the cities and overall municipal treatment needs in the Huai River Basin, as shown in the 3H Action Plan. The project cities supported by the HRWPCP in Anhui and Shandong provinces are highlighted. **Table S-1** illustrates the enormous backlog of municipal wastewater treatment needs in the Basin that require additional funding.

Thus the HRWPCP is part of a much larger comprehensive effort to control industrial and municipal pollution in the Huai Basin. This project has been designed to complement the activities already underway in order to move more quickly toward WPCP goals.

Table S-1: Overall Municipal Treatment Needs in Basin

WwTW City/Country	Capital Cost (RMB million)	No. of WwTWs	WwTW City/County	Capital Cost (RMB million)	No. of WwTWs	WwTW City/Country	Capital Cost (RMB million)	No. of WwTWs
Baofeng	45	1	Linquan	58	1	Wugang	90	1
Bengbu*	150	1	Linyi	154	1	Xiangcheng	191	2
Bozhou*	60	1	Lingying	45	1	Xiaoxian	16	1
Cangshan	60	1	**Lu'an****	50	1	Xinmi	18	1
Chang	65	1	Luohe	114	1	Xinyang	70	1
Chuzhou	80	1	Mengcheng	42	1	Xinyang	44.5	2
Dengfen	63	1	Mengyin	49	1	Xinyi	7	1
Feixian	54	1	Mingguang	60	1	Xinzheng	25.5	1
Fengtai	32	1	Minquan	20	1	Xiping	50	1
Fengxian	10	1	Peizhou	6	1	Xuchang	127	1
Feicheng**	50	1	Pingdingshan	228	1	Xuecheng	50	1
Fuyang*	80	1	Qufu	11	1	Xuzhou	100	2
Gansu	53	1	**Rizhao*****	36	1	Yancheng	150	1
Guoyang**	50	1	Shanqiu	144	1	Yangzhou	160	1
Guanyuanxian	52	1	Shanqui	74	2	Yanzhou	132	1
Guozhenxian	28	1	Sihong	8	1	Yinan	50	1
Haian	100	1	Sishui	50	1	Yishui	95	1
Huaibei*	60	1	Suiping	50	1	Yantai	32	2
Huaiyin	45	1	Suqian	53	1	Yuzhou	60	1
Huainan*	48	1	**Suzhou***	50	1	Zaozhuang	105	1
Heze**	80	1	Taihe	34	1	Zhengzhou	640	1
Jieshou	70	1	Tengzhou	186	1	Zhumadian	170	1
Jining	426	1	Tainchang	60	1	Zhuokou	100	1
Kaifeng	165	1	Tongshan	3	1	Zoucheng	97	1
Lianyunggang	136	2	Woyang	60	1			

Note: * HRWPCP Project City, Anhui/Shandong Provinces, in 3H Action Plan
**** HRWPCP Project City, Anhui/Shandong Provinces, not in 3H Action Plan**
***** Rizhao Municipality contains Rizhao City and Ju County Project Area**

6 OVERVIEW OF HRWPCP COMPONENTS

6.1 Anhui Province

The HRWPCP is designed to supplement these ongoing efforts in the major cities of the Anhui Province that have not been addressed by other projects. **Table S-2** shows the projects that are proposed for the HRWPCP in Anhui Province:

Table S-2: HRWPCP-Anhui Province Components

Project City	Sewerage Main-pipe (km)	Sewerage Sub-pipe (km)	Sewerage Pumping Mains (km)	Total Length	Pump station (No.)	Treatment plant capacity (m^3/d)
Bozhou	56.3	50.0		106.3	4	Bi-lateral
Huaibei	63.8	35.0		98.8	5	Bi-lateral
Guoyang	37.3	35.0		72.3	1	40,000
Suzhou	52	22.0		74.0	3	Bi-lateral
Fuyang	81.7	50.0	3	134.7	4	Bi-lateral
Bengbu	78.9	60.0	1.61	140.5	3	Bi-lateral
Huainan	48.6	39.0	2.6	90.2	4	Bi-lateral
Lu'an	32.5	5	2.4	39.9	3	40,000
Total	**451.1**	**296**	**9.61**	**756.7**	**27**	**80,000**

Figures S-2 to S-9 provide schematics of the proposed Anhui project components. It is proposed to take thickened and dewatered sludge from the WwTW at Guoyang and Lu'an to sanitary landfill sites near the cities.

The Anhui Component also includes a sub-component to strengthen the capability of the Anhui Environmental Monitoring Centres operated by the Provincial and municipal EPBs. The sub-component will include rehabilitation of laboratory facilities, water quality sampling and analysis equipment and training.

6.2 Shandong Province

Shandong Province is currently proposing four municipal wastewater schemes and one industrial pollution control sub-component for inclusion in the HRWPCP. All the municipal wastewater schemes involve improvement and extension of existing sewerage networks and three include new WwTWs. Most of the sub-components also include operation and maintenance equipment including laboratory equipment and vehicles. The Rizhao City component also includes construction of sea outfalls. One of the cities, Ju County, already has a WwTW under construction using local funding. Hence, this WwTW is outside of this project.

The sewerage schemes will involve both the interception of existing municipal sewage and industrial wastewater outfalls and provision of first wastewater collection in more recently developed areas of the cities. Wastewater will be conveyed to WwTWs and will make a major contribution to control of water pollution in the Huai River Basin, and in the case of Rizhao, control pollution in off-shore waters and nearby bathing beaches. **Table S-3** shows the project details that are proposed for the HRWPCP in Shandong Province:

Table S-3: Proposed Sewerage in Shandong Province

Project City	Sewerage Main-pipe (km)	Sewerage Sub-pipe (km)	Sewerage Pumping Mains (km)	Total Length	Pump station (No.)	Treatment plant capacity (m^3/d)
Feicheng	19.5			19.5		40,000
Heze	26.2	28.4		54.6	4	80,000
Rizhao	31.1		8.5	8.5	3	100,000
Ju County	15.0			15.0		Local funded
Chengwu Paper Mill				0		20,000 (WWTP) 1300 (Black liquor)
Total	**91.8**	**28.4**	**8.5**	**128.70**	**7**	**220,000 (municipal WWTP)**

Notes: Feicheng also includes 7 km of DN315 PVC recycled effluent pressure main.
Rizhao also includes 2.8km DN 1600 pressure pipe to header chamber, 2.5km twin DN1200 outfall and 0.5km DN1200 emergency outfall.

Figures S-10 to S-14 provide schematics of the proposed Shandong project components.

6.3 Implementation Schedule

An overall implementation program for the current phase of the HRWPCP is shown in **Table S-4**, based on WB appraisal in late 2000. Individual component implementation programmes can be found in the sub-component PIPs and PPPs.

Table S-4: HRWPCP Implementation Programme

Year / Activity	2000	2001	2002	2003	2004
Final design and bid document preparation					
Pre-qualification (NCB contracts only)					
Bidding and Award process					
Construction and commissioning					
Commence operation (all WwTW)					
Technical assistance (supervision, studies and training)					

6.4 Technical Assistance

The WB considers it critical that institutions responsible for implementing and managing HRWPCP sub-projects are equipped with the management and technical knowledge, skills and equipment necessary to carry out their mandates. A technical assistance (TA) programme is scheduled which will provide institutional strengthening and training (including equipment) to the provincial PMO, city PIUs, Provincial and City EPBs, and the new municipal wastewater companies.

Of particular relevance to the EA, the project includes an overall environmental strengthening component in the area of environmental monitoring. This strengthening is aimed at improving the Basin wide ability to monitor and report on environmental condition, as well as providing the means to better assess the environmental performance of the project investment package. This component would be implemented under the Huai River Basin Commission.

7 WATER AND ENVIRONMENTAL OBJECTIVES

All surface waters in China have been classified according to ambient stream standards. The following is a general translation of the surface water classes:

Class	Description
I	used for water sources and state nature reserves
II	used for class I protection areas for drinking water sources, protection zones for valuable fish, spawning grounds of fish and shrimps
III	used for class II protection areas for drinking water sources, general protection zones for fish and bathing areas **[Huai River mainstream target]**
IV	used for general industrial water areas and water recreation areas where no direct contact with humans occurs **[Major tributary target]**
V	used for agricultural water areas and scenic water areas.

A new Environmental Quality Standard for Surface Water, GHZB-1 1999, was issued on July 20, 1999, and became effective on January 1, 2000. This new standard replaced the previous GB3838-88 standard. The parameters of most significance to the HRWPCP wastewater schemes are shown below:

Parameter (mg/l)	Class III	Class IV
Non-ionic ammonia	0.02	0.2
D.O. (Min.)	5.0	3.0
COD_{cr}	20	30
BOD_5	4.0	6.0

8 PROJECT BENEFITS AND IMPACTS

8.1 Project Benefits

Public health projects like the HRWPCP carry many general benefits for the citizens of the project cities. The project feasibility and EA reports outline specific benefits including:

- Raising the output of agricultural, fish and livestock production;
- Increased domestic output due to improved water resources;
- Public health improvements;
- Increased revenue from tourism;
- Increased real estate values;
- Improved surface water quality.

Other additional potential benefits might include:

- Reduced risk of groundwater contamination in the service areas.

- The impact of making realistic charges for wastewater services should help to encourage waste minimisation at source, and internalise the costs of pollution control.
- Amenity benefits to the population of project cities are likely to accrue as the quality of the adjacent rivers improve. This could include use of the river for recreational purposes and the development of riverside walks and parks for public use.

8.2 Social Impacts

Resettlement and compensation plans have been prepared and are covered in separate "Resettlement Action Plans" (RAP) for each province. The final Anhui Province RAP was prepared for the WB at the same time as the EA and the summary is shown in **Table S-5.**

Table S-5: Project Affected Land Statistics, Anhui Province

City	Permanent Land Acquisition (Mu)								Temporary Land (Mu)			
	Irrig. land	Dry land	Veg. land	Fish ponds	State-owned land	Other land	Sub-total	Affected people	Veg. land	Fruit orchard	Sub-total	Affected people
Huaibei	0.0	3.4	2.9	0.0	0.0	0.0	6.3	31	0	0	0	0
Bengbu	4.1	1.6	3.5	0.0	0.0	0.0	9.2	28	0	0	0	0
Huainan	3.0	0.0	0.0	1.3	9.0	1.1	14.4	7	0	0	0	0
Fuyang	0.0	0.0	0.0	0.0	0.5	1.8	2.3	21	0	0	0	0
Bozhou	0.0	4.3	0.0	0.0	3.9	0.0	8.2	17	0	0	0	0
Lu'an	29.6	16.4	8.2	0.0	1.6	33.6	89.4	131	0	0	0	0
Guoyang	0.0	85.0	0.0	0.0	0.5	10.0	95.5	141	0	0	0	0
Total	36.7	110.7	14.6	1.3	15.4	46.5	225.2	376	0	0	0	0

Note 1: Suzhou sub-project dose not require any resettlement, as the land for the sub-project is government land which is reserved for landscape works in the city. The government has agreed that this land is used for the project and as such a resettlement action plan for Suzhou is not required as there are no affected people.
Note 2: 15 Mu equal one Hectare

The final Shandong Province RAP was also prepared at the same time as the EA and the summary is shown in **Table S-6.**

