

# Environmental Impact Assessment

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36437-013  
January 2015

## PRC: Integrated Ecosystem and Water Resources Management in the Baiyangdian Basin Project

Prepared by Baoding Municipal Government for the Asian Development Bank. This is an updated version of the draft originally posted in May 2007 available on <http://www.adb.org/projects/36437-013/documents>.

## CURRENCY EQUIVALENTS

(as of 1 March 2015)

Currency Unit	-	<b>Yuan (CNY)</b>
CNY 1.00	=	US\$ 0.1613
US\$ 1.00	=	CNY 6.2

## ABBREVIATIONS

ADB	—	Asian Development Bank
B-EPB	—	Baoding Municipal Environmental Protection Bureau
BERMP	—	Baiyangdian Lake ecosystem rehabilitation master plan
BMG	—	Baoding municipal government
BWRB	—	Baoding Municipal Water Resource Bureau
CED	—	clean energy development
C-EPB	—	county environmental protection bureau
COD	—	chemical oxygen demand
dB(A)	—	A-weighted decibel
GEF	—	Global Environment Facility
EIA	—	environmental impact assessment
EMP	—	environmental management plan
EPB	—	environmental protection bureau
ECS	—	environmental supervision company
FSR	—	feasibility study report
HEPB	—	Hebei Provincial Environmental Protection Bureau
IA	—	implementing agency
IEE	—	initial environmental examination
IWM	—	integrated water management
PMO	—	project management office
PRC	—	People's Republic of China
RP	—	resettlement plan
RRP	—	report and recommendation of the President
SEIA	—	summary environmental impact assessment
SEPA	—	State Environmental Protection Administration
SEPP	—	soil erosion prevention plan
SIEE	—	summary initial environmental examination
SNWTP	—	South-to-North Water Transfer Project
SWM	—	solid waste management
UFM	—	urban flood management
WSS	—	water supply systems
WWTP	—	wastewater treatment plant

## **WEIGHTS AND MEASURES**

kg	–	kilogram
km	–	kilometer
m <sup>2</sup>	–	square meter
m <sup>3</sup>	–	cubic meter
mu	–	1/15 <sup>th</sup> of a hectare
ha	–	hectare (10,000 m <sup>2</sup> )
MW	–	megawatt (1 million watts)
t	–	ton (1,000 kg)

## **NOTE**

- (i) In this report, "\$" refers to US dollars.

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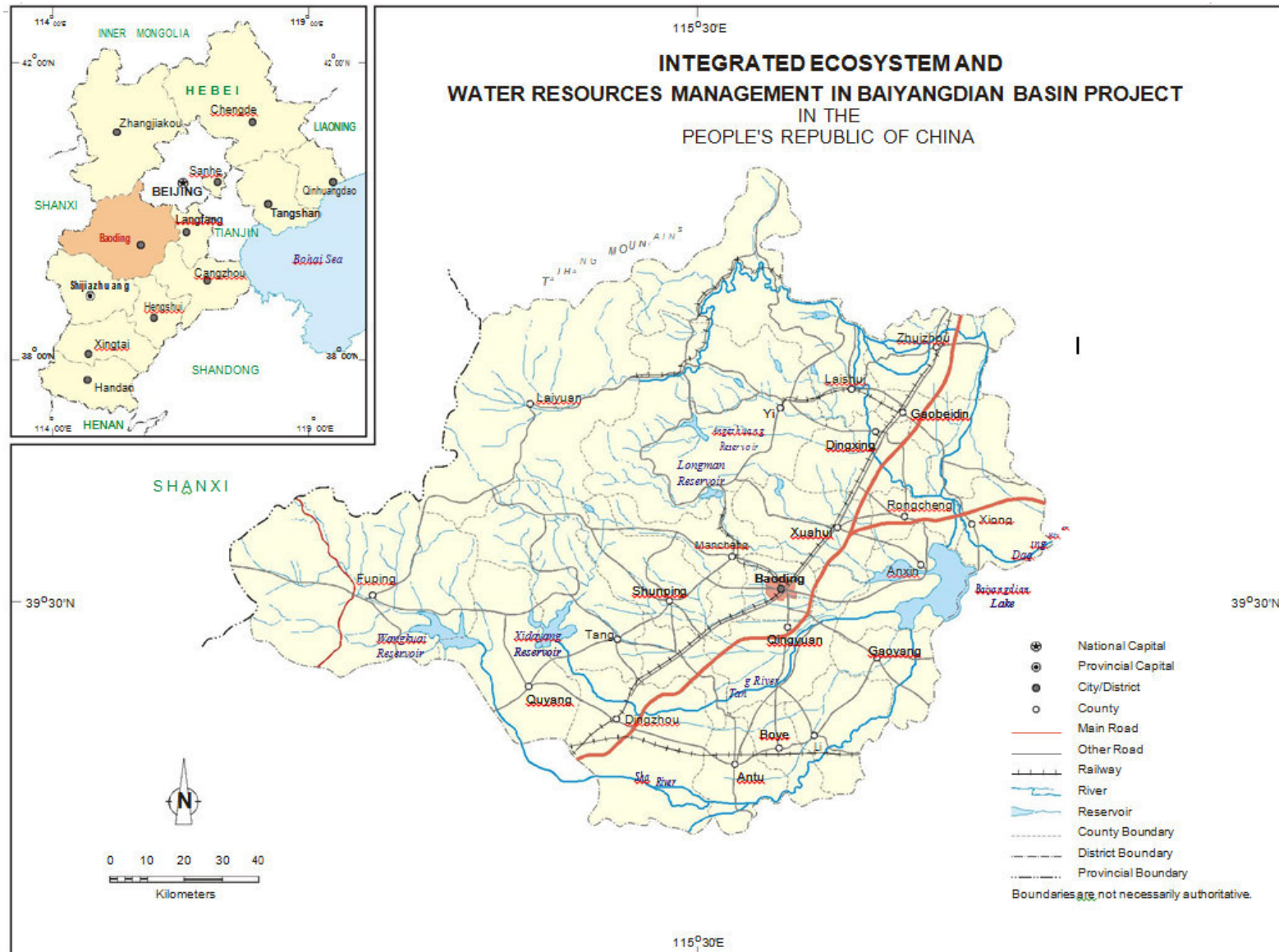
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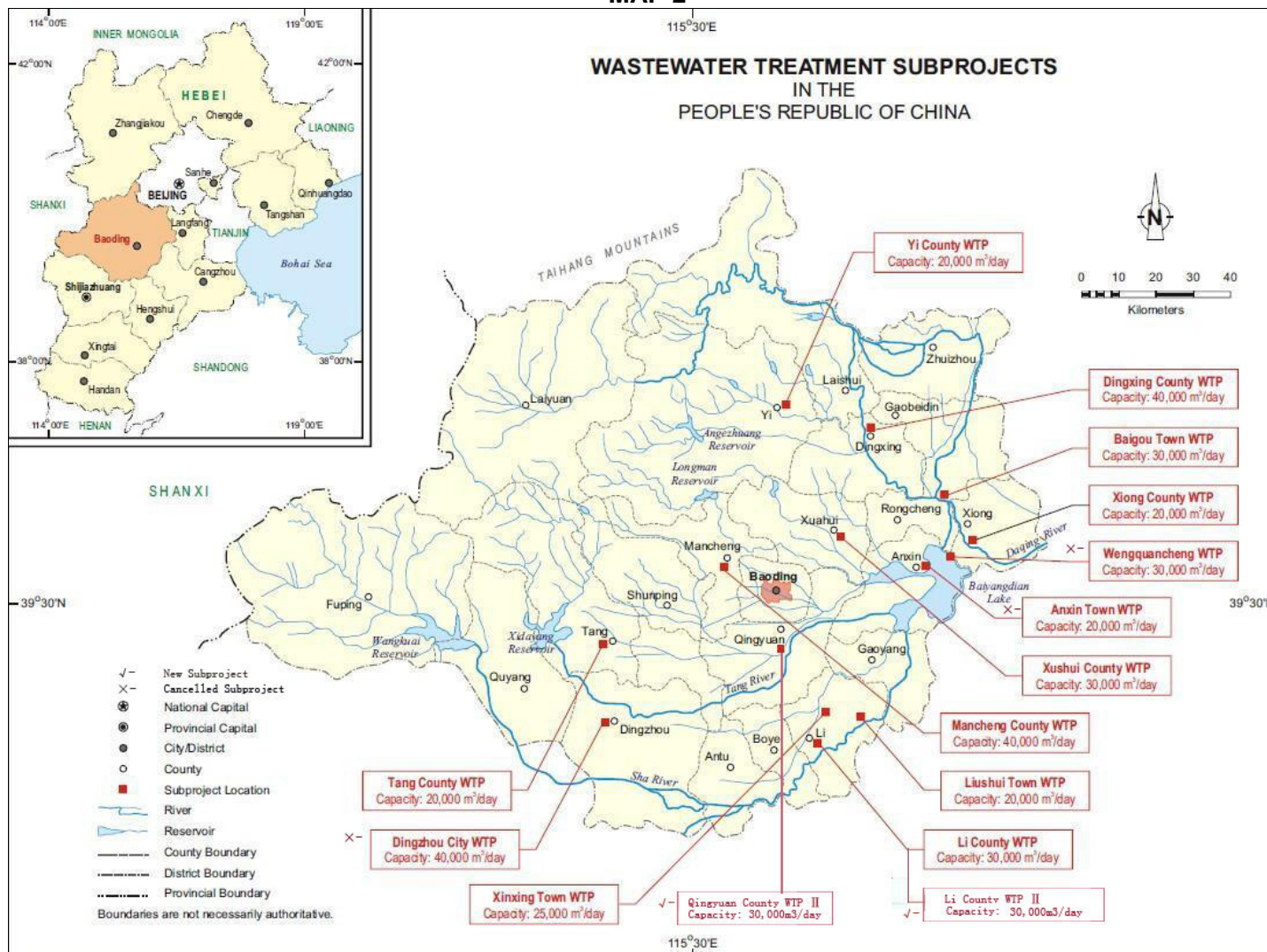
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MAP 1