Table S-6: Project Affected Land Statistics, Shandong Province

City	Permanent Land Acquisition (Mu)							Temporary Land (Mu)					
	Tilled	Veg. land	Wood land	Others	Sub-total	State-owned land	Affected people	Tilled	Veg. land	Others	Sub-total	State-owned land	Affected people
Rizhao	107.3	54.9	-	52.4	214.6	214.6	435	68.1	6	125.5	199.6	199.6	255
Ju County	-	-	-	-	-	-	-	21	5	-	26	26	78
Feicheng	70.95	-	0.75	1.80	73.5	-	94	19.2	-	1.5	20.7	1.5	52
Heze	91.75	-	-	28.22	119.97	9.62	129	4.95	0.72	230.5	236.1	227.7	12
Total	**270.0**	**54.9**	**0.75**	**82.4**	**408.1**	**224.2**	**658**	**113.25**	**11.72**	**357.5**	**482.4**	**454.8**	**397**

Note 1: No land acquisition or resettlement is needed for the Chengwu Paper Mill component as all works will occur on empty land within the existing factory compound.
Note 2: 15 Mu equal one Hectare

8.3 Environmental Impacts

During the construction period, there are potential impacts on the social environment, natural environment and living quality and these are generally temporary and relatively minor. Construction of wastewater collection and treatment facilities will inevitable cause some disruption to traffic and local communities. The project will also affect noise and air quality of the immediate surrounding areas. Construction will also impact on sidewalk trees, vegetation and rainfall inlets

Mitigation measures for the construction period have been built into the project and these should enable the unfavourable effects to be minimised or eliminated entirely. These mitigation measures are based on international approaches to similar problems elsewhere. For disruption to local communities involving temporary and permanent land acquisition the RAP include detailed measures for compensation and livelihood restoration in accordance with PRC laws and WB policy.

These construction impacts have been sorted according to their geographic location within the overall project. Details of mitigation measures, the monitoring required to ensure that mitigation measures are effectively implemented, and responsibilities are provided in detailed charts within the Consolidated EAs. HRWPCP PMOs will have an ongoing responsibility to track and report the monitoring work of all the identified agencies, in addition to their own direct monitoring activities.

The potential operational phase impacts are relatively minor and easily mitigated. Many of the concerns have been addressed in the course of the design of the wastewater collection and wastewater treatment facilities. Details of mitigation measures, a programme for monitoring mitigation measures and responsibilities are provided in detailed charts in the Provincial EAs.

Potential impacts that were evaluated included:

- Raw sewage discharges and intermittent operation of overflows;
- Industrial wastewater influent problems (WwTW upsets, sewer corrosion);
- Noise problems at pump stations and WwTWs;
- Odour problems;
- Air Quality impacts;
- Treated effluent impacts at outfall locations;
- Sludge treatment and disposal;
- Improper O&M of WwTWs.

The financial analysis for HRWPCP components indicates that they are affordable for the stakeholders (municipal governments, service population and industries). This project is meeting a "backlog" need for environmental infrastructure and should not induce adverse extensive growth or secondary impacts. The present environmental problems are serious and the provision of this environmental infrastructure is necessary for current needs and to mitigate current problems. Future problems without the project would become even more critical.

9 ALTERNATIVES REVIEWED IN PROJECT DEVELOPMENT

The evaluation of alternatives for individual project components covered issues such as:

- Sewerage system interception ratio;
- Pipe materials;
- Pipeline construction;
- Number of pump stations and pressure mains;
- Number of WwTWs;
- WwTW site selection;
- Wastewater flows and capacity of the WwTWs;
- The quality of wastewater to be treated;

- The use of septic tanks;
- Treated effluent standards;
- The degree of treatment;
- Wastewater treatment options;
- Variants of the oxidation ditch;
- Sludge disposal;
- Chengwu Paper Mill treatment processes;
- "Without Project" alternatives.

10 MITIGATION AND MONITORING

10.1 Mitigation and Monitoring Budget

The capital budgets prepared for HRWPCP components include allowances for laboratory construction and equipment for use by the wastewater companies. Use of this equipment to perform the necessary testing by the wastewater company is also included in the operations budget for the project.

Furthermore, accomplishing the specified monitoring and reporting outlined in this mitigation plan will be greatly enhanced by the TA programme. This TA programme will also allow for improved overall performance assessment of the HRWPCP programme relative to meeting the project objectives. Future phases of the HRWPCP will benefit from such assessments.

Despite the above facilities and training the conduct of the mitigation monitoring programme will require additional funding. Cost estimates to cover long-term environmental monitoring have been estimated. "Long-term" is defined as annual monitoring required to verify the environmental performance and other operational mitigation measures previously outlined. These mitigation monitoring costs have been added to the wastewater company operational cost estimates. Costs for mitigation measures that relate to the management of construction will be included in the tender documents and responsibility passed on to the construction contractors.

Table S-7 summarises the monitoring cost estimates for Anhui Province.

Table S-7: Anhui Environmental Monitoring Costs

HRWPCP City	Environmental Monitoring Cost Estimates (10^4 Yuan/Year)					
	World Bank Projects		Bi-Lateral Projects		Total, WB and Bi-Lateral	
	Short Term (5 years)	Long Term	Short Term (5 years)	Long Term	Short Term (5 years)	Long Term
Bozhou	7.24	8.10	36.16	5.40	43.40	13.50
Huaibei	7.24	8.10	39.16	5.40	46.40	13.50
Guoyang	27.00	7.50	N/a	N/a	27.00	7.50
Suzhou	8.24	8.10	40.16	5.40	48.40	13.50
Fuyang	8.24	8.10	46.16	5.40	54.40	13.50
Bengbu	8.24	8.10	46.16	5.40	54.40	13.50
Huainan	8.24	8.10	46.16	5.40	54.40	13.50
Lu'an	27.00	7.50	N/a	N/a	27.00	7.50
Anhui Total Annual Cost	101.44	63.6	253.96	32.4	355.4	96

Table S-8 summarises the monitoring cost estimates for Anhui Province.

Table S-8: Shandong Environmental Monitoring Costs

No.	Sub-project	Monitoring management fee per year (10000yuan)
1	Rizhao wastewater treatment plant and pipe network	30
2	Ju County wastewater pipe network (include wastewater plant)	10
3	Heze wastewater treatment plant and pipe network	15
4	Chengwu paper mill	20
5	Feicheng wastewater treatment plant and pipe network	12
6	Total investment for environmental protection	87

10.2 Annual Environmental Quality Report

The recommended environmental monitoring programme is important during both the construction and initial operation phases of the project and involves participants from both the sub-component and provincial levels. The results of this environmental monitoring programme will be summarised in an Annual Environmental Quality Report (AEQR) for each Province, which is distributed to all relevant project offices as well as the World Bank. The charts in the beginning of the mitigation and monitoring chapter of each provincial EA provide convenient checklists for these reports.

At the beginning of January every year, each PIU will sort the relative monitoring data and provide it to their provincial PMO. The Provincial PMO will then consolidate the data in an AEQR. The minimum information that should be reported in an AEQR is shown in **Table S-9.**

Table S-9: Minimum Monitoring Data in Annual Environmental Quality Report

Year ended December 31	Unit	2000	2001	2002	2003	2004
1. Physical Parameters						
Wastewater generated	1000 m3/y					
Wastewater collected	1000 m3/y					
Wastewater treated	1000 m3/y					
Wastewater billed	1000 m3/y					
Sewer connections	Number					
Length of combined sewers	Km					
Length of separate sewers	Km					
Length of interceptor sewers	Km					
Total treatment capacity	1000 m3/d					
Capacity of treatment plant No1	1000 m3/d					
Capacity of treatment plant No 2	1000 m3/d					
Biochemical Oxygen Demand outlet (No1)	Mg/litre					
Chemical Oxygen Demand outlet (No 1)	Mg/litre					
Suspended Solids outlet (No 1)	Mg/litre					
Biochemical Oxygen Demand outlet (No2)	Mg/litre					
Chemical Oxygen Demand outlet (No 2)	Mg/litre					
Suspended Solids outlet (No 2)	Mg/litre					
BOD in the recipient downstream a)	Mg/litre					
COD in the recipient downstream	Mg/litre					
SS in the recipient downstream	Mg/litre					
DO in the recipient downstream b)	Mg/litre					
E-Coli (triplicate sampling) c)	MPN/100ml					
2. Management of Operating Agencies						
Agency employees d)	Number					
Employees/1000 connections	Number					
3. Financial Parameters						
Average sewerage tariff	RMB/m3					
Days of account receivable	Number					
Receivables over billing	%					
Working ratio	%					
Operating Ratio	%					
Maintenance expenses to total cost of operations	%					
Contribution to investment	%					
Debt service coverage	Number					
Debt equity ratio	Number					
4. Institutional Development Parameters						
Days training accomplished	Number					
TA days input	Number					
Number of Board meetings	Number					
Staff recruited	Number					
Key Action Plan target dates achieved						
a) approval of business (A) license (B) charter	Date Date					
b) appointment of Board	Date					
c) first Board Meeting	Date					
d) issue of RfP for TA	Date					
e) commence TA	Date					
f) commence training program	Date					

a) BOD, COD, SS, DO and E-Coli in receiving river would be sampled quarterly and the respective progress report would show lowest and highest results

b) Dissolved Oxygen

c) Applicable methodology (multiple-tube fermentation technique or membrane filter technique) determined at pre-appraisal.

d) Excluding casual labourers.

11 PUBLIC PARTICIPATION IN THE ENVIRONMENTAL ASSESSMENT

During the 12-month project development time leading up to this provincial consolidated EA, there have been many meetings with the city PIUs, utility companies, city EPBs and other affected city organisations to discuss the proposed projects and preparation of the sub-component environmental assessment reports. These meetings have occurred monthly at a minimum and have resulted in full collaboration with local officials and full support of the project and the EA process. It is estimated that in total 30-40 meetings have been held with the public and over 50 meetings have been held with local government officials during the development of the projects, in both of the HRWPCP provinces.

HDI also prepared a survey form to gauge the public perception of the positive and negative impacts of each of the proposed projects in Anhui Province. The investigation was made with representatives of the local government sectors, People's Congress, political consultative conference, women's federation, communist youth league, trade union and other organisations, as well as urban residents' committee. The survey results showed widespread support for the HRWPCP in all Anhui cities.

In Shandong Province, SIEP undertook public participation activities included random opinion sampling questionnaires and holding meetings/conferences in order to inform and obtain suggestions from the public. These activities involved both representatives of local government sectors (similar groups to those used by HDI in Anhui) and also villages, factories and enterprises near the proposed WwTWs. The public included workers, farmers and students etc. of different ages, professions and educational levels. The public participation results showed widespread support for the HRWPCP in all Shandong cities.

In addition, each PIU announced project information using local newspapers, TV, etc. The public was able to inspect the sub-component and consolidated EA reports or summaries of these reports at local locations arranged by the sub-component PIU, and express their views on the proposed projects.

The many meetings with public officials in the province coupled with the surveys of public support show that these projects are considered to have large positive benefits and are well received by the public. Comments received have been addressed, for example, comments that adequate compensation should be assessed for acquired land have been fully addressed in the RAPs. No objections have been received by the city PIU's and there is no indication that there is anyone that is not is support of these projects or would try to stop their completion.

Details of the public participation events including time, place, attendees and issues are provided in the consolidated EAs for Shandong and Anhui respectively.