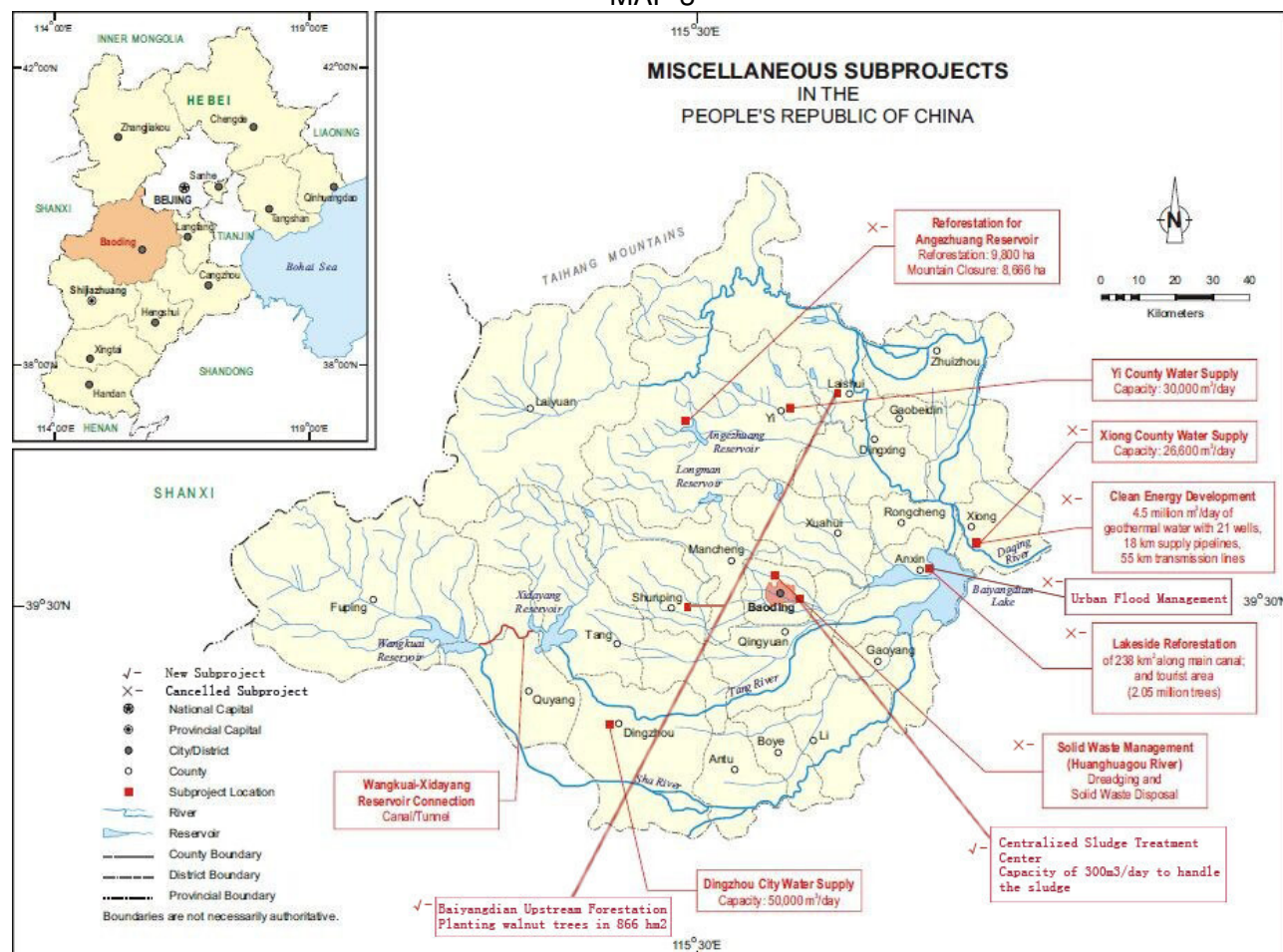


MAP 2



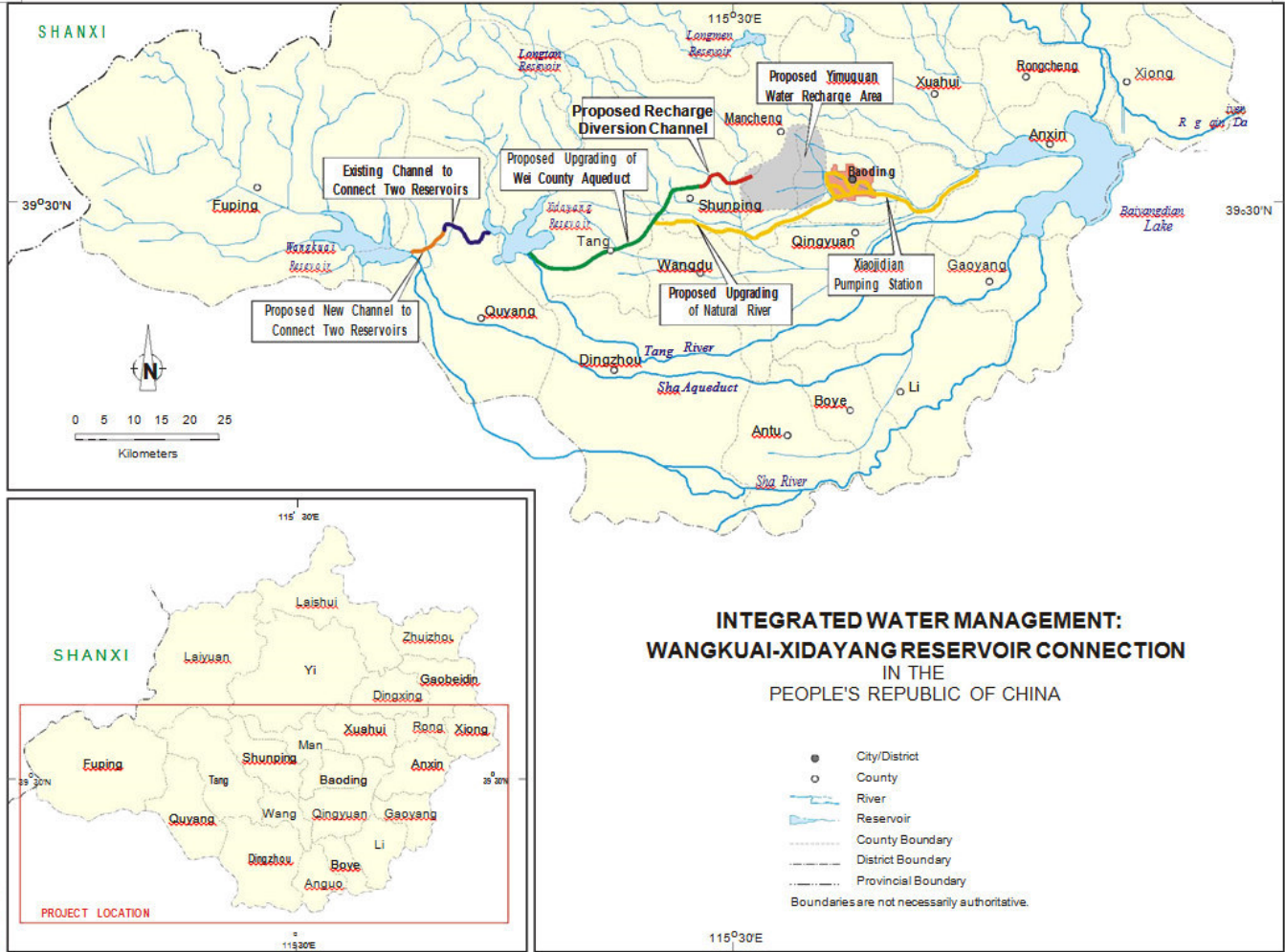


MAP 3



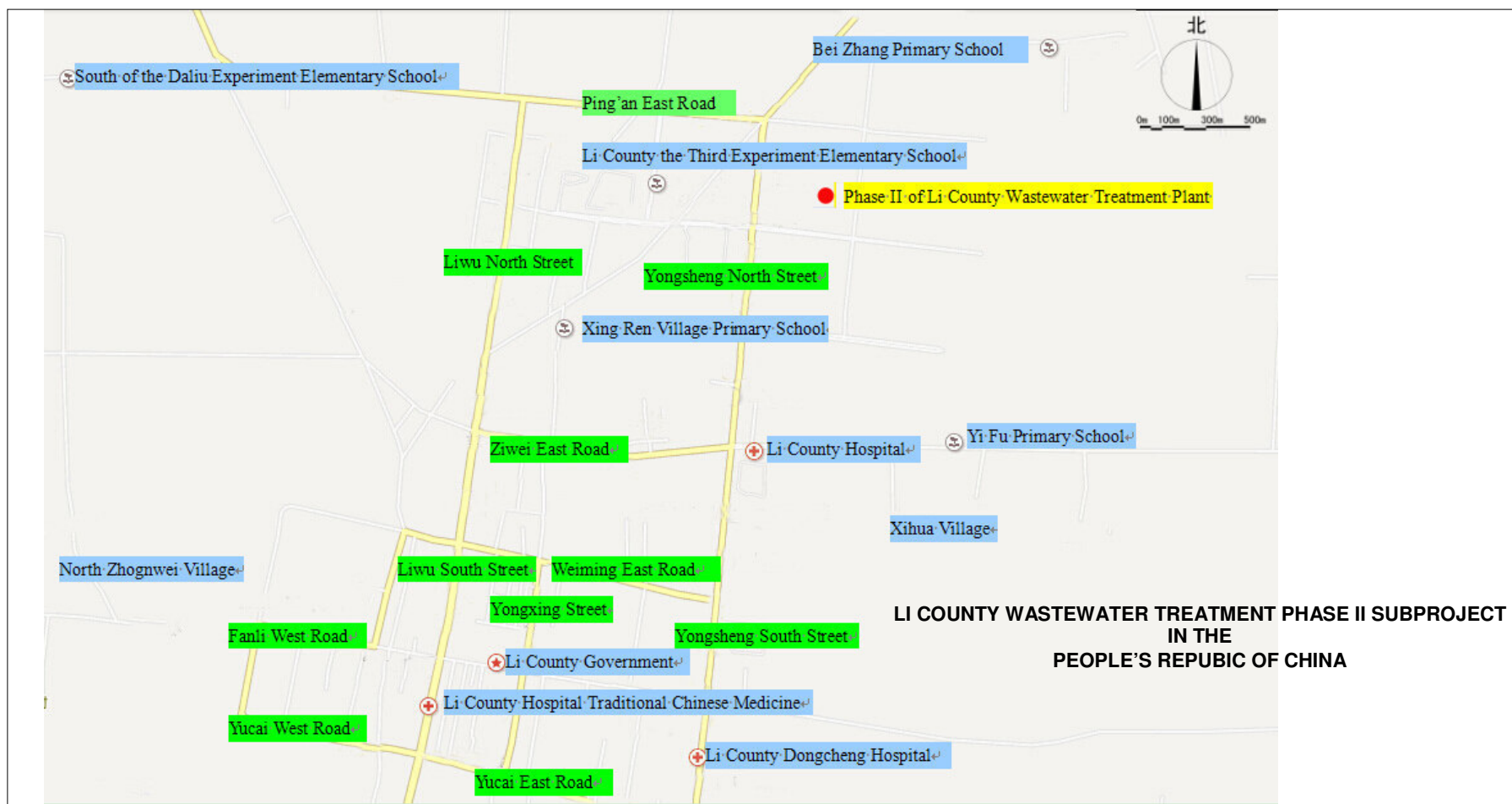


MAP 4

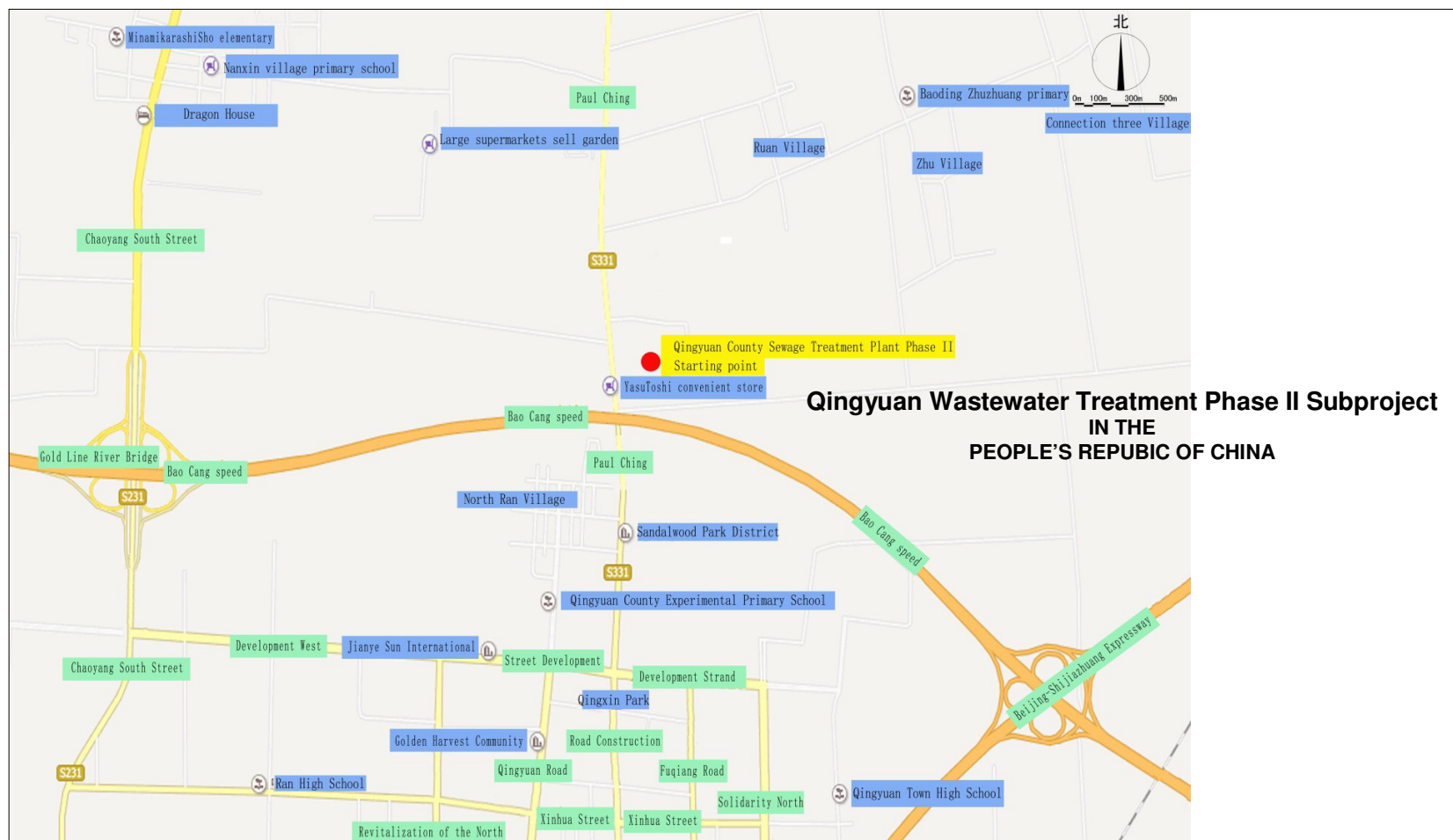




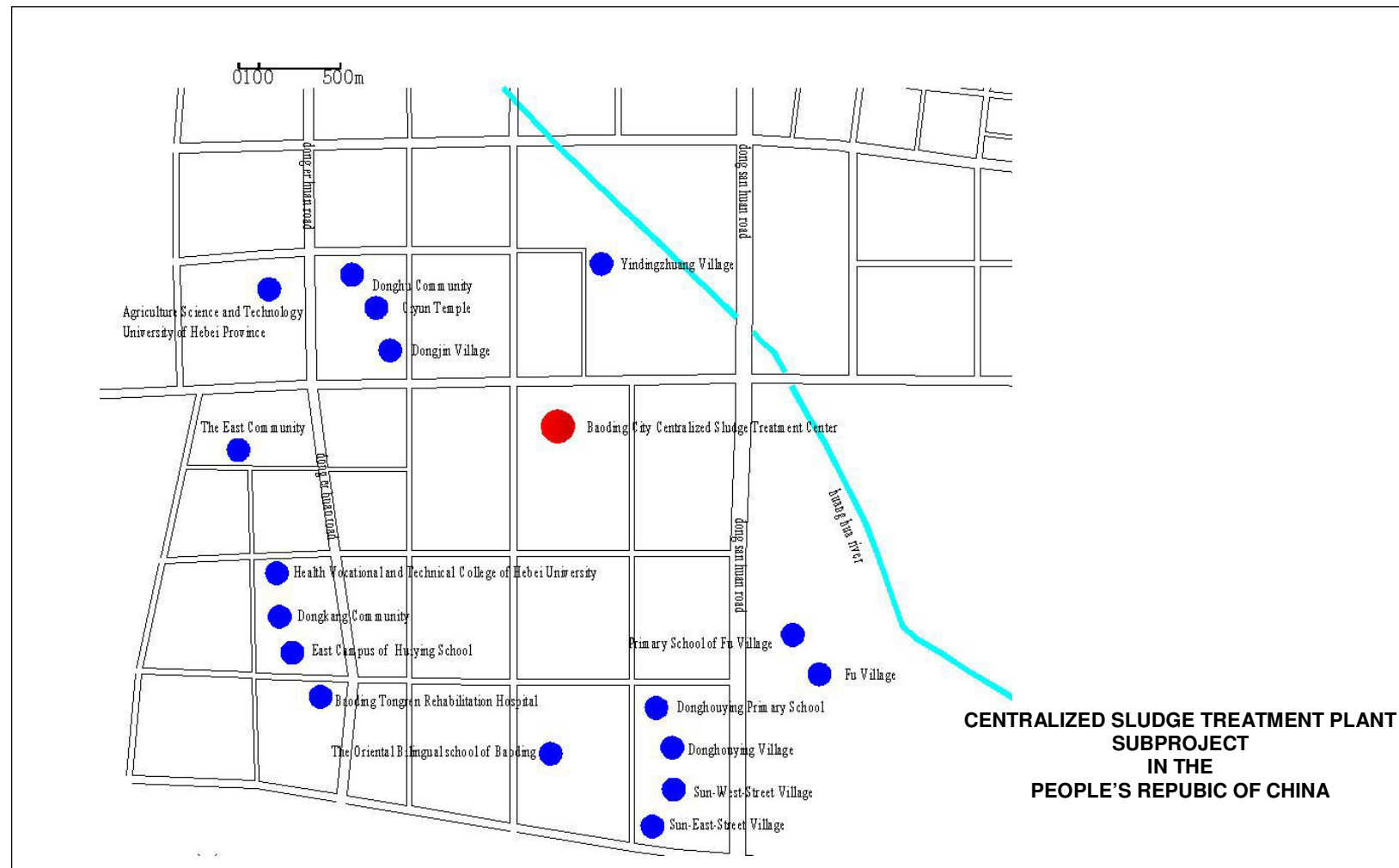
## MAP 5



MAP 6

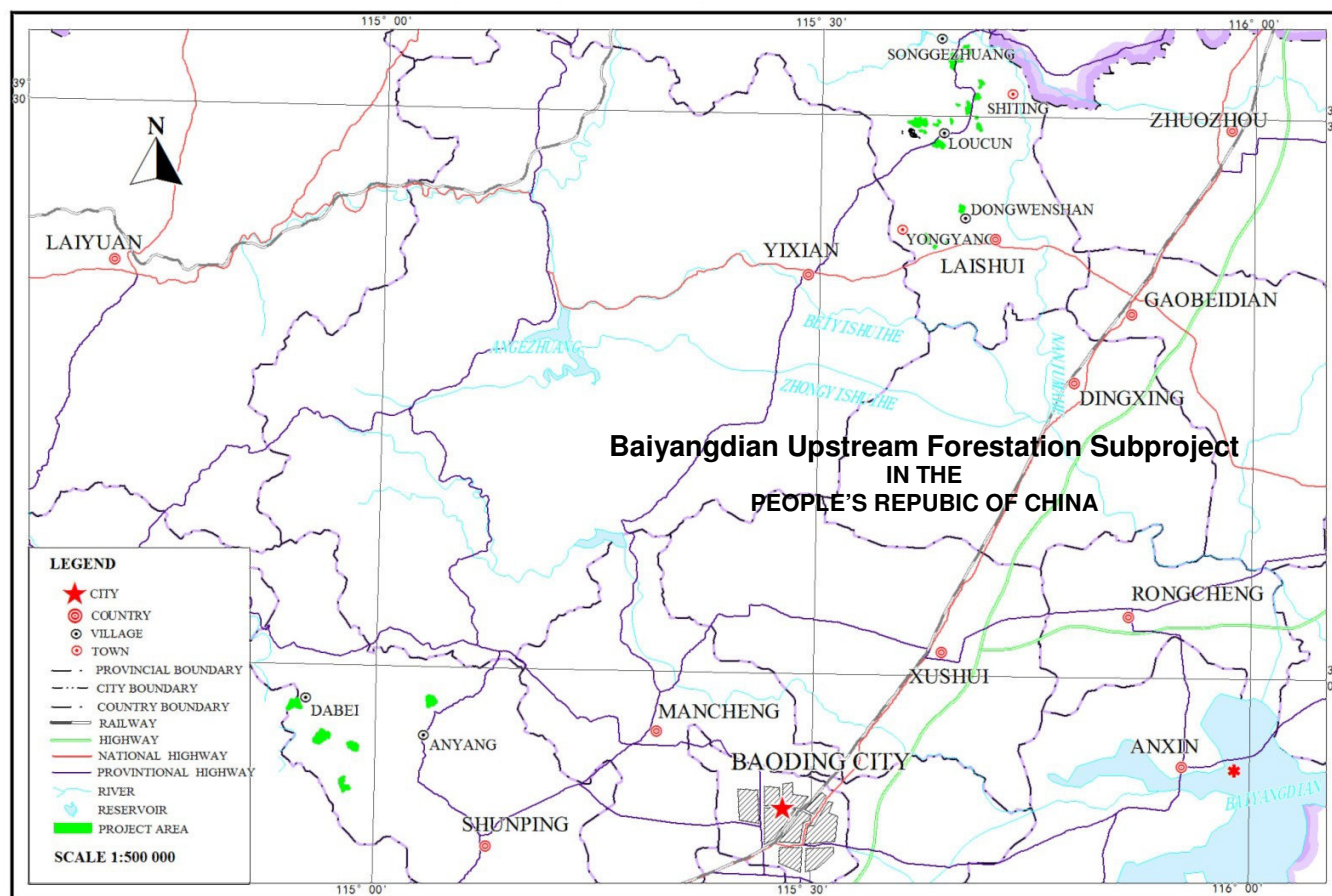


## MAP 7





MAP 8







## I. INTRODUCTION

1. Baiyangdian Lake (the Lake) in Hebei Province is the largest remaining semi-closed freshwater body in the northern part of the People's Republic of China (PRC) (Map 1). The Lake lies in the middle reaches of the Daqing River basin<sup>1</sup> and empties itself into the Bohai Gulf, Yellow Sea. Much of the upstream catchment totalling 31,500 square kilometers (km<sup>2</sup>) lies within the jurisdiction of Baoding Municipality<sup>2</sup> and all of the lake body is located in Anxin and Xiong Counties of Baoding Municipality. The Lake has a surface area of 366 km<sup>2</sup> and comprises a series of natural low-lying depressions and reed marshes. Historically, the Lake has served the four main functions of (i) supporting significant biodiversity and ecological balance of the region as important wetlands; (ii) regulating floodwater discharge, and moderating waterlogging to protect downstream cities and Jin-Hu railway;<sup>3</sup> (iii) providing local people with their main sources of livelihood (e.g., freshwater fishery, reed production, and tourism services), water for drinking and irrigation, and major transportation routes; and (iv) providing water to industrial users, especially the stated-owned Hubei oil field.

2. Rapid economic growth and continued urbanization and industrialization, coupled with the severe shortage of water resources and improper water resource management, have seriously impaired the proper functioning of the Lake's important economic and environmental services. The increased demand for water for irrigation, industry, and residential uses has been a major reason for intercepting the water and storing it in reservoirs. With the demand exceeding the supply in the Daqing River basin, the frequencies of no or low inflows to the Lake has become more acute, especially during dry years, thus contributing to more incidences of low water levels in the Lake. Moreover, the rising population and expanded agricultural and industrial activities with limited measures for disposing of wastes upstream and in and around the Lake areas have transformed it into a major depository of pollutants including solid waste, leachate, wastewater discharges, and sediments from soil erosion. To date, eutrophication of the Lake is serious. All the above factors have contributed to the decline of the lake's water quality from Class III to Classes IV and V,<sup>4</sup> and deterioration of the Lake ecosystem, and a drastic loss in biodiversity as the habitat of the biotic communities, especially in the wetland littoral zones. The biodiversity has reportedly been reduced to just 47 kinds of water plants, 54 fish species, 192 types of birds, and 14 wild mammal species. The livelihood of people who are dependent on the lake for income has been adversely affected.

3. The Government of the PRC recognizes the urgent need to address those issues in a holistic manner using the integrated Basin management approach. The Baiyangdian Ecosystem Rehabilitation Master Plan (BERMP) proposed in 2005 by Hebei Provincial Government (HPG) and Baoding Municipal Government (BMG) calls for integrated efforts to reduce the pollution loads in the Lake and rehabilitate the ecosystems of the Basin, with a planned investment of about \$1.0 billion. In conjunction with the initiatives of the BERMP, the proposed Asian

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<sup>1</sup> The Daqing River Basin is one of the nine main river systems within the Haihe River Basin. It has a total area of 43,065 km<sup>2</sup> comprising mostly Hebei Province, a small portion of Shanxi Province, and portions of Beijing and Tianjin municipalities.

<sup>2</sup> Baoding is the third largest municipality in Hebei Province, with a total area of 22,112 km<sup>2</sup> and a total population of 10,922,000 (including 1,006,000 urban residents) in 2005. The municipality comprises 22 counties and 4 urban districts.

<sup>3</sup> The railway line from Tianjin to Shanghai.

<sup>4</sup> The *National Ambient Water Quality Standards for Surface Water* divides water quality into five classes, with Class III being a minimum standard for drinking water and Class V being the lowest quality equivalent to raw sewage.

Development Bank (ADB) loan project (the Project)—of the same title—will help achieve their wastewater management objectives set for 2010, which include attaining Class III water quality in the lake and Class IV in urban rivers. The proposed Project is part of the first phase of the BERMP, and will have a demonstration effect for future undertakings.