12 OVERALL HRWPCP PROJECT ASSESSMENT

The HRWPCP projects have been properly formulated and they will form an important contribution to the achievement of the goals of the WPCP. The construction of WwTWs in the Huai River Basin has lagged behind the planned schedule of the WPCP, making it more important to accelerate WwTW construction. Significant progress has been made in regard to the control of industrial pollution since the WPCP was formulated. However, domestic wastewater collection and treatment remains well behind the WPCP schedule.

With respect to environmental protection, the general urban plan and the drainage project plan, the design of wastewater facilities and the locations selected for proposed pump stations and treatment works for HRWPCP projects in the Anhui and Shandong project cities has proved to be reasonable. The locations of the WwTWs meet the requirements of the local urban plans and environmental protection. For the Chengwu Paper Mill, project alternatives have been comprehensively assessed, and the proposed project is technically superior and cost-effective.

12.1 COD Removed, Anhui Province

HDI predicted the reduction in COD discharged to the Huai River Basin for the two HRWPCP WwTWs is shown in **Table S-10** and in **Table S-11** for all HRWPCP cities, both in the "near future" (with existing World Bank and bi-lateral WwTW) and the "further future" (assuming all municipal WwTW needs have been met in the cities.

Table S-10: Estimated COD Reductions for HRWPCP WwTWs

Sub-components	Wastewater Quantity (t/d)	Amount of Discharge before Treatment(t/a)	Amount of Discharge after Treatment(t/a)	Reduction (t/a)	Total Controlled Amount of CODcr Discharge (t/a)
Lu'an WwTW (near future)	80,000	10804	3504	7,300	3600
Guoyang WwTW (near future)	50,000	6388	2190	4,198	2190

Note that HDI analyses in the Chinese EA used these higher WwTW capacities for the two WwTWs at Guoyang and Luan based on the SDPC approval documents. The proposed capacities of these HRWPCP WwTWs were reduced 40,000 m^3/day, which reduces the COD removal rate to 3,650 t/a at Luan and 3,358 t/a at Guoyang (total reduction for both WwTW therefore 7,008 t/a). Similarly, **Table S-11** uses the SDPC proposed WwTW capacities in these cities. Using the actual proposed capacities reduces the short-term COD removal in the Province by about 4,400 t/a.

Table S-11: Estimated COD Reductions for Projects Cities in the Future

Unit: t/a (except items remarked)

Project Sub-component	Wastewater Quantity (10,000t/d)		Discharge Quantity before Treatment	Discharge Quantity after Treatment	Reduction (t/a)
Huaibei	Ding Lou WwTW	8 (near future)	9198	3504	5694
		12 (further future)	13797	5252	8541
Bengbu	Xi Jia Gou WwTW	10 (near future)	10950	2190	8760
		20 (further future)	21900	4380	17520
	Yang Taizi WwTW	20 (further future)	25550	4380	21170
Huainan	Nr. 1 WwTW	10 (near future)	10366	2190	8176
		20 (further future)	20732	4380	16352
Fuyang	Ying Nan WwTW	10 (near future)	15184	4380	10804
		20 (further future)	30368	8760	21608
	Ying Bei WwTW	15 (further future)	22776	6570	16206
Bozhou	Bozhou WwTW	8 (near future)	10512	3504	7008
		20 (further future)	26280	8760	17520
Suzhou	Cheng Nan WwTW	8 (near future)	11680	3504	8176
		16 (further future)	23360	7008	16352
Lu'an	Cheng Bei WwTW	4 (near future)	10804	3504	7300
		25 (further future)	33763	10950	22813
	Cheng Dong WwTW	8 (near future)	10804	3504	7300
Guoyang	Cheng Dong WwTW	4 (near future)	6388	2190	4198
		10 (further future)	12775	4380	8395

12.2 COD Removed, Shandong Province

Feicheng, Heze, Rizhao City and Ju County in Shandong Province will benefit from improved urban surface water quality after construction of sewerage and WwTWs. In the case of Rizhao City, the adjacent sea water quality will also be improved with benefits to fisheries and important tourist bathing beaches. The improved wastewater treatment systems at the Chengwu Paper Mill will significantly reduce current levels of pollution discharging to the Dong Yu River benefiting downstream communities.

After the HRWPCP is implemented the situation with respect to COD_{cr} discharges will be as shown in **Table S-12.**

Table S-12: Total COD_{cr} Discharged in Shandong Sub-components

Sub-component	Sewage treatment volume (m^3/d)	COD Discharged after treatment (t/a)	COD removed (t/a)	Total control standard for river section (t/a)
Rizhao	100,000	10220	5110	10220
Ju county	40,000*	1752	5548	1752
Heze	80,000	3504	11096	1000
Feicheng	40,000	1168	5402	1700
Chengwu Paper Mill	1,300 (black liquor) 20,000 (wastewater)	2380	9989.2	3375

* Sewerage is part of HRWPCP - WwTW is being built using local funding and is not part of HRWPCP

Based on the maximum permitted COD discharge for each COD control section in **Table S-12**, the COD discharged before the HRWPCP is implemented and the distance between the sewage discharge site and the control section, it can be seen that without the HRWPCP, the COD discharged to the control section of the receiving rivers will exceed the COD standard.

The construction of the project will have great effect on the realising of total volume control target in Huai River Basin administrated by Shandong. **Table S-13** provides the SIEP estimates of COD reductions associated with HRWPCP projects.

Table S-13: COD forecast for Zhushui, Kangwang, Dongyu River

River	Section	Flow period	COD concentration (mg/l)			% reduction
			before project	after project	reduction	
Zhushui	2000m down stream from the WwTW outfall	Low flow	94.0	36.0	58.0	61.7
Kangwang	100m upstream from the junction with the Hui River	Low flow	137.2	63.7	73.5	53.6
		Flood period	63.6	26.0	37.6	59.1
		Normal flow	117.4	51.9	65.5	55.8
Dongyu	Zhangzhuang	Low flow	660.9	130.6	530.3	80.2
		Flood period	85.8	46.3	39.5	46.0
		Normal flow	103.4	44.3	59.1	57.1

From **Table S-14**, it can be seen that the COD concentration in the river near the proposed WwTWs will be greatly reduced by the HRWPCP. During the low flow period the Zhushui River will be able to reach Class V standard and during the flood period the Kangwang River will be able to reach Class IV. However, the Kangwang, Dongyu and Shu (Ju County) rivers will still not be able to attain better than Class V for all flow periods, although they can satisfy the water quality requirement of farmland irrigation. (wet farming: COD<200 mg/l; dry farming: COD<300 mg/l; vegetable COD<150mg/l).

Table S-14: Water Quality Situation of Zhushui, Kangwang, Dongyu River after Implementing HRWPCP

River	Section	Flow period	COD concentration (mg/l)	COD standard for river (mg/l)	Proportion of standard
Zhushui	2000m down stream from the WwTW outfall	Low flow	36.0	40	0.9
Kangwang	100m upstream from the junction with the Hui River	Low flow	63.7	30	2.1
		Flood period	26.0	30	0.9
		Normal flow	51.9	30	1.7
Dongyu	Zhangzhuang	Low flow	130.6	30	4.3
		Flood period	46.3	30	1.5
		Normal flow	44.3	30	1.5

Using the hydrological parameters receiving rivers and COD reduction percentage, SIEP forecasted the incremental additional COD concentration at the control section of the receiving river before and after finishing each sub-project. The results are shown in **Table S-15**.

Table S-15: Forecast Result of Water Quality Improvement to the Control Section of Related River

Unit: mg/l

River	Section	Flow period	Additional COD concentration		COD reduction concentration after treating the wastewater
			Before finishing project	After finishing project	
Shu	Xiazhuang	Low flow	31.5	7.6	23.9
		Flood period	6.1	1.5	4.6
		Normal flow	18.9	4.5	14.4
Zhuzhaoxin	Yulou	Low flow	35.5	12.1	23.4
		Flood period	14.3	4.9	9.4
		Normal flow	23.8	8.1	15.7
Daqing	Wangtai bridge	Low flow	15.5	7.2	8.3
		Flood period	1.2	0.5	0.7
		Normal flow	14.9	6.6	8.3
Dongyu	Xuzhai brake	Low flow	493.1	115.9	377.2
		Flood period	31.9	6.1	25.8
		Normal flow	92.3	16.5	75.8

From **Table S-15,** the water quality of the control section of the receiving river will be improved by varying degrees following implementation of each municipal WwTW and Chengwu sub-project. In particular, after the alkali recovery and wastewater wastewater treatment plant of Chengwu paper mill has been put into operation, the mill's wastewater effluent will reach the required discharge standard and the water quality of the Dongyu River (Xuzhai section) will be improved significantly.

The water quality of Shu River (Xiazhuang section) and Zhuzhaoxin River (Yulou section) will also be improved by varying degrees after finishing the WwTW of Ju County (WwTW not WB funded) and Heze. However, because of the longer distance (approximate 100km) between Feicheng WwTW and the Wangtai bridge section of Daqing River and the relatively small quantity of wastewater treated by the WwTW compared to the flow of the Daqing River, its ability to significantly improve the water quality of the Daqing River after finishing the project is limited.

The discharge quantity of COD_{cr} meets the requirement of the Total Quantity Control index made by the provincial government. So the construction of project will play an active role in reaching the target of Total Quantity Control in the Huai River Basin of Shandong province. However, the HRWPCP cannot attain the total control indicators on its own in the short-term, and significant additional investment is required for both point and non-point source pollution to allow the Shandong river reaches to meet the water quality targets.

13 CONCLUSIONS AND RECOMMENDATIONS

1. The environmental conditions are serious and the environmental infrastructure needs of Anhui and Shandong Provinces are extensive and continue to expand rapidly.

2. The HRWPCP projects have emerged from a basin-wide prioritisation process, are well formulated, and have detailed feasibility stage designs and cost estimates.

3. There is good public support for the projects based on meetings in the project cities and public opinion surveys.

4. The proposed projects can meet financial and economic tests of sustainability and are affordable to the local citizens.

5. Social impacts, consisting mainly of land acquisition and resettlement, are addressed by detailed RAPs, and, in any case, are not significantly adverse.

6. The potential environmental benefits of the HRWPCP are large, as reported in the previous sections. However, there are significant additional point and non-point water quality controls necessary as well as a need to maintain or augment existing minimum stream-flows, before the WPCP goals can be realised in the Basin.

7. Potential construction and operational phase impacts of the HRWPCP have been adequately assessed and no major issues have been identified. Detailed mitigation actions and monitoring procedures have been prepared which should adequately minimise any effect of these potential impacts. Monitoring costs have been included for this work and assignments detailed.

8. The recommendations included herein by the Hefei Design Institute are rational and should be considered in the design and construction of these projects. These recommendations included:

    - HDI suggests that the related sectors relax the phosphorus discharge standards for the two proposed WwTWs. [The Anhui Provincial EPB have agreed to the proposed effluent standards and specific facilities for phosphorus removal are not included in the design. If required, chemically assisted phosphorus removal can be implemented easily at a later date].
    - HDI recommends that further treatment of effluent be considered before the effluent is used directly for agricultural irrigation water supply. [The HRWPCP projects are designed for direct discharge, so this recommendation is considered one for the future if direct land application of effluent is proposed by the project cities.]

9. The recommendations included herein by the Shandong Research and Design Institute are rational and should be considered in the design and construction of these projects. These recommendations included:

    - Main plants discharging pollutants in the service area of WwTW should improve spot pollution source control. The concentration of wastewater discharge should attain the standard for discharge to sewers;
    - Other cities in Huai River Basin of Shandong Province should built WwTWs as soon as possible.
    - Tertiary wastewater treatment equipment should be constructed in order to improve treatment further when the economic conditions allow. Tertiary wastewater treatment provides positive conditions for safe reusing of treated wastewater.
    - It is suggested that secondary biochemical treatment technique should be adopted when the second phase of construction of Rizhao WwTW is being carried out.

10. The overall conclusion is that the potential positive impacts are large, the potential negative construction and operation impacts can be successfully mitigated, and the projects contain no

serious problems or "fatal flaws" in its formulation. The project components are essentially environmentally positive and should be approved.

14 ONGOING ACTIVITIES

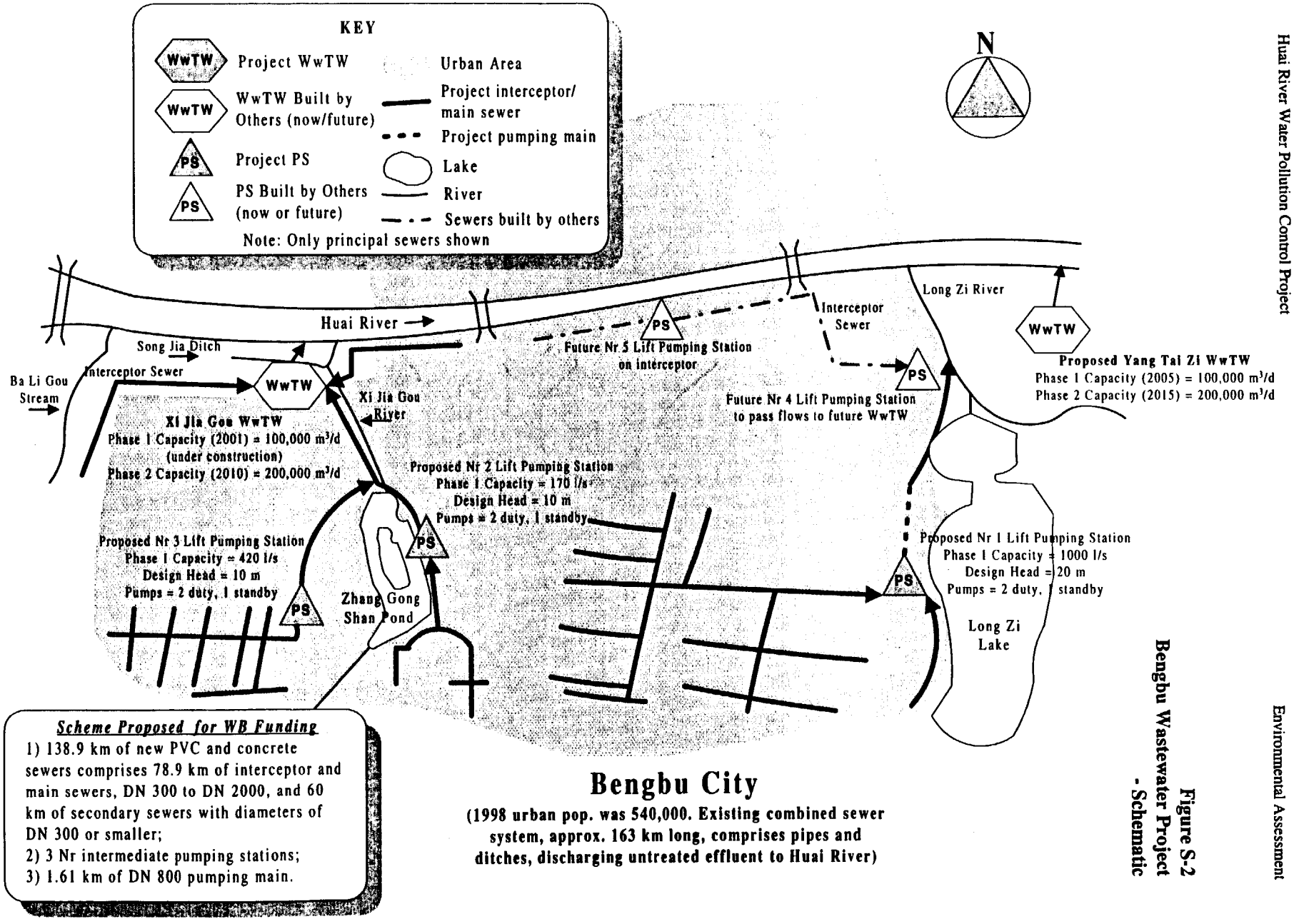
The enormous pollution loads, both point and non-point, in the Huai River Basin, coupled with the monsoon rain pattern that causes little stream baseflow during the dry season, make the realisation of the national goals for the Basin difficult. The HRWPCP is a critical step on the road to making these goals a reality, but a wide range of additional activities and interventions will be necessary in conjunction with, or following the HRWPCP. The 3H Action Plan is an ongoing effort to develop "big-picture" planning for the Huai River Basin, along with the Hai and Huang River Basins. Basin-wide water quality modelling efforts are also underway to provide better predictive tools to assess the impacts and cost-effectiveness of proposed interventions.

Due to the large backlog of water pollution control needs shown in the 3H Action Plan, it is likely that the HRWPCP will be only the beginning of a long-term investment programme for environmental infrastructure in the Basin. Further phases of the HRWPCP will benefit from the work contained in the 3H Action Plan, the basin-wide water quality modelling work, the improved water quality monitoring program, and the preparation work for this project. Some of the problems that may be considered in the future are the backlog of municipal and industrial treatment projects, the TVEs and other rural sources including non-point source pollution, as well as water rights management and other structural and non-structural methods to improve the seasonal low-flow problems in the basin.

15 ATTACHED FIGURES

The following figures are included in this summary to illustrate the proposed sub-components in more detail:

- **Figures S-2 to S-9** provide schematics of the proposed Anhui municipal sub-components.
- **Figures S-10 to S-14** provide schematics of the proposed Shandong municipal and industrial sub-components.



Scheme Proposed for WB Funding

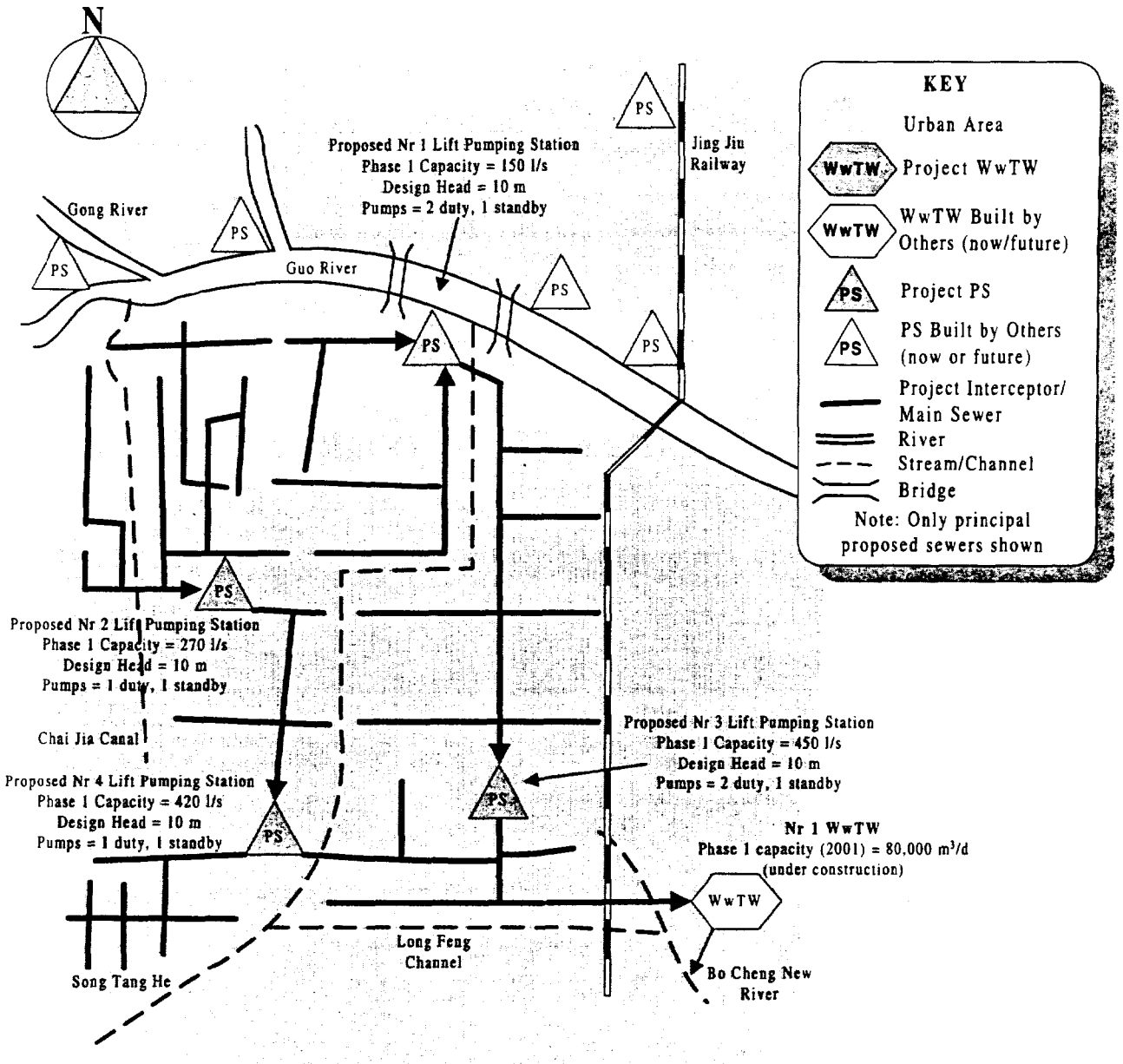
1) 138.9 km of new PVC and concrete sewers comprises 78.9 km of interceptor and main sewers, DN 300 to DN 2000, and 60 km of secondary sewers with diameters of DN 300 or smaller;
2) 3 Nr intermediate pumping stations;
3) 1.61 km of DN 800 pumping main.