4. Associated with the Project, interventions supported by the Global Environment Facility (GEF) are also being proposed.<sup>5</sup> The GEF interventions will go beyond the “baseline” (consisting of ADB loan-financed interventions, and other government interventions such as the 11th Five-Year Environmental Protection Plan of Baoding Municipality<sup>6</sup> and the BERMP) to directly address underlying weaknesses that threaten proper ecosystem functioning and biodiversity conservation in the Baiyangdian Basin. It is expected that through the GEF interventions, incremental global environmental benefits from the conservation of significant biodiversity resources will be achieved.

5. The ADB Project will comprise 22 subprojects of seven different categories; i.e., 13 wastewater treatment plants (WWTPs), three water supply systems (WSS), two reforestation, and one each for clean energy development (CED), urban flood management (UFM), integrated water management (IWM), and solid waste management (SWM). Of these 22 subprojects, two subprojects are classified as category A and the remaining 20 are classified as category B.

6. During project implementation, due to various reasons, nine subprojects decided to cancel the loan proceeds utilization of \$42.9 million. To maximize the project impact, the Baoding Government has selected four new subprojects to utilize this loan surplus, which including two WWTPs, one sludge treatment in WWTP, and one reforestation. All these four subprojects are classified as category B for environment. In terms of this scope change, the original SEIA was updated.

7. This updated consolidated report of the summary environmental impact assessment (SEIA) and the summary initial environmental examination (SIEE) describes possible environmental impacts related to the Project with a focus on two category A subprojects, 20 original category B subprojects and four new category B subprojects, and cumulative effects with current and future potential projects in the Basin. The report recommends mitigating and monitoring measures for reducing the adverse impacts. This SEIA/SIEE is primarily based on the full environmental impact assessment (EIA)/initial environmental examination (IEE) reports for all the individual subprojects and the cumulative effect assessment completed during preparation of the feasibility studies reports (FSRs). The EIAs and IEEs for original 22 subprojects were prepared by institutes/companies licensed by the State Environmental Protection Administration (SEPA, Appendix 1) and have been approved by Baoding Municipal Environmental Protection Bureau (B-EPB) before April 2007. Approval of the cumulative effect assessment by Hebei Provincial Environmental Protection Bureau (HEPB)/State Environmental Protection Administration is in July 2007. The IEEs for four new subprojects were also prepared by qualified institutions and have been approved by B-EPB in 2014. Preparation of these EIAs followed PRC Environmental Protection Law (1989) and PRC Environmental Impact Assessment Law (2002) including other regulations related to environmental protection for air and water qualities, noise, solid waste, and ecology, etc. Draft EIAs of these subprojects also

<sup>5</sup> The Full-Size Project (FSP) Brief is under preparation. An advance version of the Brief, highlighting the synergies of the GEF component with the loan investments, will be completed by end May 2007. The final FSP Brief will be submitted to GEF for work program inclusion before 31 August 2007. GEF Council approval is expected by end November 2007.

<sup>6</sup> Baoding Environmental Protection Bureau. 2005. *11<sup>th</sup> Five-Year Environmental Protection Plan of Baoding Municipality*. Baoding.

include an environment management plan (EMP) in accordance with their own situation, respectively. Based on the draft EIAs, this appraisal report of the newly-added subprojects is prepared for its final evaluation of the viability of project loan adjustment for the Baoding PMO. Other sources for the SEIA/SIEE are (i) the FSRs<sup>7</sup> for the individual subprojects; (ii) field surveys and public consultations by the consultant for the project preparatory technical assistance (PPTA);<sup>8</sup> (iii) the work of the technical assistance team under the PPTA;<sup>9</sup> and due diligence review mission conducted by ADB.

## II. DESCRIPTION OF THE PROJECT

8. The ADB Project will comprise 26 subprojects of 7 different categories as summarized in Table 1. Detailed description of the two Category A subprojects and four newly added subprojects are provided hereunder.