Bengbu City

(1998 urban pop. was 540,000. Existing combined sewer system, approx. 163 km long, comprises pipes and ditches, discharging untreated effluent to Huai River)

Figure S-2
Bengbu Wastewater Project
- Schematic

Figure S-3
Bozhou Wastewater Project
- Schematic



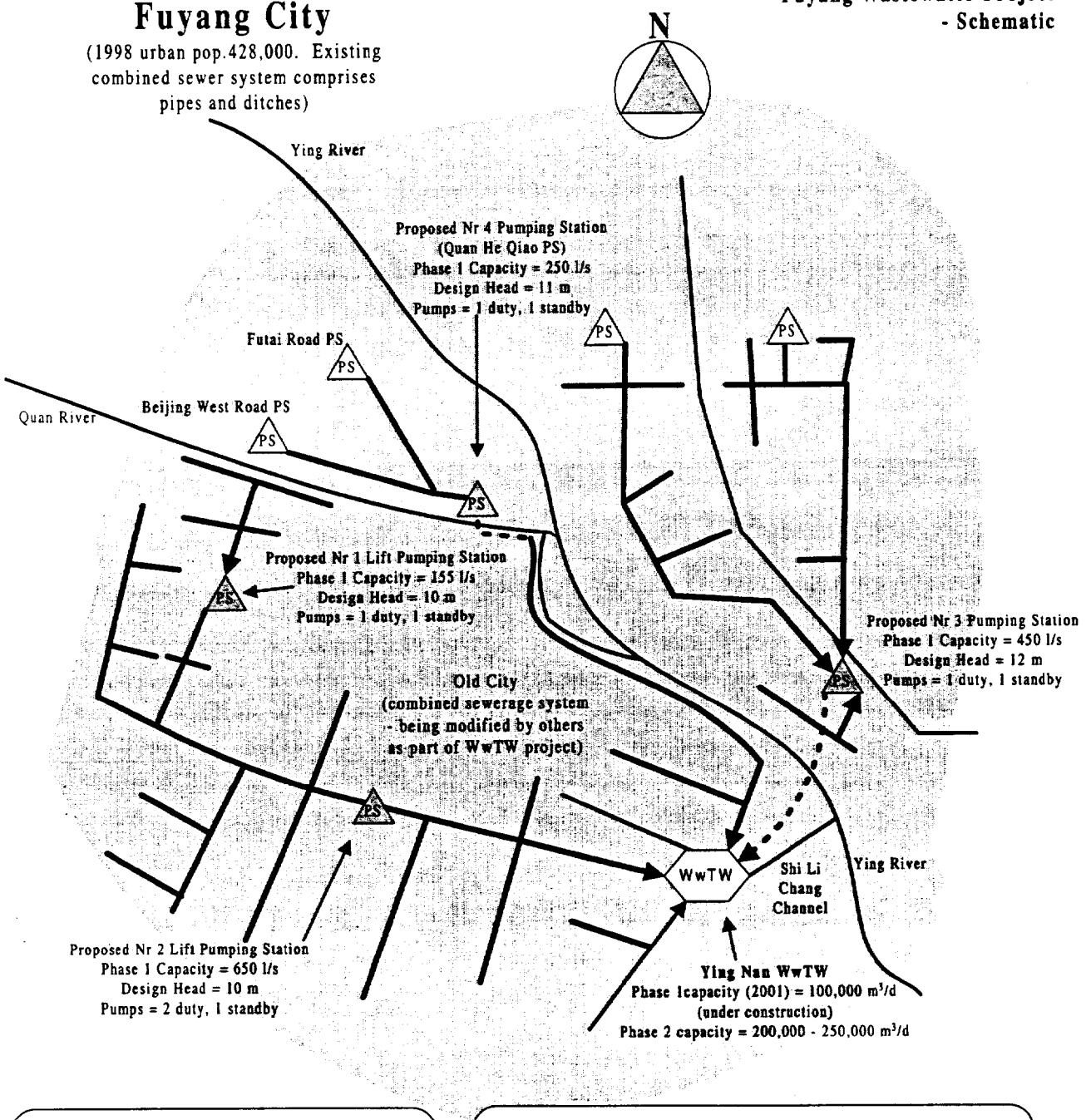
Bozhou City

(1998 urban pop. was 241,800. Existing combined sewer system, approx. 154 km long, comprises pipes and ditches discharging untreated effluent to river system)

Scheme Proposed for WB Funding

1) 106.3 km of new concrete and PVC sewers comprising 56.3 km of interceptor and main sewers, DN 300 to DN1600, and 50 km of secondary sewers with diameters less than DN 300;
2) Four intermediate pumping stations;

Figure S-4
Fuyang Wastewater Project
- Schematic



Scheme Proposed for WB Funding

1) 131.7 km of new PVC and concrete sewers comprises 81.7 km of interceptor and main sewers, DN 400 to DN 1500, and 50 km of secondary sewers with diameters of DN 300 or smaller;
2) 4 Nr intermediate pumping stations;
3) 3.0 km of pumping main, DN600 to DN900.

KEY

- WwTW — Project WwTW
- WwTW — WwTW Built by Others (now/future)
- PS — Project PS
- PS — PS Built by Others (now or future)
- Urban Area
- Project interceptor/ main sewer
- Project pumping main
- River

Note: Only principal proposed sewers shown

Figure S-5
Guoyang Wastewater Project
- Schematic

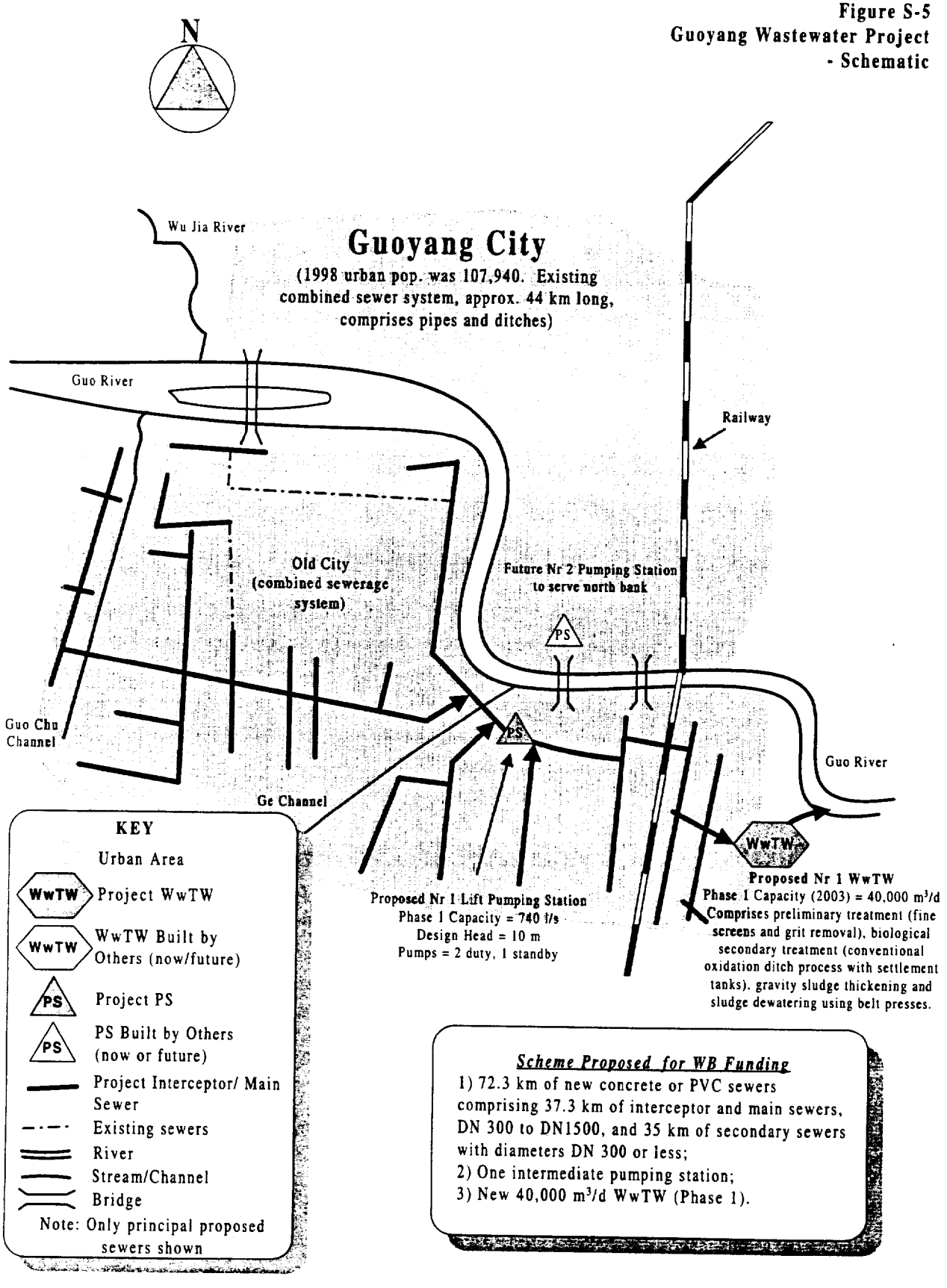
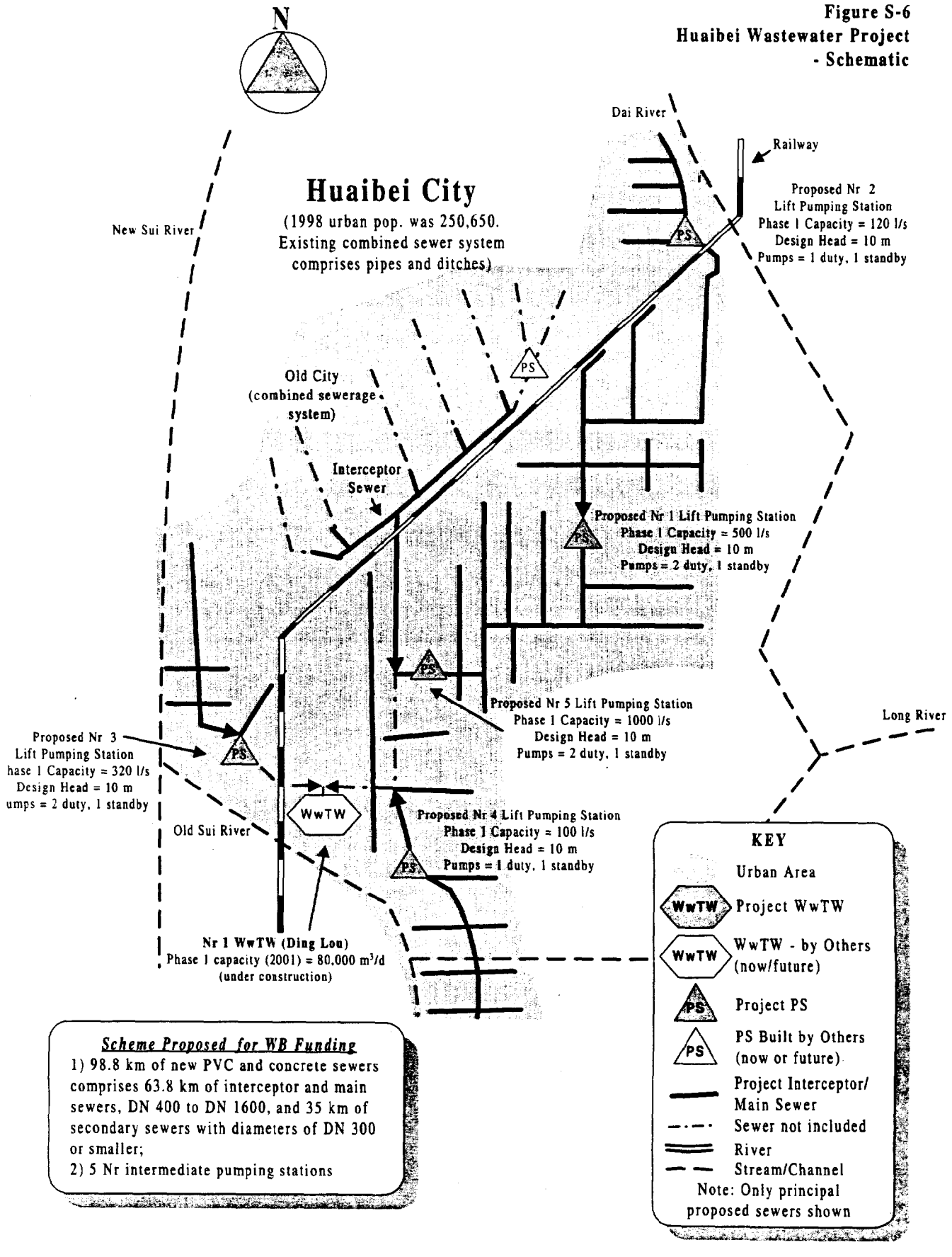
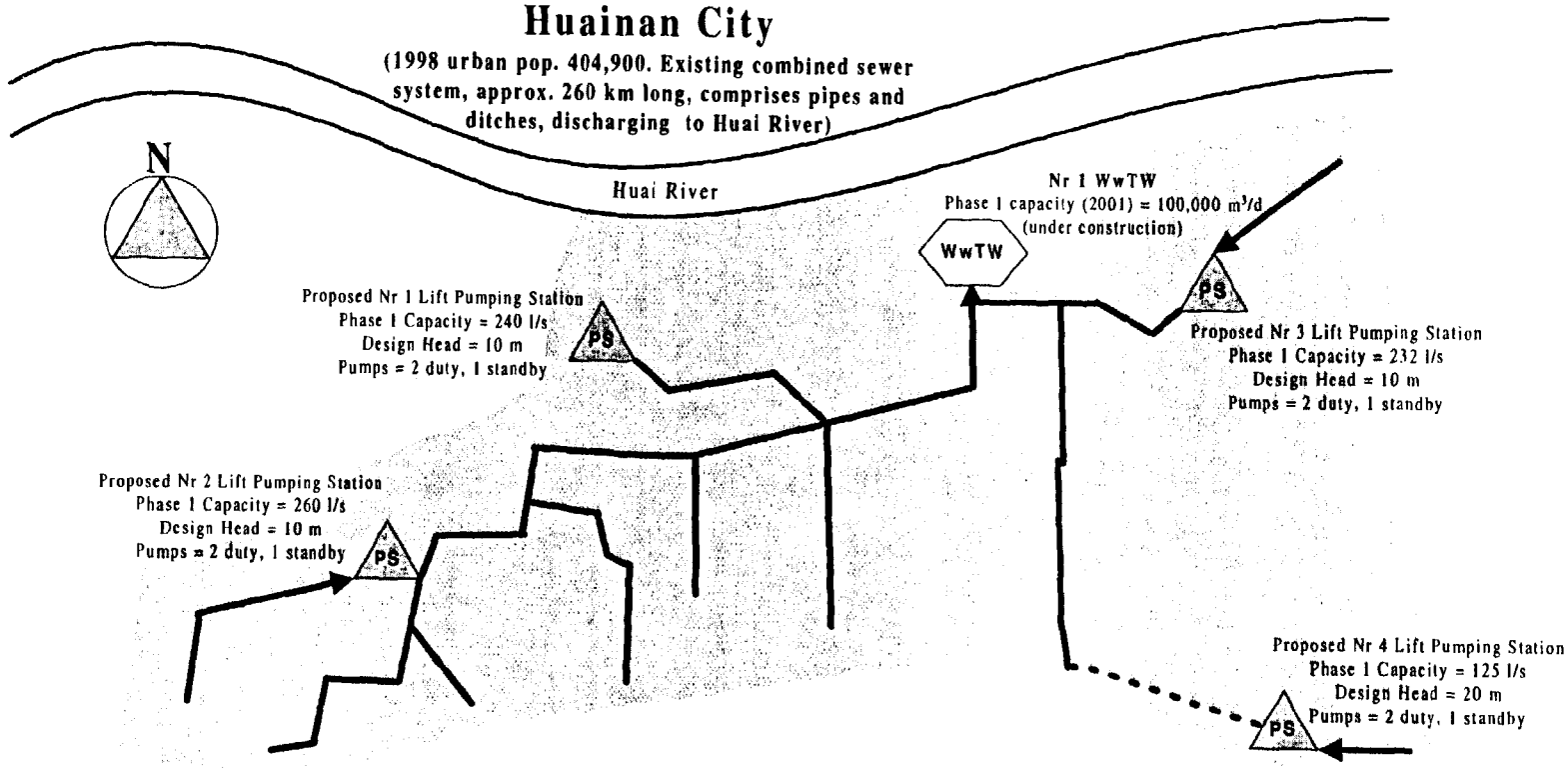


Figure S-6
Huaibei Wastewater Project
- Schematic





Scheme Proposed for WB Funding

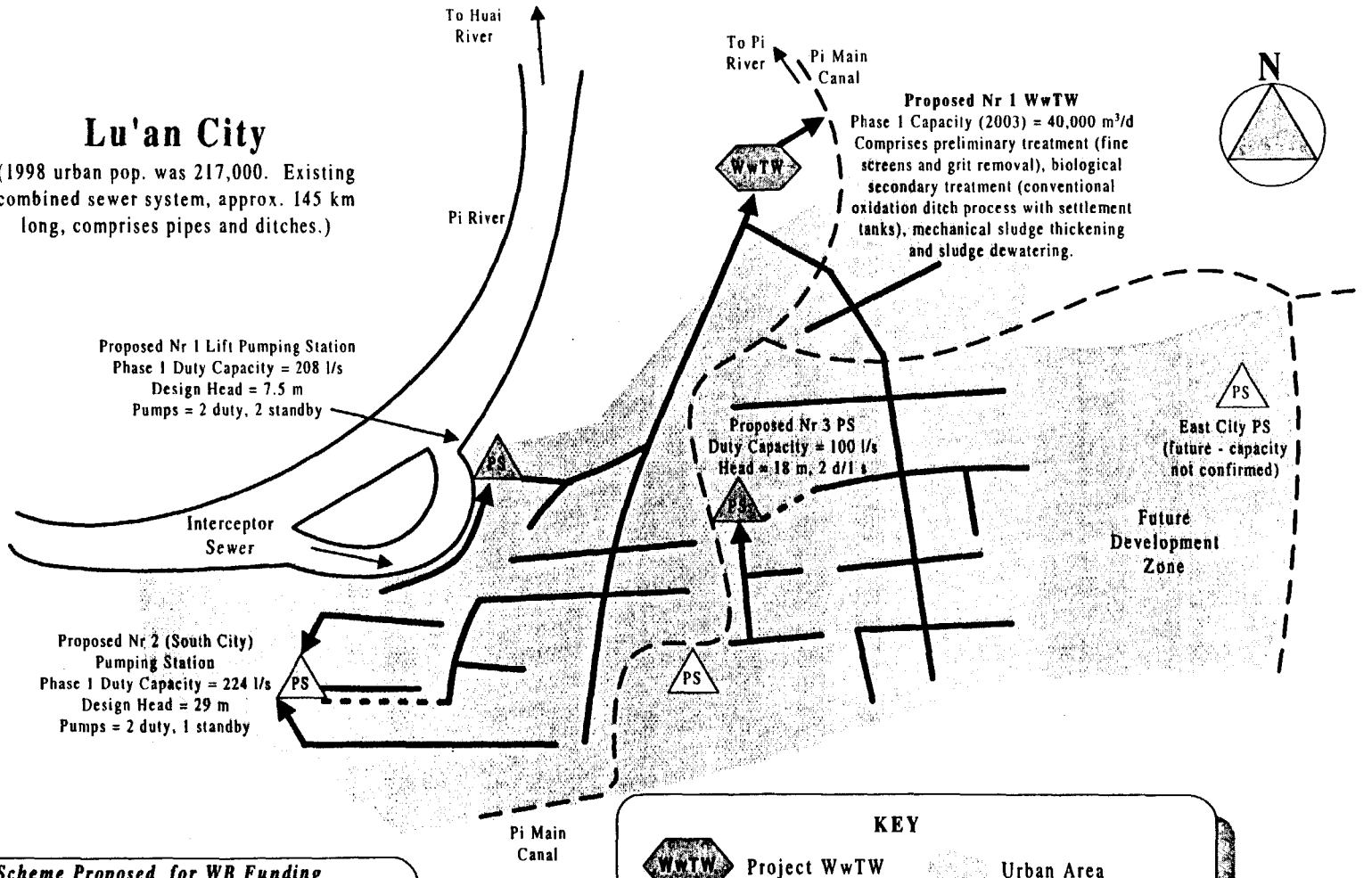
1) 87.6 km of new PVC and concrete gravity sewers comprises 48.6 km of interceptor sewers, DN 400 to DN 1800, and 39 km of secondary sewers with diameters of DN 300 or smaller;
2) 4 Nr intermediate pumping stations;
3) 2.6 km of DN 400 pumping main.

KEY

- WwTW — Project WwTW
- WwTW — WwTW Built by Others (now/future)
- PS — Project PS
- PS — PS Built by Others (now or future)
- Urban Area
- Project Interceptor Sewer
- Project pumping main
- River
- Stream/Channel

Note: Only principal proposed sewers shown

Figure S-7
Huainan Wastewater Project - Schematic



Scheme Proposed for WB Funding

1) 34.9 km of new gravity sewers comprises 29.9 km of interceptor and main sewers, DN 300 to DN 1800, and 5 km of secondary sewers with diameters of DN 300 or smaller;
2) 2.4 km of pumping main, DN 300 to DN 600;
3) 3 Nr intermediate pumping stations;
4) One wastewater treatment works with capacity of 40,000 m³/d.