**Table 1: Summary of the Proposed Subprojects**

A. Category A Subprojects					
No.	Project Name	Location	Description		
1	Integrated Water Management	Baoding City	(i) Construction of 14.45 kilometer (km) canal to connect two reservoirs to divert water from Wangkuai to Xidayang ; (ii) diversion of water from Xidayang to replenish Baiyangdian Lake and recharge Yimuquan groundwater.		
2	Solid Waste Management*	Baoding City	(i) Relocation of 0.55 million tons of dumped waste to Baoding Municipal Landfill; (ii) rehabilitation of the coal fly ash storage of Baoding Thermal Power Plant.		
B. Category B Subprojects					
No.	Wastewater Treatment Plants	Location	Description		
			Treatment Process	Treatment Capacity (m³/day)	Sewer Pipes (km)
3	Liushi Town	Li County	CAST	20,000	4.6
4	Xushui	Xushui City	Orbal oxidation ditch process	30,000	10.0
5	Baigou Town	Gaobeidian City	UNITANK	30,000	20.4
6	Li County	Li County	CAST	30,000	15.0
7	Xinxing Town	Li County	Orbal oxidation ditch process	25,000	4.3
8	Anxin County*	Anxin County	Biolak	20,000	
9	Yi County	Yi County	CASS	20,000	31.3
10	Dingxing	Dingxin County	Biolak	30,000	28.4
11	Dingzhou City*	Dingzhou City	CAST	40,000	22.6
12	Mancheng County	Mancheng County	UNITANK	40,000	11.1
13	Xiong County	Xiong County	UNITANK	20,000	16.5
14	Tang County	Tang County	CAST	20,000	2.9
15	Wenquancheng*	Baoding City	Wetland treatment system	15,000	
16	Li County II (New)	Li County	CASS	30,000	13.2
17	Qingyuan County (New)	Qingyuan County	A²O	30,000	24.5
18	Baoding Municipal Sludge Treatment Center (New)	Baoding City	Anaerobic sludge digestion	300 <sup>10</sup>	
Total				400,000	
No.	Water Supply Systems	Location	No. of New Wells	Capacity (m³/day)	Water Mains (km)
19	Yi County	Yi County	14	25,000	129.8
20	Xiong County*	Xiong County	10	26,600	23.02
21	Dingzhou City	Dingzhou City	10	50,000	35.47
Total				91,000	
No.	Miscellaneous Subprojects	Location	Description		

<sup>7</sup> Individual Design Institutes. 2006. *Feasibility Study of Individual Subprojects and the Bundled Project*. Baoding.

<sup>8</sup> ADB. 2005. *Technical Assistance to the People's Republic of China for Preparing the Integrated Ecosystem Management and Environmental Protection of the Baiyangdian Lake Catchment Project*. Manila.

<sup>9</sup> PPTA Team. 2006. *Technical Assistance Consultant's Final Report for the Integrated Ecosystem Management and Environmental Protection of the Baiyangdian Lake Catchment Project*. Baoding.

<sup>10</sup> This is the capacity to treat sludge from WWTP, so it is not included in the total capacity calculation.

22	Angezhuang Watershed Reforestation*	Yi County	(i) 9,800 ha of plantations including 2,000 ha of fast-growing and high-yielding forests, 2,000 ha of water conservation forests, 4,666 ha of soil erosion control forests and 933 ha of ecological protection forest with non-timber products, and (ii) 8,666 ha of mountain closure for forest recovery.
23	Baiyangdian Lakeside Forestation*	Anxin County	Forest rehabilitation of 264 ha; reforestation of 268 ha; 1,200 ha of landscape forests; 99 ha of green belts
24	Baiyangdian Upstream Forestation (New)	Laishui and Shunping Counties	866 ha uncultivated land of planting walnut trees in the upstream of Baiyangdian Lake.
25	Clean Energy Development*	Xiong County	Geothermal; four central supply stations, and 18 km of supply pipelines
26	Urban Flood Management*	Anxin County	Embankment of 6.7 km; bank reinforcement

Note: Biolak is a multistage combined anaerobic and aerobic wastewater treatment process. CASS (cyclic activated sludge system) is a combination of a biological selector and variable volume process reactor. The process operates with a single sludge in a single reactor basin to accomplish both biological treatment and solids-liquid separation. In CAST (cyclic activated sludge technology), similar to CASS; the sequences of fill, aeration, settle, and decant are consecutively and continuously operated in a compartment reactor. UNITANK is a technology used for domestic and industrial wastewater treatment consisting of one reactor divided into three compartments. These are hydraulically connected by an opening in the common connecting walls. Each compartment is equipped with an aeration system.

\* Nine subprojects decided to cancel the loan proceeds utilization

Sources: 2006 feasibility study reports for individual subprojects, and individual design institutes.

### A. Integrated Water Management: Wangkuai-Xidayang Reservoir Connection Subproject

9. Wangkuai Reservoir, with an annual inflow of 379 million m<sup>3</sup> (at 50% guarantee rate), currently supplies 164 million m<sup>3</sup>/annum of water to Sha irrigation area and 10 million m<sup>3</sup>/year to Changzhou City. It also discharges about 170 million m<sup>3</sup>/year through Sha aqueduct to replenish the Baiyangdian Lake during flooding season. After deducting conveyance loss due to infiltration and evaporation, about 65 million m<sup>3</sup>/year reaches the Lake (Figure A2.1). However, it has been decided that, starting in 2010, the middle route of the South-to-North Water Transfer Project (SNWTP) will exclusively use the Sha aqueduct. Due to the limited flow capacity of the Sha aqueduct and difficulties in coordinating water management from two sources, SNWTP office prohibited the use of the Sha aqueduct to release water from the Wangkuai Reservoir to the Lake. Therefore, an alternative route is urgently needed (Map 4).

10. The IWM subproject will link Wangkuai Reservoir to Xidayang Reservoir and supply water to the Lake using the existing canals and rivers downstream of Xidayang Reservoir which flows through Baoding City (Figure A2.2). The subproject will also enable floodwater harvesting; the excess floodwater which could not be regulated by the two reservoirs will be used to recharge the groundwater aquifer at Yimuquan near Baoding City. It is estimated that 35 million m<sup>3</sup>/year will be discharged from Xidayang Reservoir for this purpose, of which 30 million m<sup>3</sup>/year will recharge the aquifer after deducting losses.

11. The IWM subproject will construct a canal linking Wangkuai Reservoir with Xidayang Reservoir and upgrading the existing canals from Xidayang to the Lake and the Yimuquan groundwater aquifer recharging area. The canal will pass through Queying, Tang, and Shunning Counties, Baoding City, and Qingyuan County. The waterway alignment starts from Wangkuai Reservoir to Xidayang Reservoir, then to the Wei County crossing flume. After the crossing flume, the alignment branches. One branch goes west to the Lake and the other goes northwest to the Yimuquan groundwater recharging area.

**Table 2: Main Features of the Water Resource Reallocation Subproject**

Component		Length (km)	Construction Work	Design Discharge (m <sup>3</sup> /s)
Transferring	Linking Wangkuai and	14.45	Constructing 10.83 km link-canal including 3.84 km	10

water to Baiyangdian Lake	Xidayang Reservoirs		tunnel. Upgrading 3.62 km channel through a natural creek	
	From Xidayang Reservoir to Wei County crossing flume	29.05	Upgrading Tang irrigation aqueduct including lining 12 km. Dredging and embankment repair where necessary	20
	From Wei County crossing flume to Baiyangdian Lake	96.31	Using the existing natural creeks and rivers including Quni river, Baicao Creek, Baoding inner city waterways, Upgrading Weicun gate (regulator) and Baicao gate and silt dredging for Baicao creek	
	<b>Total</b>	<b>139.81</b>		
Recharging Yimuquan groundwater source area	From Wei County crossing flume to Yimuquan recharging area	20.75	Upgrading 3.82 km of the existing canal and construction new 5.18 km canal	10

Source: China Academy of Ecological Research Centre. 2006. *Environmental Impact Assessment Report*. Beijing.

## B. Solid Waste Management: Rehabilitation of Huanghuagou River Subproject

12. **Activity 1: Relocation of Huanghuagou Dump Site.** The Huanghuagou dump site is located on the north side of the Huanghuagou River. Waste, in a 4.6 ha area, were dumped in a sand quarry pit from 1993 to 2003. Currently, the dump site with no leachate-preventing measures stores about 550,000 tons of waste consisting of 70% domestic and 30% construction waste. The dump site has seriously polluted the Huanghuagou River water and the groundwater aquifer nearby, and poses a potential health risk. This activity will excavate and transport all the domestic waste to the Baoding sanitary landfill.

13. **Activity 2: Closure of the Ash Storage of Baoding Cogeneration Plant.** The current ash storage of the Baoding co-generation plant (BCP) is located west of Lekai Avenue of Baoding and is one of the major sources of dust in the city. Ash including bottom and fly ash collected is temporarily stored here and then sold in the market as raw material for cement, concrete, and road construction.<sup>11</sup> This ash storage will be closed and the ash will be transported to various users over two years as planned by the Baoding Comprehensive Ash Utilization Office. A new back-up ash storage will be constructed by BCP before closing current storage to temporarily store ash generated in the future before it is sold to the end users. The project will also pump 400,000 m<sup>3</sup> of wastewater from the ash pond to the Lugang WWTP for treatment. The temporary silo and spare storage are currently in the pre-feasibility study stage and an EIA will be conducted to ensure environmental safety.

14. **Activity 3: Improvement of 0.5 km of Huanghuagou River.** This consists of (i) silt dredging for a 0.5 km section of Huanghuagou River; (ii) constructing 0.5 km of sewer pipelines along the north side of the river, and (iii) rehabilitating the Huanghuagou wastewater pit<sup>12</sup> by constructing 0.5 km of river embankment with reforestation to separate the wastewater pit from Huanghuagou river and pumping 175,000 m<sup>3</sup> of wastewater in the pit to Lugang WWTP.

15. **Activity 4: Rehabilitation of the Dump Site, Wastewater Pit, and Ash Storage.** The subproject will rehabilitate the dump site and wastewater pit into an eco-theme park with a total

<sup>11</sup> Flyash is a valuable resource/raw material for cement, concrete, and many other value-added applications such as brick manufacturing and road construction primarily because of its pozzolanic characteristic. Currently the market demand for ash is good considering many highway projects, i.e., Changshi and Baochuang expressway.

<sup>12</sup> The Huanghuagou wastewater pit is located next to the waste dump site and connects to the dump site and Huanghuagou River. The wastewater is mainly from upstream towns, villages, and paper mills.

increase of 12.9 km<sup>2</sup> of green space, and turn the ash storage site into urban land for future development.

### **C. Li County WWTP Phase II**

16. Li County is located southeast of Baoding City about 50-km from the Baoding City Center and currently has a WWTP (Phase I) located at northern part of County which has 30,000 m<sup>3</sup>/day biological treatment capacity and 16.8-km of sewer networks with pipe diameters ranging from 600 to 1200 millimeters (mm). The Li County WWTP Phase I has a treatment process of CASS and has met the most stringent requirements of Level 1A per National Guideline of GB18918-2002. Its effluent discharges directly into the Yueming River, then to Xiaoyi River, and eventually to the Baiyangdian. Dewatered sludge cakes, via belt filter press, at water content less than 80% are presently disposed off-site to a landfill. Owing to aggressive urban and economic development, the service area of the Li County WWTP Phase 1 will need to be expanded to accommodate these plans and development. Also, industrial development in Li County has been planned and progressed well, so as the industrial wastewater will be generated and eventually flow into the WWTP after its required pre-treatment. Thus, due to its location and contribution to the comprehensive BERMP, the subproject is proposed by the Baoding PMO as one of the candidate subprojects to add more water quality improvement for the Project (see Map 5).

17. The Li County WWTP Phase II will construct additional treatment capacity of 30,000 m<sup>3</sup>/day plus 13.2-km long sewer networks, with pipe diameters ranging from 300 to 600 mm, in addition to the existing system. It will also equip with advanced treatment process for 10,000 m<sup>3</sup>/day wastewater reclamation plus 20,000 m<sup>3</sup>/day secondary effluent for wastewater reuse, and 4.5-km long of reclaimed water distribution pipelines with pipe diameters ranging from 100 to 500 mm. After the Phase II project completion, the total service area for the Li County WWTP will be increased to 9.3 km<sup>2</sup> with population of 198,000 in 2020.

### **D. Qingyuan WWTP Phase II**

18. Qingyuan County is located south of Baoding City about 10-km and currently has a WWTP (Phase I), with 30,000 m<sup>3</sup>/day of treatment capacity and 15.7-km of sewer networks and a booster pumping station. Phase I of the Qingyuan WWTP has equipped a biological treatment process of inverted A2/O to be able to meet the most stringent requirements of Level 1A per National Guideline of Municipal WWTP Discharge Standards, GB18918-2002. Its effluent discharges directly into the Jinxian River and dewatered sludge cakes at less than 80% water content are currently disposed off-site to a landfill. The service area of the Qingyuan WWTP Phase I will need to be expanded to cover the county-wide development plan, due to aggressive economic development and urbanization. Industrial development in Qingyuan County has been progressed well, and the associated pre-treated industrial wastewater eventually flows into the WWTP. Also, due to its location and contribution to the comprehensive BERMP, therefore it is proposed by the Baoding PMO as one of the candidate subprojects to add more water quality improvement for the project.

19. Qingyuan WWTP Phase II will construct additional treatment capacity of 30,000 m<sup>3</sup>/day plus 24.5-km long sewer networks, pipe diameter ranging from 400 to 800 mm, in addition to the existing system. After the Phase II project completion, total service area for the Qingyuan WWTP will be about 21 km<sup>2</sup> with population of 200,000 in 2020 (see Map 6).

## **E. Centralized Sludge Treatment Subproject**

20. Baoding City currently has 3 municipal WWTPs at a total capacity of 320,000 cubic meters per day ( $\text{m}^3/\text{day}$ ) to serve about an area of 94 square kilometres ( $\text{km}^2$ ). All three WWTPs are under upgrade and modification to achieve Level 1A of National Guideline of GB18918-2002 based on the requirements of BMG. Also, in accordance with the newly announced Recommended Guideline for Sludge Disposal (GB/T23485-2009), dewatered sludge cake requires water content less than 60% for any landfill to accept its final disposal. Due to this newly announced National Guideline for sludge disposal, all WWTPs in Baoding are facing challenge to convert the existing sludge handling facilities with additional capabilities and capacities to meet with the subject objective. It is urgently required for upgrades and modifications, so that all municipal WWTPs in Baoding can be continued functioning and to ensure the water quality of Fu River section in Baoding and eventually to Baiyangdian.