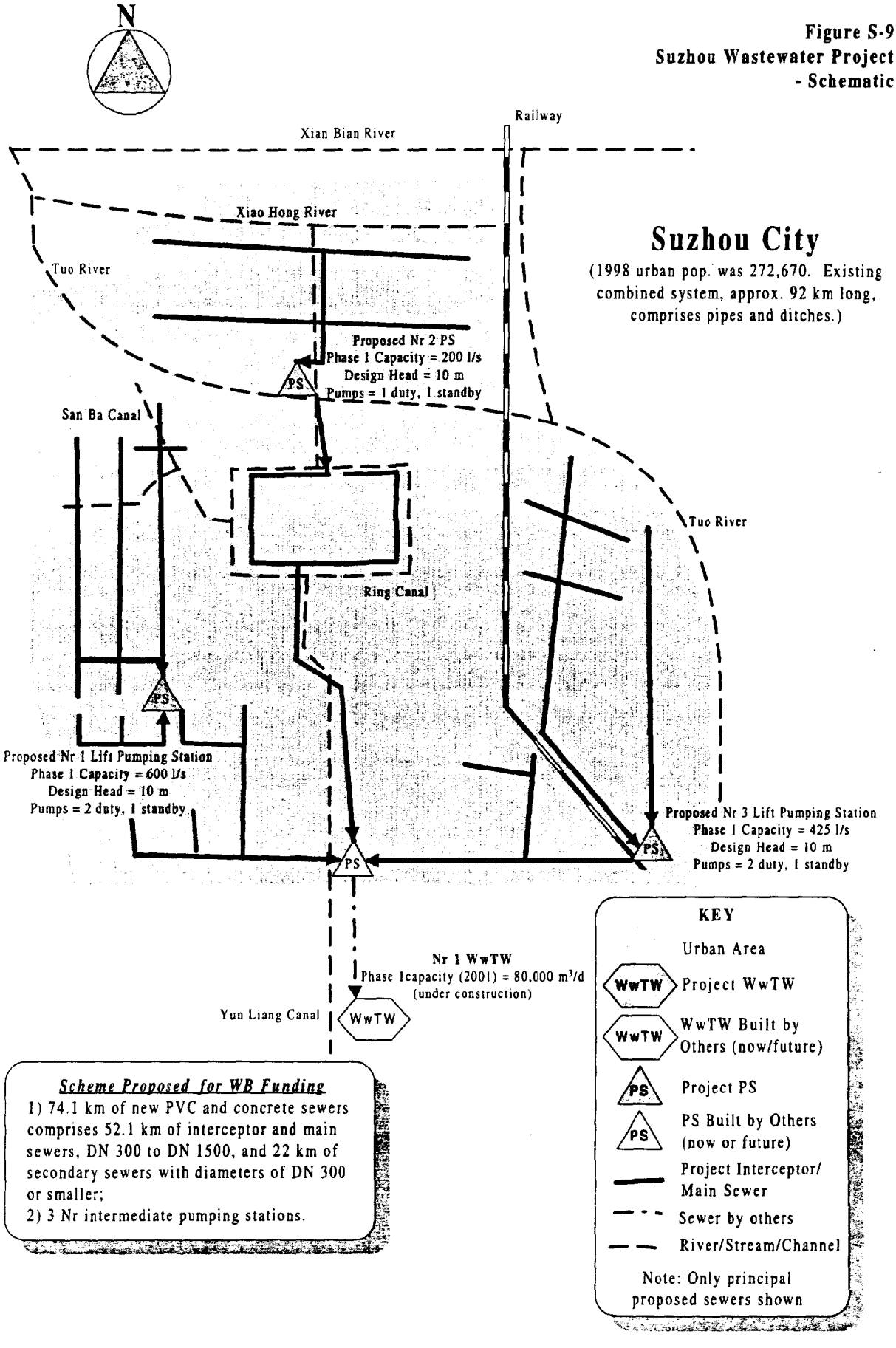
KEY

- WwTW — Project WwTW
- WwTW — WwTW Built by Others (now/future)
- PS — Project PS
- PS — PS Built by Others (now or future)
- Urban Area
- Project interceptor/ main sewer
- Project pumping main
- River

Note: Only principal proposed sewers shown

Figure S-8
Lu'an Wastewater Project - Schematic

Figure S-9
Suzhou Wastewater Project
- Schematic



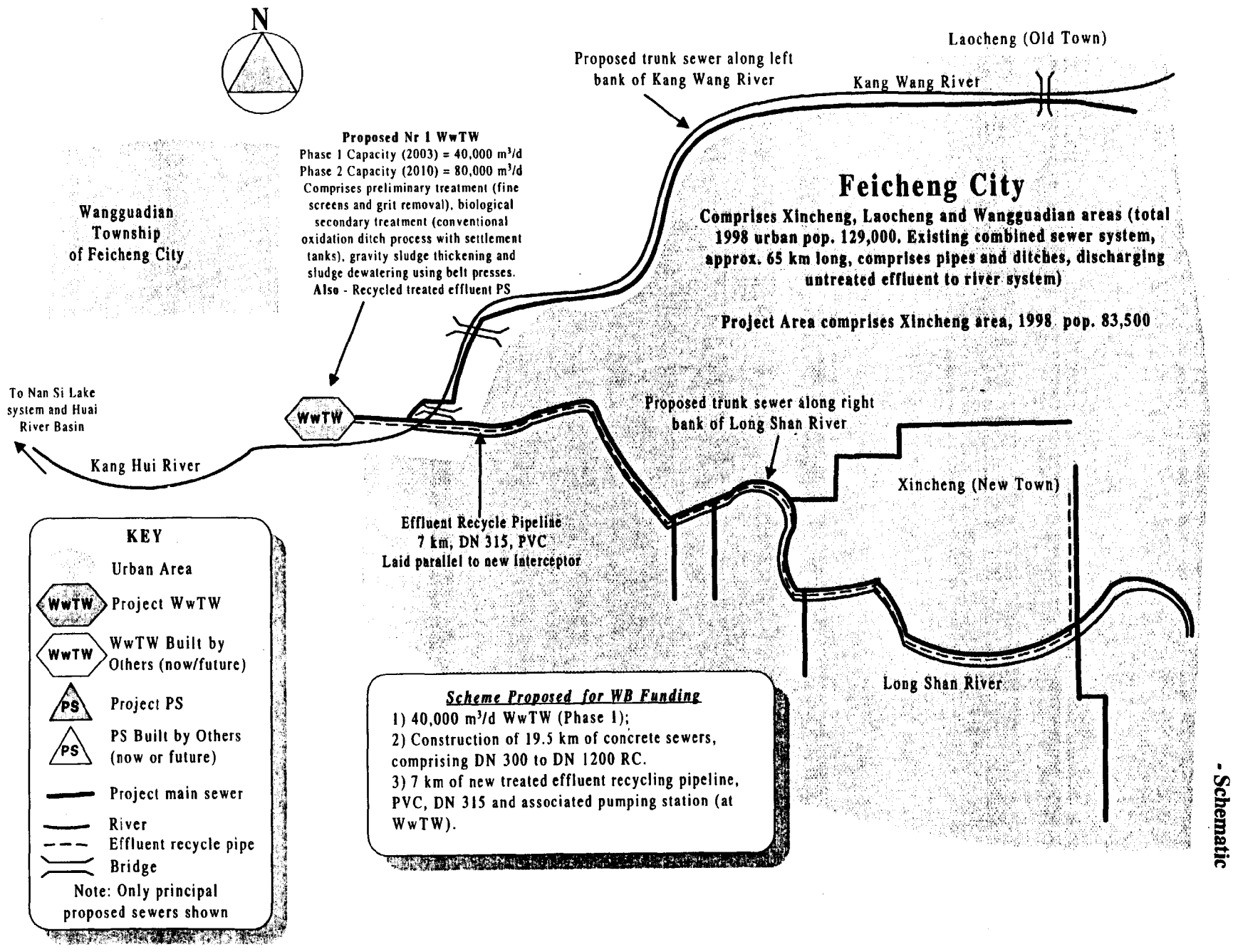


Figure S-10
Feicheng Wastewater Project
- Schematic

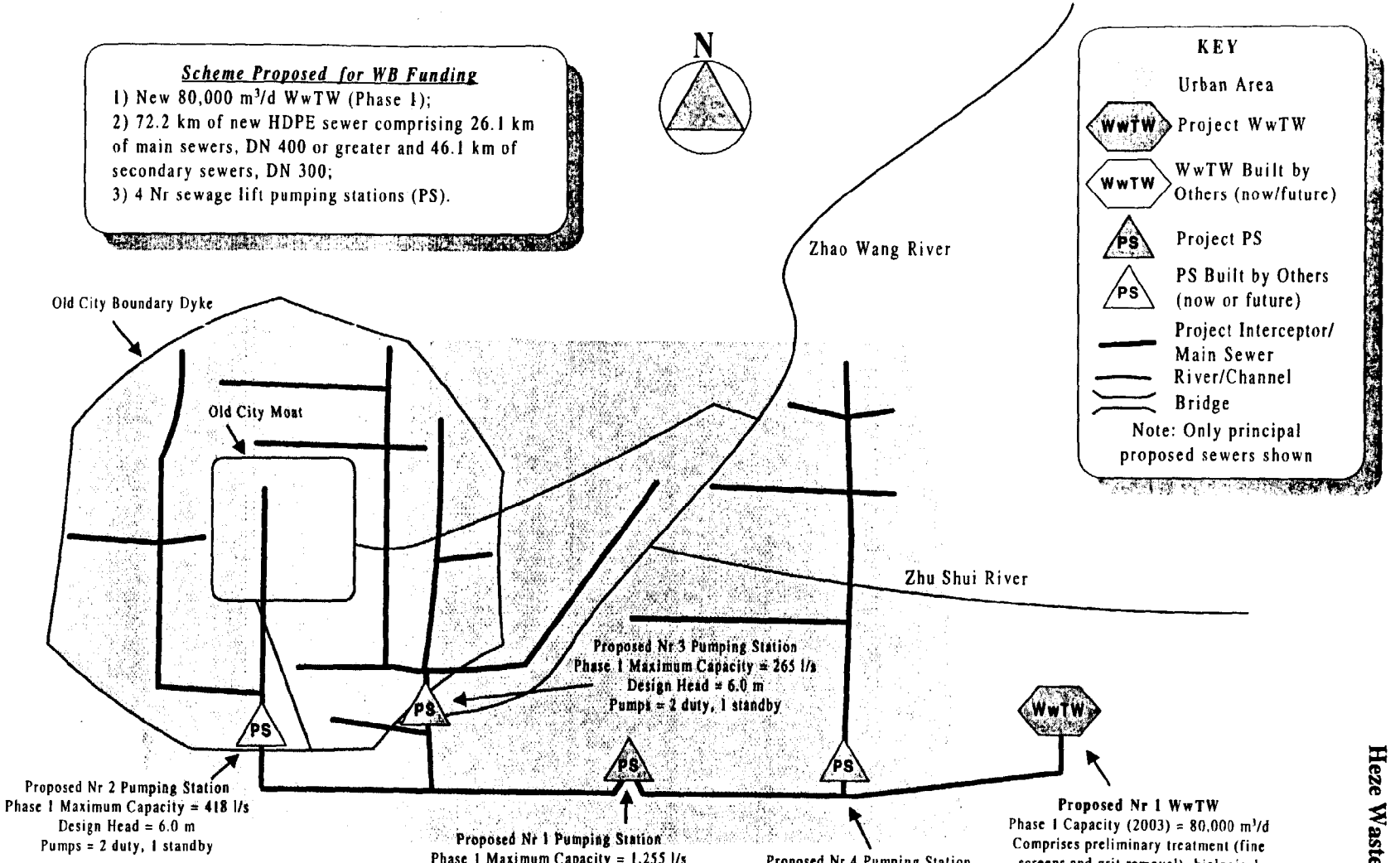
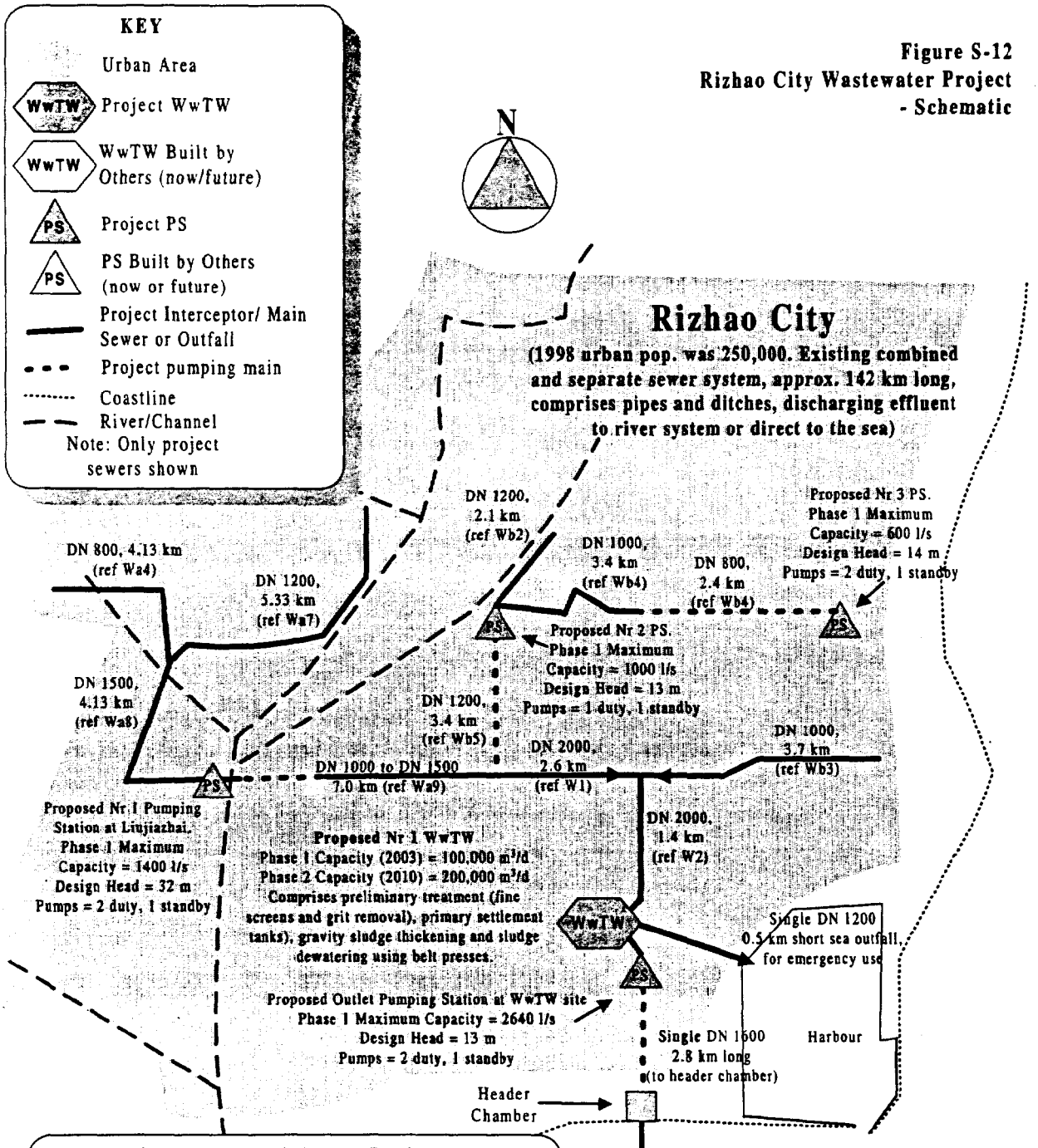