21. After initial alternative analysis to consider individual upgrade or modification at each WWTP comparing to a combined facility for all WWTPs, the latter option is more achievable with economic and management advantages. Thus, the CSTC has been proposed to accept all dewatered sludge (water content at 80% or higher) from these WWTPs and treated with anaerobic digestion process to further stabilize the quality and reduce the quantity for better treatment efficiency and cost effectiveness. Also, due to its location (upstream) and contribution to the comprehensive BERMP, thus the CSTC is proposed by the Baoding PMO as one of the candidate subprojects to add more water quality improvement to the Project (see Map 7).

## **F. Baiyangdian Upstream Forestation**

22. The upstream forestation subproject will plant walnut trees and shelterbelt in Laishui and Shunping Counties. The subproject areas over 10 villages cover an area of  $866 \text{ hm}^2$  (see Map 8). The subproject is in line with the Master Plan for Ecological and Environmental Improvement in the Baiyangdian Lake and its Upstream and the Fruit Industry Development Plan in the Western Mountainous area of Baoding Municipality, and will generate environmental benefit as well as social economic benefits.

23. Since it is ecological forestation project, thus no major wastes to be produced so to provide better ecological environment. The project sites are mostly located in hilly area with uncultivated land, so the project can prevent soil erosion and enhance ecological environment, so to generate more social, economic and environmental benefits. The forestation subproject will be able to resolve some problems for those unemployed population and extra labour force of villages, then to increase their income and social benefits.

# **III. DESCRIPTION OF THE ENVIRONMENT**

24. Four newly-added subprojects lie within the jurisdiction of Baoding Municipality and close to the sites of previous subprojects. Owing to this similarity and vicinity to the Project, most of the environmental situations related to these subprojects are similar to what has been discussed as following.

## **A. General Project Setting and Physical Environment**

### **1. Location, Topography, and Climate**



25. The Project is located in the Baiyangdian Basin under the jurisdiction of Baoding Municipality. Baoding lies in the central part of Hebei Province, 125 km from the provincial capital city, Shijiazhuang, in the south; 141 km from Beijing, the capital of the PRC in the north; and 155 km from Tianjin in the east.

26. The Project area can be divided into three major geographic regions: (i) Taihang mountains (above 500 m in altitude), constituting the western 30% of the Basin; (ii) a low hill transition zone of <500 m in altitude, covering 40% of the Basin; and (iii) the lowland plains occupying 30% of the Basin area. The Project area is in the northern temperate zone and has a monsoon climate characterized by distinct seasonal variations. Average annual precipitation is 570 millimetres (mm), with the bulk occurring from June and August. The annual average evaporation is high, about 726 mm. The annual average temperature is 12°C, with recorded temperatures ranging from 42°C (July) to -30°C (January) in the past 5 years.

## 2. Water System and Water Quality

27. Baiyangdian Lake, the largest freshwater lake in northern PRC, has been known as the pearl of the region, thanks to its rich local products, convenient transportation facilities, favourable geographical location, and scenic beauty. The total Basin area in Baoding is about 31,500 km<sup>2</sup>. The Lake has a surface area of about 366 km<sup>2</sup>,<sup>13</sup> and consists of 143 lakes with water levels of 6–10 m. There are four large reservoirs upstream of the Lake: Wangkuai, Xidayang, Angezhuang, and Longmen. From south to north, nine rivers flow into the lake: the Juma, Sha (Zhulong), Xiaoyi, Tang, Fu, Cao, Pu, Ping, and Baigou.

28. In the last four decades, the beneficial uses of Lake and its associated wetlands have diminished. Construction of large reservoirs and destruction of vegetation in the upstream Basin, and continuous droughts in recent years have led to a dramatic decline in water inflows, from 11.43 billion m<sup>3</sup> in 1970–79 to low as 0.065 billion m<sup>3</sup> in 2000–02. At present, base flows from the rivers entering the Lake are limited making it a manually controlled flood storage and drainage wetland reservoir surrounded by numerous man-made dikes. Except when the floodgates at Zaolinzhuang are open and during the operations of the pumping stations when the irrigation gates are open, natural flows or water movements within the lake have been minimal and are confined to the lakeshore where seasonal inflows from rivers enter the Lake. Over the last four decades, the size of the Lake has decreased by almost half due to the controlled water flows, continuous droughts, and soil erosion.

29. The Lake and its extensive network of rivers are heavily polluted. Since the mid-1980s, water pollution resulting from rapid economic growth, industrialization, and urbanization have caused significant deterioration in water quality throughout the towns and counties. The large quantity of untreated wastewater discharged directly into the rivers has caused major water quality problems in these watercourses. The current water quality in most of the Basin rivers is Class V or worse. Most of the towns and counties have no wastewater treatment plant and just discharge both domestic and industrial wastewater into the rivers that flows to the Lake. The inadequate sewerage system of the in-lake villages also contributes to the degradation of the water quality. According to BERMP, currently only 10% of the water surface of the Lake meets Class III of *Environmental Quality Standard for Surface Water of the PRC* (SEPA, GB3838-2002); most of the water body meets only Class V or exceeds Class V of the PRC standards. The surface water quality of the rivers, Lake, and reservoirs is summarized in Table 3.

<sup>13</sup> The size of the Lake is variable depending on the water level. When the water level is 6.5 m above sea level (dry-up status), the Lake measures 69 km<sup>2</sup>. When the water table reaches 10.5 m, the lake measures about 366 km<sup>2</sup>.

Continuous drought has worsened the Lake water quality. Fish died frequently during the drought years and the most recent occurrence was in March 2006.<sup>14</sup>

30. Groundwater quality was monitored on 25 and 26 November 2006 at four locations, two upstream of the ash storage and dump site separately, and two downstream of each site. The monitoring data suggest that groundwater quality downstream of both sites exceeds the PRC class III of *Quality Standard for Groundwater* (GB/T 14848-93)<sup>15</sup> while water quality upstream of each site meets class III of the PRC standard. It is concluded that the water quality downstream of the ash storage and waste dump site is polluted.

**Table 3: Surface Water Quality**

River/Canal/ Reservoirs/ Baiyangdian Lake	Monitoring Section	Major Pollutants	Existing Water Quality	Water Quality Target
A. Surface Water				
Fu River	Baoding-Anzhou	Permanganate value, BOD <sub>5</sub> , NH <sub>3</sub> -N, TP	>V	Ⅳ
Inner city river	Inside Baoding city	Permanganate value, BOD <sub>5</sub> , NH <sub>3</sub> -N, TP	>V	Ⅳ
Huanghuagou	Near the dump site and ash storage	Permanganate value, BOD <sub>5</sub> , NH <sub>3</sub> -N, TP	>V	V
Zhulong River	Beigoucun to Baiyangdian	BOD <sub>5</sub> , NH <sub>3</sub> -N, oil, permanganate value	Ⅳ	Ⅲ
Xiaoyi River		BOD <sub>5</sub> , NH <sub>3</sub> -N, permanganate value	>V	Ⅳ
Tang River	Upstream of Baihe (Xidayang Reservoir)		Ⅲ	Ⅲ
	Downstream of Baihe	BOD <sub>5</sub> , NH <sub>3</sub> -N, TP	>V	Ⅲ
Cao River	Baoding Section	BOD <sub>5</sub> , NH <sub>3</sub> -N, TP	>V	Ⅲ
Pu River	Xushui-Baiyangdian	BOD <sub>5</sub> , NH <sub>3</sub> -N, TP	>V	Ⅲ
Baigou River		BOD <sub>5</sub> , COD <sub>Cr</sub> , NH <sub>3</sub> -N, TP	>V	Ⅲ
Wanguai, Xidayang, and Angezhuang reservoirs	Inside the reservoirs		Ⅲ	Ⅱ
Baiyangdian Lake	Shaochedian, Zhaolindian Wangjiazhai, Quantou, Duancun, Caiputai, Guangdianzhangzhuang	BOD <sub>5</sub> , COD <sub>Cr</sub> , NH <sub>3</sub> -N, TP	Ⅳ	Ⅲ
	Nanliuzhuang		>V	Ⅳ
	Gudingdian		NA	V
B. Groundwater				
Ash storage	Caozhuang (150 m upstream of the ash storage)		Ⅲ	Ⅲ
	120 m downstream of the ash storage	Hardness, TDS	Ⅳ	Ⅲ
Waste dump site	Shenzhuang (150 upstream of the waste dump site)		Ⅲ	Ⅲ
	120 m downstream of the waste dump site	Hardness, TDS, NH <sub>3</sub> -N	Ⅳ	Ⅲ
Yimuquan drinking water source area	No.14, 19, 34 drinking water wells		Ⅱ	Ⅲ
River/reservoirs/the lake	Monitoring section	Major pollutants	Existing Water Quality	Water Quality Require ment

BOD<sub>5</sub> = 5-day biological oxygen demand, COD = chemical oxygen demand, NH<sub>3</sub>-N = ammonia nitrogen, TDS = total dissolved solids, TP = total phosphorus. Monitoring year is from 2001 to 2005 for surface water and 2006 for groundwater. NA = no data available since Gudingdian has dried up in the last 5 years.

Sources: (i) B-EPB. 2006. *Environmental Quality Status Report of Baoding Municipality from 2001 to 2005*. Baoding; (ii) BWRB. 2005. *11th-Five-Year Plan for Baoding Water Resource Development*. Baoding.

<sup>14</sup> The large-scale fish kill in March 2006 attracted nationwide attention, and several government officials were disciplined.

<sup>15</sup> According to the Baoding Environmental Protection Bureau (B-EPB), class III of *Quality Standard of Groundwater* (GB/T 14848-93) should be applied to the groundwater within Baoding municipality.

### 3. Air and Noise

31. In general, air quality in the project area except Baoding City meets the PRC's class II *Ambient Air Quality Standard* (GB3095-96, as amended).<sup>16</sup> In Baoding City, about 58 days in 2005, air did not meet class II. Primary pollutants are particulates and sulfur dioxide (SO<sub>2</sub>) from coal burning and dust from construction sites. The project sites enjoy a quiet environment. There are no major sources of noise and the monitored noise levels at the representative subproject sites are well within the PRC class II Environmental Noise Standard for Urban Area (GB3096-93) according to the EIA reports of the two subprojects.

#### B. Ecological Environment

32. **Baiyangdian Lake and Upper Watershed.** The Lake and its upper watershed in the Taihang Mountains support significant biodiversity of regional and global significance within the Daqing river basin. The open water and aquatic beds of the Lake serve as spawning grounds and feeding habitats for a diverse array of fish and other animal species. It is also an important resting and refueling site during spring and autumn for migratory water birds, supporting up to 192 species of birds, including at least 7 of global conservation significance. During peak migration, more than 100,000 ducks transit through the Lake. The Taihang Mountains, which contain most of the last remaining natural forests in Baoding, support a wide range of rare and endemic animals such as the brown-eared pheasant *Crossoptilon mantchuricum*, grey-sided thrush *Turdus feae*, leopard *Panthera pardus*, and golden takin *Budorcas taxicolor*. The site is also recognized as a centre of plant endemism in the PRC.

33. Due to heavy pollution and water shortage in the Lake, its ecosystem is threatened. Eutrophication of the Lake is serious, with its water quality deteriorating from Class III to Classes IV and V. There has been a drastic loss in biodiversity as the habitat of the biotic communities especially in the wetland-littoral zones. The livelihood of people who are dependent on the Lake for income has been adversely affected.

34. **Angezhuang Forestation Area.** The existing vegetation of Angezhuang forestation area is composed mainly of secondary forests of oak, mountain poplars, birch, and a mixed forest of mountain poplar and birch. In remote mountains the vegetation is composed mainly of various shrub species. In low mountains, the vegetation is mainly different grass species. Forestation will be in selected in areas that have not been covered with forests or other types of vegetation (i.e., barren mountains). Wild animals such as hedgehogs, hares, squirrels and migratory birds can be found in the area.

35. **Wanguai<sup>17</sup> and Xidayang Reservoirs.**<sup>18</sup> Due to human activities, the vegetation around the two reservoirs is composed mainly of bush and secondary forests such as brambles,

<sup>16</sup> According to *Ambient Air Quality Standard of PRC* (SEPA, GB3095-96) and its amendment (SEPA, 2000), ambient air quality (i) class I is applied to natural scenic and specially protected areas; (ii) class II to urban areas and mixed urban, residential, business, and traffic areas; and (iii) class III to industrial areas. Therefore, class II should be applied to the project area.

<sup>17</sup> The Wanguai reservoir, located in the upper reach of Sha River, was constructed in 1958, expanded in 1969, and reinforced in 2005. Its main functions are flood control and irrigation for agriculture in Shashe and Qunzhong districts. Its drainage area is about 3,770 km<sup>2</sup>. The total designed capacity of the reservoir is 1.4 billion m<sup>3</sup> with a usable capacity of 0.58 billion m<sup>3</sup>.

<sup>18</sup> The Xidayang reservoir, located in the upper reaches of Tang River, was constructed in 1958, expanded in 1970–72 and reinforced in 1992–93 and 2006. Its main functions are flood control, irrigation, and water supply. Its drainage area is about 4,420 km<sup>2</sup>. In 2003, Xidayang became the main source of drinking water for Baoding City.

*Zizyphus jujuba* Mill var. *spinosa* Hu and *arborvitae*, etc. *Glycine soja* in level II of the list of national protective plants is found around Xidayang Reservoir, but beyond the construction area (the section where the two reservoirs will be connected).

36. Wangkuai and Xidayang Reservoirs had been used as intensive fish farms. In 2003, the intensive fish farms were banned in these reservoirs and fish has been raised without feeding to protect water quality since then. The main aquatic lives were cultivated fishes such as carps, chubs, *crucian*, etc. No rare and endangered species are found in the two reservoirs.

## **C. Social and Economic Development**

### **1. Social and Economic Profile**

37. Baoding is the third largest municipality in Hebei Province, with a total area of 22,112 km<sup>2</sup> and a population of about 10.9 million (including about one million urban residents) in 2005. The Municipality comprises 3 districts, 4 county-level cities, and 18 counties. The total gross domestic product (GDP) of the municipality in 2005 was CNY109 billion, or about a 14% increase over the previous year. Its growth rate during the 10th Five-Year Plan Period (2001-05) averaged 11% per annum, with industry as the lead sector, followed by services and agriculture. Baoding blends industry and agriculture into a dynamic economy. There are over 630 industrial enterprises mainly involved with metallurgy, machinery, chemistry, and forestry. These industries produce steel, transformers, paper, and world-renowned hand-woven carpets. Baoding's agricultural products include wheat, rice, peanuts, pears, and apples. The municipality is most famous for its strawberries and the Mancheng snow peach.

38. Although Baoding has witnessed rapid economic development recently, the average per capita GDP for the municipality is CNY9,971, slightly below the average per capita GDP of the country, CNY10,533. The per capita GDP within the municipality varies significantly; in Tang County it only about CNY3,695. About 6.2% of the total population in Baoding lives below the national poverty line, with net income less than CNY900 per capita/year. The Lake has 39 in-lake villages, which are surrounded by water, and 44 partly in-Lake villages, which are partly surrounded by water. An estimated 100,000 persons live in the in-Lake villages and another 100,000 persons in the surrounding areas of the Lake. The provincial government listed 24 of the 39 in-Lake villages as poverty villages.

### **2. Natural and Cultural Heritage Sites, and Tourism Resources**

39. Baoding has a long history of over 2,300 years and it has played many different roles under its dynasties. The city was destroyed by the Mongolian army early in the 13th century and rebuilt later in the same century under the Yuan dynasty. It served as an important cultural centre through the Ming and Qing dynasties. Baoding is also a cultural city. Two relic sites of the Yangshao culture have been found there. In the Yuan, Ming, and Qing dynasties, Baoding City was called Baoding Fu<sup>19</sup>; in the era of the Republic of China and the early stage of the PRC, it was the capital of Hebei Province until 1958 when that role was assumed by Shijiazhuang. The Lianchi Academy set up in the Yongzheng reign of the Qing dynasty (1644–1911) was well-known all over the country. The Old Lotus Pond was one of the top ten ponds at that time.

The total designed capacity of the reservoir is 1.3 billion m<sup>3</sup>.

<sup>19</sup> "Fu" means "Capital." Baoding was the provincial capital then.

40. Baoding has unique scenery and many places of tourist interest. The latter are the Old Lotus Pond, the provincial government office of Zhili Province in ancient times, Baiyangdian Lake that is now known as "the Bright Pearl in North China," the West Tomb of the Qing dynasty in Yi County, the Tomb of the Han Dynasty with Jade Clothes Sewn with Gold Threads, and the Changxin Palace Lantern, the North Yue Fei Temple in Quyang City, and the Kaiyua Pagoda in Dingzhou. Baoding also has more than 300 scenic spots such as the Yesanpo (literally, wild mountain slopes) in Laishui County and the Zhuozhou Movie City. None of the individual subproject locations will interfere with any cultural or heritage sites.

#### IV. ALTERNATIVES

41. During project preparation, various alternatives were proposed, screened, and compared on the basis of the predefined technical, economic, and environmental criteria. The primary objective of the environmental criteria was to identify and adopt the least-cost options, giving full consideration to environmental impacts and benefits. The detailed alternative analyses for the two category A subprojects are summarized as follows.

##### A. Alternatives for the Integrated Water Management Subproject

42. **No Action.** Currently the annual inflow at 50% guarantee rate into Wangkuai Reservoir is 379 million m<sup>3</sup>. The reservoir mainly supplies about 164 million m<sup>3</sup>/year water for Sha irrigation area and 10 million m<sup>3</sup>/year for Changzhou City, and releases about 167 million m<sup>3</sup>/year to the Lake through Sha aqueduct during and before flood season. However, in 2010 the Sha aqueduct will be merged with SNWTP<sup>20</sup> as a sub-channel to supply water to Cangzhou and Langfang municipalities, etc. Due to the limited flow capacity of the Sha aqueduct and difficulties in coordinating management of water from two sources, use of the existing route for releasing water from Wangkuai to the Lake after 2010 was rejected by the SNWWTP office. Therefore, a new channel for diverting water to the Lake is needed.

43. **Water Savings.** Significant amount of water from both reservoirs is used for irrigation, i.e., 164 million m<sup>3</sup> for Sha irrigation and 59 million m<sup>3</sup> for Tang irrigation provided by Wangkuai and Xidayang reservoirs, respectively. Therefore, most of the water savings have to come from efficient irrigation practices. The water savings can be realized mainly through two interventions (i) the price of irrigation water is raised so that farmers do not substitute labor for water, and (ii) high-value crops are adopted to increase farm income that leads to adoption of efficient irrigation technologies. Both these interventions are unlikely to materialize in the short to medium term due to policy and economic situation prevailing in the Municipality. Even if there were water savings from Sha irrigation, the additional water will not be able to flow to the Lake after 2010 as Sha aqueduct will be taken over by the SNWTP. And the water savings from Tang irrigation will not be sufficient to meet the water requirement for the Lake.

44. **Alternative Alignments.** Various alternative alignments were examined during the FS and two major alternatives (Alternatives I and II; see Figures A2.2 and A2.3) were compared in detail during the EIA stage on the basis of technical, economic, and environmental criteria. Alternative I is to use the existing Sha River waterway (dried up since construction of Wangkuai

<sup>20</sup> The Middle Route Project (MRP) for South-to-North Water Transfer Project will divert water, in the near future, from Danjiangkou Reservoir on the Haijiang, a tributary of Changjiang River, to Beijing City through Canals to be built along Funiu and Taihang Mountains. In the future, additional water will be obtained from Three Gorges Reservoir or the downstream of the dam on main Changjiang. However, the water will be used only for drinking and industrial purposes. Therefore, this alternative water source is not available to Baiyangdian Lake.

Reservoir except in flood season) for releasing water into Baiyangdian. And, Alternative II was recommended on the basis of the detailed comparative analysis.

45. It is estimated that SNWWTP will supply 145 million m<sup>3</sup>/year of water for Sha irrigation area and Canzhou City. In Alternative I, only 96 million m<sup>3</sup>/year will reach the Lake (58 million m<sup>3</sup>/year of water from Wangkuai Reservoir through Sha River waterways; and 38 million m<sup>3</sup>/year from Xidayang Reservoir through Tang aqueduct) and this volume is insufficient to sustain the Lake's ecosystem. After the completion of SNWTP, in Alternative II, Wangkuai Reservoir will be able to release 200 million m<sup>3</sup> water at 50% guarantee rate to the Lake and Yimuquan ground water aquifer via Xidayang Reservoir. About 128 million m<sup>3</sup>/year will reach the Lake and 29 million m<sup>3</sup>/year will recharge the Yimuquan aquifer. Alternative II will also improve water quality of Fu River and Baoding City's urban rivers from worse than Class V up to Class IV or close to Class III.

**Table 4: Alternatives for the Integrated Water Management Subproject**

Criteria	Alternative I	Alternative II
Engineering	No engineering works	Technically feasible but relatively complicated: construction of 14.45 km of canal to connect the two reservoirs including a 3.84 km tunnel
Resettlement	No resettlement	Land acquisition of 35.5 ha
Water for environmental uses	Only 96 million m <sup>3</sup> inflow can reach Baiyangdian Lake due to high infiltration of Sha River and high evaporation due to the longer distance; not enough to maintain the Lake water level at 7.3 m	128 million m <sup>3</sup> inflow reaches Baiyangdian Lake (adequate to maintain the Lake water level at 7.3 m); and 29 million m <sup>3</sup> recharges Yimuquan aquifer which is used as a drinking water source
Environmental benefits	Decrease of water inflow will cause adverse impacts on Baiyangdian Lake ecosystem	Sustainable ecosystem management of Baiyangdian Lake; improvement of Baoding inner city water bodies; and recovery of Yimuquan groundwater source
Water supply	Water supply is not optimized.	Increased water supply guarantee rate due to the optimization of the two reservoir water resources in time and space and increased guarantee rate of drinking water supply to Baoding City and to Guohua Dingzhou Thermal Power Station
Water pollution	(i) Many township and village enterprises, along its course, discharge wastewater in Sha River. Due to remote locations, they will not be connected to sewer systems in the near future. (ii) Relatively higher risk to pollute Baiyangdian Lake. The diverted water, through Sha River, will first enter the Mapeng Lake which is deep. Once polluted water enters Mapeng Lake, it will quickly enter the main Baiyangdian Lake and pollute it further.	The divert water will first enter the Caoza Lake, which is separated from the main Baiyangdian Lake and can be disconnected by gates. In case the diverted water is polluted, Caoza Lake could be treated as a natural oxidation pond because it is shallow and rich in bulrush.
Cost	Almost no investment	Relatively higher investment; about \$21.2 million
Economic benefit		(i) The estimated EIRR is 18.9%. The economic value of health and drinking water benefits is CNY26.1 million/year. <sup>21</sup> (ii) Net present value of incremental environmental benefit compared without the

<sup>21</sup> ADB estimates.

Criteria	Alternative I	Alternative II
		subproject is CNY87.0 million. <sup>22</sup>

Source: China Ecological Center of China Science Academy. 2006. *Environmental Impact Assessment Report for Water Diversion Subproject*. Beijing.

## B. Alternatives for the Solid Waste Management Subproject

46. **No Action.** As an alternative “no action” was eliminated due to serious environmental issues in Huanghuagou River area. Environmental issues related to the existing dump site, wastewater pit, and flyash storage of the Baoding Cogeneration Plant are (i) strong odour around the dump site, especially in the summer months, resulting in large populations of flies and mosquitoes; (ii) biogas generated from the anaerobic degradation of organic waste that poses a potential threat of fire blast and a health/life risk to scavengers living on the dump site; (iii) serious water pollution to Huanghuagou River and groundwater by leachate from the dump site and wastewater pit, due to lack of interception and drainage system, as well as proper liner and coverage (see Section III); (iv) serious health impacts on large number of scavenger families, i.e., ingestion of particulates, bio-aerosols, and volatile organics; direct contact with contaminated material; dog and rodent bites; puncture wounding by sharp waste objects leading to tetanus, hepatitis, and HIV infection; and injuries due to surface subsidence, underground fires, and waste slides; and (v) serious air pollution around the sites due to dust and flying ash from the dump site and ash storage. These adverse environmental effects can be mitigated or eliminated by the proposed subproject.

**Table 5: Alternatives for Solid Waste Management Subproject**

Item	Alternative I: Construction of New Landfill On-Site	Alternative II: Shipment of Existing Wastes to the Baoding Sanitary Landfill
Technical appraisal	Reliable	Baoding sanitary landfill has the capacity to receive the wastes, also simple and very reliable.
Requirements for operational management	Specific personnel needed; requires leachate collection and treatment, methane induction, rainwater discharge, etc.	Destination is a standardized sanitary landfill well-equipped for leachate collection, methane induction, rainwater discharge, etc. No additional requirement for operational management is needed at this site.
Engineering	Cover layers, gas collection system, leachate collection system	Involving a huge amount of transportation.
Environmental impacts	Potential environmental issues such as gas emission and leachate	Noise impacts caused by transportation
Future land use	Green areas turned in to eco-theme park	Green areas turned into eco-theme park and other areas earmarked for urban and industrial development
Costs	Relatively higher cost	Relatively low cost

Source: *Environmental Impact Assessment Report for Huanghuagou Watershed Rehabilitation Subproject*, Baoding, 2006

47. **Comparison of Alternatives for the Closure of Huanghuagou Dump Site.** Two main alternatives for closure of Huanghuagou dump site are proposed and compared. Alternative I would construct a new landfill using one of the sand quarry pits near the dump site and redevelop the dump site into green space. Alternative II would completely relocate the wastes to the Baoding sanitary landfill and redevelop the site. Alternative I would need operation and maintenance with special personnel compared with Alternative II since Alternative I would need to build a new sanitary landfill on site with a gas collection and leachate collection system.

<sup>22</sup> PPTA. 2007. Draft Final Report of Integrated Ecosystem Management and Environmental Protection of Baiyangdian Lake. Baoding.



Considering (i) technical feasibility, (ii) monitoring and control requirement, (iii) future development, and (iv) construction costs, Alternative II is recommended.

### **C. Alternatives for Baoding Municipal Sludge Treatment Center Subprojects**

48. Water content below 60% of the dewatered sludge cakes will not only meet the recent National Guideline requirements, but also to reduce the volume and difficulty in dealing its final disposal. It will further save the service life of the landfills. Yet, without the upgrade and modifications proposed for the CSTC subproject, three municipal WWTPs in Baoding City will not be able to continue their function and created more environmental issues, such as sludge cake disposed at uncontrolled sites, plant shut-down by government due to its non-compliance with the requirements, etc. Inadequate sludge disposal (300 m<sup>3</sup>/day) is one area of deficiency and untreated wastewater (320,000 m<sup>3</sup>/day) will further deteriorate the water quality to the Baiyangdian Basin.

49. Environmental and health issues related to the CSTC are: i) untreated wastewater to downstream water bodies; ii) deteriorated water quality to the Fu River; iii) contaminated groundwater by leachate from uncontrolled sludge disposals; iv) less service life of landfill; and iv) health impact to general public for those untreated wastewater or uncontrolled sludge disposal. Proposed CSTC subproject can mitigate these adverse environmental effects.