Figure S-11
Heze Wastewater Project - Schematic

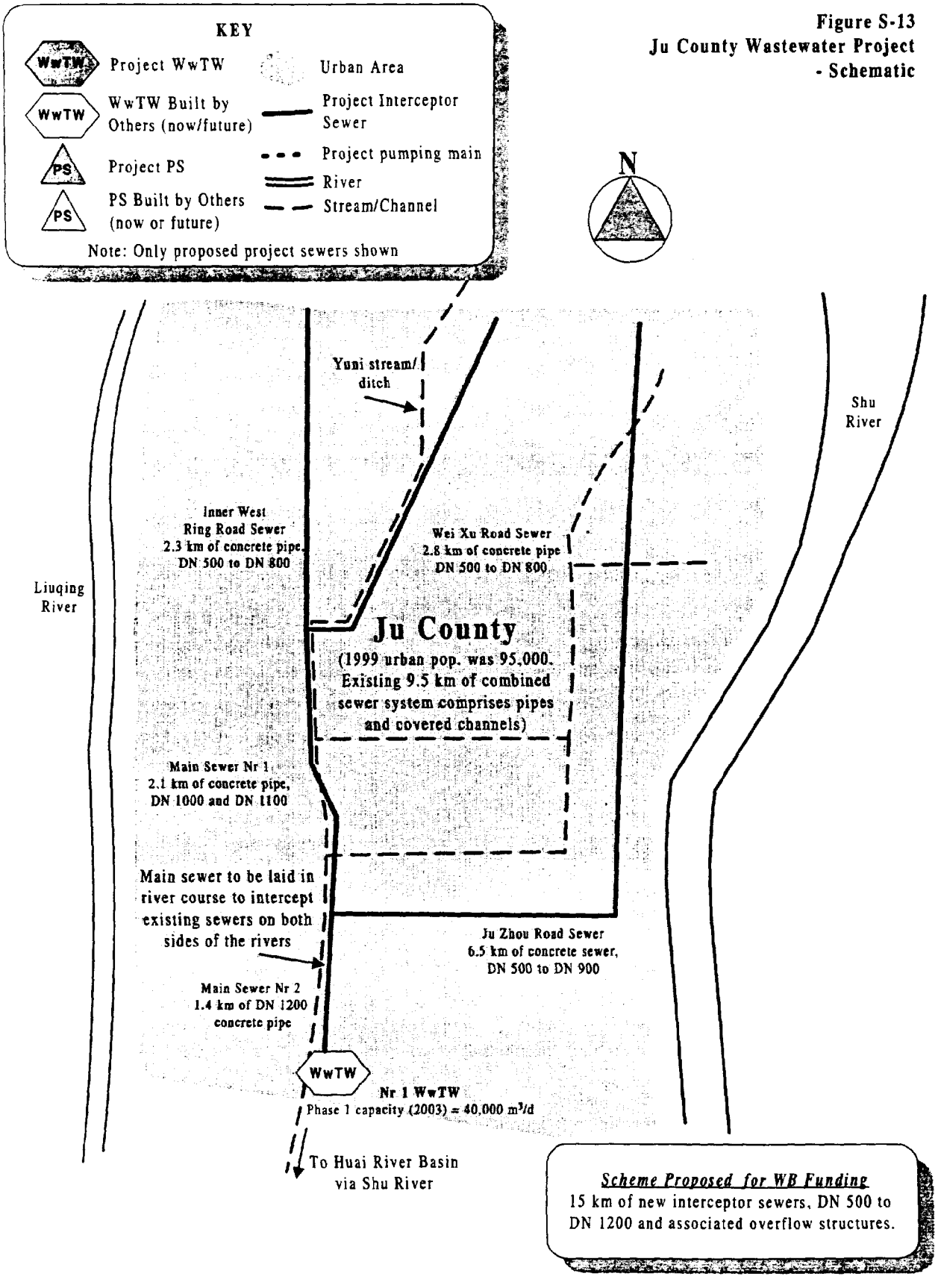
Figure S-12
Rizhao City Wastewater Project
- Schematic



Scheme Proposed for WB Funding

1) 39.6 km of new RC interceptor, main sewers and pumping mains, DN 800 to DN 2000;
2) 3 Nr sewage intermediate pumping stations;
3) 100,000 m³/d WwTW (Phase 1) providing preliminary and primary treatment;
4) 1 Nr outlet pumping station to pump flows to outfall header chamber;
5) 2.8 km of DN 1600 pressure main to head chamber
6) Header chamber and 2.5 km long sea outfall comprising twin DN 1200 laid in submarine trench;
7) Single DN 1200 short sea outfall pipe for emergency use.

Figure S-13
Ju County Wastewater Project
- Schematic



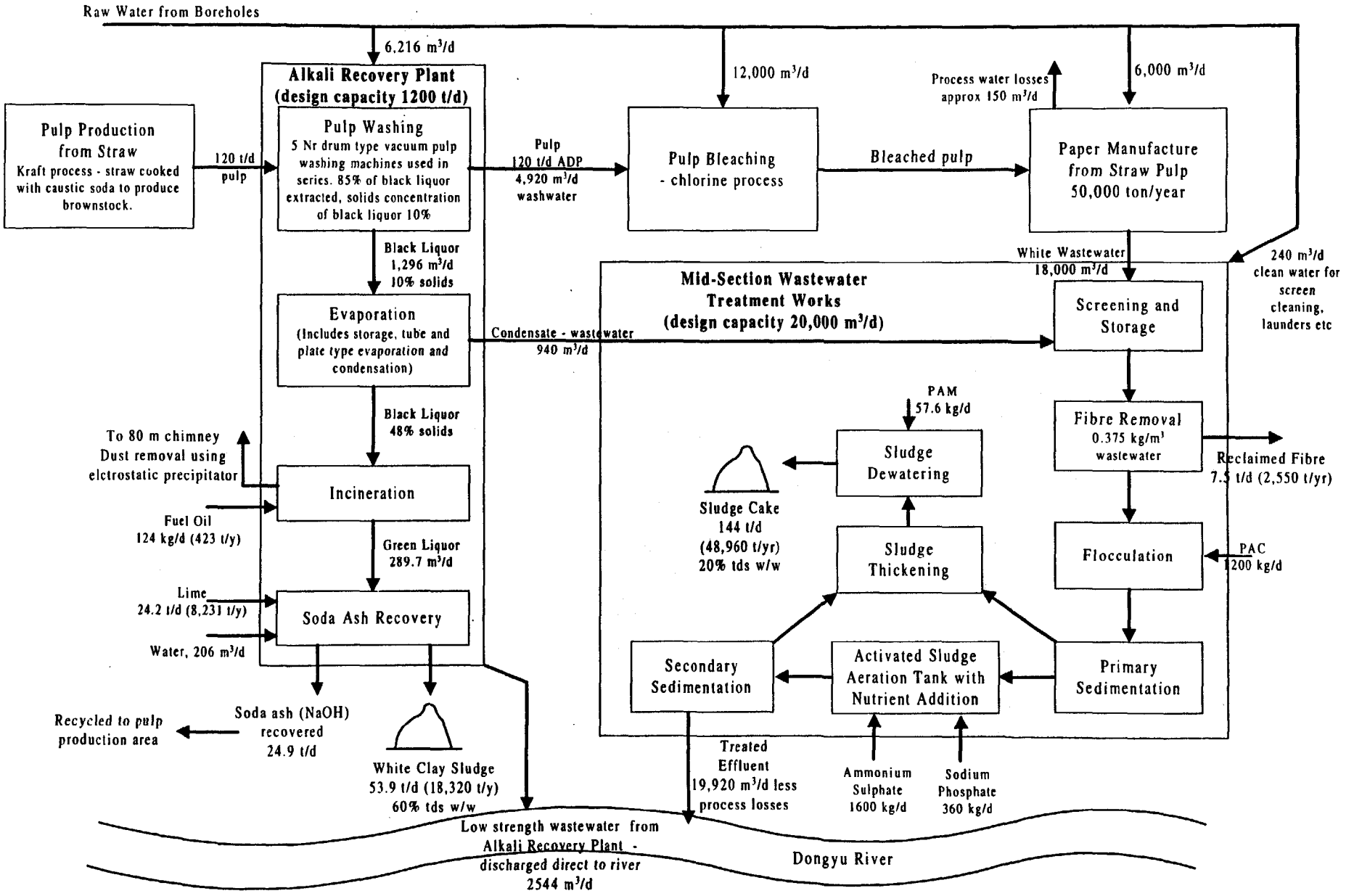


Figure S-14 Chengwu Paper Mill - Proposed Pollution Control Process