### **D. Alternatives for WWTP Subprojects**

50. In order to accommodate the service area expansion and increasing industrial wastewater, both Li County and Qingyuan WWTPs are required to construct additional sewer networks and capacity. Alternatives for the technical approaches for site for expansion, sewer network alignment, pipeline materials, treatment technology and sludge handling, etc. were considered. Without the expansion, those additional wastewater generated by the municipal and industrial users will not be able to get adequate treatment and eventually pollute the water quality to the Baiyangdian Basin.

51. Environmental and health issues related to these WWTPs are: i) untreated wastewater to downstream water bodies; ii) deteriorated water quality to the Baiyangdian Basin; and iii) potential health impact to general public for those untreated wastewater or uncontrolled sludge disposal. These adverse environmental effects can be mitigated by the proposed subprojects.

## **V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

### **A. Positive Impacts**

52. After completion of original WWTPs and associated sewer network, wastewater will be treated before being discharged into natural water bodies. It is estimated that the 13 WWTPs will reduce 37,880 tons/year of chemical oxygen demand (COD), 3,334 tons/year of ammonia nitrogen (NH<sub>3</sub>-N), and 347 tons/year of total phosphorous (TP). The modelling results show that in spite of the reduced pollution loading, the water quality of the receiving rivers will still not meet Class III-IV of the national standards (SEPA, *GB3838-2002*) due to the lack of natural water flows in the receiving rivers. Nevertheless, treatment will represent an important first step toward the rehabilitation of the ecosystem of Baiyangdian Lake by initiating and piloting the implementation of the BERMP.

53. After completion of four new WWTP expansion and associated sewer network, wastewater will be treated before being discharged into natural water bodies. It is estimated that two WWTP expansions plus the Baoding WWTPs upgrade from Levels 1B to 1A<sup>23</sup> will be further reduced to a total of 8,103 tons/year of COD, 635.1 tons/year of NH<sub>3</sub>-N, and 76.7 tons/year of TP respectively to the receiving water body, such as Fu River and Baiyangdian Lake. The water will flow through Fu River and other urban rivers in Baoding City, thereby slowly improving the water quality further.

54. The health of the target population is expected to improve significantly after the WWTPs and WSS are completed. More specifically, WWTP/WSS subprojects will (i) improve sanitation and hygiene for the residents within the sewerage service area and residents near the rivers and the Lake (about 1.12 million people); (ii) provide clean water and improve the living standards for 260,000 people; (iii) reduce the risk from waterborne diseases; and (iv) raise food safety to a certain level by using treated effluent instead of raw wastewater for irrigation.

55. The CED subproject will benefit local air quality and reduce carbon dioxide (CO<sub>2</sub>) emission. It is calculated that the subproject will replace 60,000 tons of coal annually, and hence reduce 500 tons/year of total suspended particulates (TSP), 1000 tons/year of SO<sub>2</sub>, and 140,000 tons/year of CO<sub>2</sub>.

56. The three reforestation subprojects will improve the ecosystem of the Basin significantly. More specially, benefits of Angezhuang watershed reforestation will bring the following environmental and ecological benefits: (i) prevent soil erosion, and hence reduce sediments entering the Angezhuang Reservoir and the Lake; (ii) reduce flood risks; and (iii) sequester carbon, which helps slow down global warming. However, the environmental and ecological benefits of reforestation will become obvious normally after the trees become relatively mature (e.g., 10 years for fast-growing species and up to 50 years for indigenous species).

57. The Anxin City UFM subproject will improve protection for Anxin City (population of 51,000) up to a flood occurrence of once in 50 years.

58. The Wangkuai Reservoir can supply a total of 200 million m<sup>3</sup>/year of water at 50% guarantee rate to replenish the Lake and recharge Yimuquan ground water aquifer after. About 128 million m<sup>3</sup>/year will reach the lake and 29 m<sup>3</sup>/year will recharge the Yimuquan drinking water aquifer. This subproject contributes to maintain the Baiyangdian Lake's ecosystem and to improve the reliability of water supply to Baoding City through recharging of the aquifer. The water will flow through Fu River and other urban rivers in Baoding City, thereby improving the water quality from Class V to Class IV or close to Class III.

59. The relocation and rehabilitation of the Huanghuagou solid waste dump site will minimize the adverse impacts associated with the dumped wastes: (i) visual and odor impacts on the local residents, (ii) surface water quality impacts caused by waste and leachate being flushed into Huanghuagou River during rainy periods (reduction of leachate by about 83 m<sup>3</sup>/d), which pollutes groundwater and Huanghuagou River, (iii) potential groundwater impacts, and (iv) soil contamination. The rehabilitation of the fly ash storage for urban land use will eliminate one of the major dust sources and improve groundwater quality in the surrounding area.

60. Socioeconomic benefits of the Project will include (i) creation of 783 permanent job opportunities during operation and 4,560 full-time jobs for locals over the construction period of

<sup>23</sup> Baoding three municipal WWTPs at total of 320,000 m<sup>3</sup>/day total capacity are all under upgrade and modification per National Guideline from Level 1B to 1A.

6 years; (ii) increase in recreation and environmental aesthetics in the local communities and promotion of tourism; (iii) increase in property values along the rivers and Baiyangdian Lake; and (iv) increase in income of local farmers who can supply the markets with forestry or agro-forestry products.

## **B. Impacts Associated with Location and Design**

61. No important historical and cultural sites, or rare and endangered species will be affected by any of the subprojects. Construction areas, sewer routes, and water diversion alignment will not be located in forests and grasslands of ecological significance, designated natural reserves, or scenic areas.

62. Each WWTP expansion subprojects and sludge treatment centre subproject will adopt measures to minimize hazards or obnoxious conditions to neighbours. The measures include providing buffer zones (200–300 m) and fences for WWTPs, abating noise and air pollution, and preparing contingency plans for accidental wastewater overflows or spills. These WWTPs will strictly monitor the enforcement of wastewater discharge standards and sludge disposal requirements. WWTP

63. Reforestation upstream of the Angezhuang Reservoir and around Baiyangdian Lake will mainly be on available Baoding municipal or local forestry bureaus land, or other government-owned unoccupied land. It will avoid any disputes on cultivated or cultivatable lands to minimize negative social and economic impacts. Environmental impact to the adjacent areas will be minimal for the Forestation subproject since it is going to cultivate the uncultivated land.

64. The design of the IWM subproject has avoided house relocation, but will acquire permanently 35.5 ha of land. Of that, 27 ha will be cultivated land, 0.33 ha woodland, and 8.3 ha uncultivated land. In addition, 16 ha of land will be temporarily occupied. In total, 650 households or 2,770 people will be permanently affected by land acquisition. The SWM in Huanghuagou River area will acquire 200 ha of uncultivated land, which will affect 15 households or 40 people.

65. The 26 subprojects will require the permanent acquisition of 317.5 ha, temporary acquisition of 160 ha, and demolition of 4,722 ha of residential and non-residential buildings. In total, 10,224 people will be permanently affected by land acquisition and/or house demolition. During the FSs and design stage, resettlement plans (RPs) have been formulated in accordance with PRC resettlement regulations and ADB policies to minimize adverse impacts on local affected people.

## **C. Impacts during Construction**

### **1. Physical Environment**

66. **Original Subprojects.** Negative impacts on air, water, and the acoustic environment are expected during construction. In general these impacts will be temporary and localized, and if proper mitigation measures are implemented during the construction period, the impacts on sensitive receptors can be minimized or even eliminated.

67. **Four New Subprojects.** Negative impacts on air, noise, surface water, groundwater and soil erosion or contamination are expected during the construction. These impacts will be temporary and localized and proper mitigation measures can minimize or resolve the impact to

the environment during the construction. Mitigation measures for each subproject are discussed in the relevant Tables of the Appendixes.

#### **a. Air Quality**

68. Construction activities will involve the use of machinery and vehicles, which produce air-polluting emissions. Measures to minimize dust generation during construction will include (i) enclosing waste excavation sites with fences; (ii) spreading water on dusty roads and construction sites; (iii) maintaining water content in construction materials; (iv) covering or enclosing transportation vehicles, controlling the speed of vehicles, and selecting transportation routes to minimize impact on dust-sensitive receivers; (v) covering or watering open field stockpiles or storage sites; and (vi) minimizing on-site storage time of construction materials and dredged silt from Huanghuagou River. All vehicles should be properly maintained and pass the annual inspection test supervised by HEPB. Dust-generating sources within or adjacent to farmlands will be covered to minimize adverse impacts on crops.

69. Significant odor impacts can be expected during excavation of old wastes and silt dredging in the SWM subproject. On windy days and in summer, the odour may affect up to 1 km of downwind areas from the excavation site of old wastes, and 50 m from the riverbed and 200 m from the temporary storage site of dredged silt. The EIA survey indicates no residents within 1 km from the waste dump site and 50 m from the riverbed. Therefore, impacts on the residents are insignificant. As a precaution, the following mitigation measures will be implemented: (i) avoiding excavation activities on windy days; (ii) avoiding temporary dredged silt storage residences within 200 m; and (iii) minimizing on-site storage time of dredged silt.

#### **b. Water Quality**

70. During the construction period, impacts on water quality will be caused mainly by water diversion tunnel construction; runoff from disturbed soil areas; servicing, maintenance, and cleaning of vehicles and equipment; and activities associated with operating construction camps (e.g., sewage and waste disposal).

71. **Tunnel Operation.** A 3.84 km tunnel for IWM subproject will be constructed. Tunnel operation will produce wastewater with a high concentration of suspended solids ranging from 800 to 10,000 milligrams per liter (mg/l). The wastewater will be collected in sediment tanks, retention ponds, and filter tanks to remove silts and then reused for tunnel operations.

72. **Soil Erosion.** Rainfall runoff from the construction sites will be polluted by silt prior to its stabilization and protection by a vegetative cover. Soil erosion prevention plans (SEPPs)<sup>24</sup> including targets for soil erosion control, mitigation measures, implementation, supervision, and reporting have been prepared for the water diversion subproject. The SEPP proposes a three-pronged approach to reducing soil erosion that includes soil stabilization, run-on control, and sediment control measures.

73. Soil stabilization is designed to prevent soil particles from detaching and being transported in stormwater runoff. Soil stabilization measures in the SEPP include

- (i) preserving existing vegetation where no construction activity is planned, or

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<sup>24</sup> According to the PRC regulations, an SEPP for water diversion projects is required. An SEPP was approved in May 2007 by the Baoding Municipal Bureau of Water Resources.

- temporarily preserving vegetation where activity is planned for a later date;
- (ii) applying temporary soil stabilization, such as covering canal slopes with plastic film, geotextiles, or similar materials if permanent protection works cannot be carried out during the rainy season; and
- (iii) applying permanent soil stabilization measures, such as vegetation and concrete pavement, upon completing construction, or when closing borrow sites, disposal sites, and temporary access roads.

74. Run-on control measures are to divert stormwater flows around disturbed soil areas or to convey flows through disturbed areas in a non-erosive manner. Run-on control measures in the SEPP include (i) earthen dikes, (ii) interception ditches, (iii) retaining walls to prevent excess earth from entering existing drainage systems, and (iv) preventing runoff from entering the disposal sites.

75. Sediment control measures are used to further reduce sediment entry into the storm drain system or into receiving water bodies so as to prevent water pollution. Sediment control measures in the SEPP include desilting basins or sediment tanks at construction sites where runoff can enter drainage systems or receiving water bodies.

76. Because tree planting in the forestation subprojects may cause minor soil erosion, the following mitigation measures will be adopted.

- (i) During planting or replanting, all vegetation to be cleared will be windrowed (banked into ridges), leaving only a narrow cleared planting avenue.
- (ii) There will be no burning; instead, the windrowed materials will be laid along the contour of the land to slow the flow of runoff (rather than up and down hillsides, which does nothing to discourage erosion).
- (iii) During clearing and replanting, the period of time that the soil is exposed without ground cover will be minimized. While trees are still small, cover crops/grass will be grown to reduce erosion while building up organic matter levels in the soil through leaf and plant litter.

77. For all the remaining subprojects, some of the above mitigation measures will be implemented if necessary.

78. **Vehicle and Equipment Maintenance and Cleaning.** Potential spill and leakage of fuel, petroleum products, lubricants, solvents, and other pollutants related to vehicle and equipment fuelling, maintenance, and cleaning may cause serious water and soil pollution. The following mitigation measures for reducing such risks are proposed: (i) all vehicles and equipment that regularly enter and leave the construction sites will be fuelled off-site and cleaned off-site; (ii) vehicle and equipment wash areas will be properly identified by signs and located away from drainage facilities and watercourses (those areas will be paved with concrete or asphalt, have berms to contain runoff, and will be equipped with ponds to collect and dispose of wash water); (iii) a handling protocol for construction materials will be prepared and applied. It will, for example, call for materials storage away from watercourses and provision of retention areas so as to contain accidental spills of such toxic, hazardous, and harmful construction materials as caustic and acidic substances, and oil and petroleum products.

79. **Construction Camp Operations.** Wastewater from each work camp will be collected in septic tanks. To protect sensitive water bodies such as Wangkuai and Xidayang reservoirs designated as class II of PRC water quality standards, effluent from septic tanks will not directly

be discharged into these surface water bodies.<sup>25</sup> Use of that effluent for agricultural irrigation, watering plants, or spraying on dusty roads and construction sites will be encouraged. No-water-flushing latrines will be installed to collect human wastes, which will be dried in a natural way or composted to be used as fertilizer.

80. **Wastewater in the Sand Quarry Pit and Ash Storage.** There are about 400,000 m<sup>3</sup> of wastewater from the ash collecting system and 177,000 m<sup>3</sup> of sewerage from upstream stored in the sand pit that connects to the dump site. Monitoring data showed that wastewater in the sand pit and ash storage meets the PRC *Discharge Standards for Municipal Wastewater (CJ3082-1999)*. Therefore all the wastewater will be pumped into Lugang WWTP,<sup>26</sup> which has the capacity to receive the wastewater.

### c. Noise

81. Noise and vibration will be generated during construction by heavy construction machinery, such as excavators, bulldozers, concrete mixers, and transportation vehicles. It is estimated that noise intensity from these activities will be in the range of 70–85 dB(A). As such, they will meet the PRC's standards<sup>27</sup> up to 150 m away from the sources during the day and 480 m during the night. The actual situation could be more severe if several activities occur simultaneously. Major mitigation measures include (i) no night construction (from 2200 to 0600 hours) using heavy machinery near residential areas; (ii) good maintenance and proper operation of construction machinery to minimize noise generation, (iii) installation of temporary sound barriers, if necessary, and (iv) selection of transport routes for large vehicles to avoid residential areas and no waste transport will be allowed at night (from 2200 to 0600 hours).

82. Blasting, particularly for tunnel construction in the water diversion subproject, is expected to occur frequently. That will create periods of severe noise peaks of more than 100 dB(A) up to 1 km from a blast site. Blasting will be carried out only with permission of the construction chief engineer, according to a pre-established schedule that will also be made known to all people within 200–500 m of the blasting site in all directions, depending on the total charge used. Blasting mats will be used to reduce flying debris and assist in suppressing noise. The 71 families within 150 m from the tunnel will be severely affected by blasting. The construction unit will come to an agreement with residents for arranging temporary shelters away from the tunnel construction site or giving appropriate compensation depending on the wish of the affected families.

### d. Solid Wastes

83. The contractor will ensure proper collection, storage, and disposal of wastes. Multi-compartment collection bins will be provided to facilitate reuse, recycling, and composting of solid waste. Wastes will be stored away from water-bodies and will be regularly hauled to a suitable landfill or designated dumping site. Contractors will provide appropriate waste storage containers, and sign agreements with local villages for waste disposal, where appropriate, through village facilities. These arrangements will be made before starting works.

<sup>25</sup> Clause 4.1.5 of *Integrated Waste Water Discharge Standard of PRC* (SEPA, GB8978-1996) states that no discharge related to the project operation and construction will be allowed into rivers with waters designated as class I and class II.

<sup>26</sup> The designed capacity of Lugang WWTP is 80,000 tons/day. Currently, Luguan WWTP receives 60,000 tons/day of waste water from Baoding Municipality.

<sup>27</sup> SEPA. 1990. *Noise Limits for Construction Sites* (GB12524-90). Beijing.

84. **Construction Waste.** Construction waste will be generated, especially in the water diversion subproject, which will generate 695,200 m<sup>3</sup> of earth and rock for disposal. Excavation and disposal of earth and rock may affect the ecosystem, natural drainage and agricultural irrigation systems, and water quality, as well as lead to soil erosion. The FS identified 10 disposal sites located in valleys and depressions that will not interfere with farmlands or forestland, and will not block existing drainage systems. The following measures will be employed for cutting and disposal sites to protect the environment: (i) as much as possible, use spoil from tunnelling or cutting as fill where it is needed so as to reduce the amount for disposal; (ii) strip and stockpile topsoil, and build retaining walls where necessary before dumping; (iii) construct intercepting ditches and chutes to prevent outside runoff from entering disposal sites, and divert runoff from sites to existing drainage systems or ponds; and (iv) rehabilitate disposal sites into grassland, woodland, or farmland after closing.

85. Excavated wastes from the Huanghuagou dump site will be sent to Baoding sanitary landfill, which has a daily disposal capacity of 1,000 tons and remaining capacity of 400 million tons lasting more than 9 years. Relocation of Huanghuagou wastes will only shorten by 1 year the service time of the Baoding landfill. Baoding municipality generates 800 tons/day of domestic wastes that are sent to the landfill. The landfill can only receive 200 tons/day or 50,000 tons/day of wastes from the dump site; therefore, the daily disposal capacity of the landfill needs to be upgraded to 1,300–1,500 tons/day, which requires roughly about CNY14 million for equipment and operation costs. To ensure that the subproject is well-implemented, during the project (2 years), the IA will provide funds for upgrading and additional investment.

86. **Ash from Coal Burning.** In nature, coal contains arsenic, which eventually goes into the ash after coal is burned. Monitoring data show the content of arsenic is far below the level of hazardous wastes.<sup>28</sup> Ash will, as usual, be sold to the market for uses that will not bring new environmental issues. The flyash is a valuable resource/raw material for cement, concrete, and many other high value added applications such as brick manufacture and road construction primarily because of its pozzolanic characteristic. Currently, there is good market for flyash especially because of the many highway construction projects being undertaken in this area, for example, Chang-Shi expressway, Bao-Chuang expressway, etc.

87. Ash will be transported to the various users over two years as planned by the Baoding Comprehensive Ash Utilization Office. A new temporary storage site and emergency (or spare storage) will be constructed by BCP before closure and rehabilitation of the ash storage start, to temporarily store ash generated in the future before they are sold to the users. Currently, BCP uses the wet-pipe collection system for ash after coal burning, but this system uses a lot of water. To minimize environmental impacts, BCP plans to adopt a more environment-friendly technology—the sealed flyash collection system, which saves water and prevents air pollution by sealing the truck carrier and the silo storage. The temporary storage silo with a capacity of 60,000 tons will be situated inside BCP, and the spare storage with a capacity of 230,000 tons will be located at Beigao of Qingyuan County, 25 kms away from BCP. The upgrading of the fly ash collection system and construction of a temporary silo and spare storage currently are in the pre-feasibility study and the EIA will be conducted to ensure environmental safety.

88. **Existing Construction Wastes and Demolition Wastes.** Rehabilitation of the waste dump site, wastewater pit, and ash storage needs 1.34 million m<sup>3</sup> of earth. The subproject will

<sup>28</sup> By using extraction procedure for toxicity testing, the contents of arsenic in the lixivium from ash is 0.106 mg/l, which is far below the limit of hazardous wastes specified in the PRC Identification Standard for Hazardous Wastes -Identification for Extraction Procedure Toxicity (1.5 mg/l) (GB 5085.3-1996).



use 165,000 m<sup>3</sup> of the existing dumped construction wastes, and 504,000 m<sup>3</sup> of earth from the demolished retaining dam of the ash storage. The rest of required earth, about 554,000 m<sup>3</sup>, will come from construction waste generated in Baoding City, which annually is about 2 million m<sup>3</sup>.

89. **Dredged Silt from Huanghuagou River.** Chemical testing for heavy metal contents of river sediments was carried out during the EIA. The results showed heavy metal levels complying with Control Standards of Pollutants in Sludge for Agricultural Use of PRC (GB4284-84, SEPA). River dredging will yield over 1,250 m<sup>3</sup> of silt that could be used as fertilizer. But to ensure greater safety, the dredged sludge will be sent to the Baoding sanitary landfill.

## 2. Ecological Environment

90. **Impacts on Vegetation.** In general, no plant and animal species on the national protection lists are found within 300 m from the subproject sites except in the Baiyangdian Lake wetland area. The adverse impact on endangered and rare species is negligible. The existing vegetation of the Angezhuang forestation area comprises mainly secondary forests of oak, mountain poplars, birch, and mixed forest of mountain poplar and birch. In remote mountains, vegetation comprises mainly various shrub species. In low mountains, vegetation is mainly different grass species. Forestation will be in selected areas that are not covered with forests or other types of vegetation (i.e., barren mountains) due to heavy human disturbance. Therefore, adverse impact is not anticipated on existing land use. Wild animals, i.e., hedgehogs, hares, squirrels, and migratory birds are found in the area. To mitigate the potential negative impacts, training to protect wild animals will be imparted to workers/farmers hired for tree planting. According to the PRC wildlife laws,<sup>29</sup> fines will be imposed for hunting wild animals.

91. The Project will permanently occupy only 1.46 ha of forest or woodland (secondary forests or cash trees), mainly in the IWM and UFM subprojects. In compliance with PRC's Forestry Law, the IAs will undertake compensatory planting of an equivalent or larger area of affected forest trees, in coordination with the Baoding and local forestry departments. Revegetation will use a variety of species that are suitable for this area and have the most appropriate attributes to survive and serve their designated functions. Forestation does not require construction of additional infrastructure.

92. **Impacts on Prime Farmland.** Dingxin and Tang County WWTPs subprojects will occupy 6.4 ha of prime farmland. In spite of the fact that the impacts on prime farmland are considered minor, the acquisition of prime farmland needs the permission of the State Council, in accordance with PRC regulations.<sup>30</sup> PRC regulations require application of the "net loss of prime farmland principle," which means that the project developer should either reclaim the same amount of prime farmland to replace that which will be permanently occupied by the Project, or pay a compensation fee for reclamation to the Hebei Provincial Land and Resource Bureau. The IAs of these two subprojects, in cooperation with provincial, municipal, and county bureaus of land and resources, will modify the current land use plan and designate the land for reclamation so as to mitigate the impacts on prime farmland and will obtain the land acquisition permit from the State Council before construction starts.

<sup>29</sup> Law on Wildlife Protection of PRC (1989) and its amendments (2004).

<sup>30</sup> State Council. 1996. *Regulations on Prime Farmland Protection*, No. 31. Beijing and Ministry of Land and Resources, PRC. 2005. *Notice on Further Protection of Prime Farmland*, No. 196. Beijing.

93. **Four New Subprojects.** In general, no plant and animal species on the national protection lists are found from the subproject sites. The adverse impact on endangered and rare species is negligible. Also, adverse impact is not anticipated on existing land use.

### 3. Socioeconomic Impacts

94. **Traffic.** It is estimated that transportation of wastes from Huanghuagou to Baoding landfill will increase vehicle volume on the main selected road by about 3%. This increase will not lead to traffic congestion.

95. **Health Impacts and Occupation Safety.** Excavation of old waste may pose potential health risk to workers and scavengers in the excavation area. The activities will expose intensively the workers and scavengers to particulates and organic dusts that can be contaminated by virus, bacteria, and hazardous substances, and hence increase the risk of allergic and nonallergic pulmonary diseases. To mitigate the risks: (i) a fence will be constructed around the excavation site to prevent uncontrolled access of scavengers, people, and livestock; and (ii) the workers will wear at least gloves and masks to reduce exposure to the waste and hence minimize the potential health risk. The same measures will be applied to workers for ash excavation. They will wear masks to avoid inhalation of particulates.

96. Sediment dredging and excavation of wastes might increase the number of flies and mosquitoes, rats and vectors, resulting in the spread of infectious diseases to both workers and residents. To mitigate health impacts, a prevention and/or education program related to the spread of infectious diseases will be implemented concurrently with project implementation.

97. **Cultural Heritage.** The proposed subproject sites may contain undiscovered cultural relics. If an important site is unearthed, works will stop immediately and the matter will be promptly referred to relevant cultural heritage authorities for evaluation and a decision on appropriate actions.

98. **Livelihood of Scavengers.** About 40 scavengers live on the waste dump site for recycling wastes. The Project will affect their livelihood and compensation of about CNY4,000 and other assistance such as job consultation will be provided to them.

99. **Socioeconomic Benefits.** The Project is expected to result in the direct creation of about 4,560 full-time jobs over the 6-year construction period. The reforestation and flood control subprojects will directly benefit local villages by using mainly local farmers for planting.

100. **Resettlement.** Land acquisition and resettlement will be considerable. The total cost for both is estimated to be CNY356.6 million. All affected persons will be compensated and resettled in a timely and adequate manner, in accordance with the RPs<sup>31</sup>, so that they will be at least as well-off as they would have been without the Project. To ensure that affected persons will be adequately compensated and rehabilitated, BMG and the project management office (PMO) will (i) keep ADB informed of progress in implementing the RPs through quarterly progress reports until resettlement is completed; and (ii) prepare a resettlement completion report. The PMO and IAs will engage an independent agency for semiannual monitoring and annual evaluation of land acquisition and resettlement until 2 years after land acquisition, resettlement implementation, and completion of resettlement.

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<sup>31</sup> IAs. 2006. *Resettlement Plans for Individual Subprojects*. Baoding. The resettlement plan will be also published on the ADB website.

101. **Four New Subprojects.** Construction activities will expose intensively the workers to particulates and dusts that can be contaminated by virus, bacteria, and hazardous substances, and hence increase the risk of diseases. To mitigate the risks that i) temporally fencing to prevent uncontrolled access of people and livestock; and ii) workers will wear at least gloves and masks to reduce exposure to the waste and hence minimize the potential health risk. There is no cultural heritage sites within the construction areas of the proposed subprojects based on the initial investigation. If a potential site is encountered, work will be stopped immediately until the matter is being addressed or resolved. Temporary land acquisitions will be required for WWTP expansion subprojects for sewer network construction. Permanent land acquisitions will be required by CSTC for facility construction. No permanent or temporary land acquisition will be required for the Forestation subproject since it afforests the un-afforest land.

#### **D. Impact during Operation**

##### **1. Physical Environment Impacts**

###### **a. Summary Environmental Impacts of Category A Subprojects**

102. **Integrated Water Management Subproject.** Both the EIA report and the Baiyangdian Lake ecosystem assessment<sup>32</sup> conclude that a water level of 7.3 m is required for sustaining basic ecological functions of the Lake or supporting the reed, aquatic life, culture fishery, and ecotourism activities. Relevant hydrological analysis in the DFR<sup>33</sup> shows that after the completion of the SNWTP, the Wangkuai Reservoir can release 200 million m<sup>3</sup> of water at 50% guarantee rate for environmental purposes after deducting future demand in the Sha and Tang irrigation areas. About 128 million m<sup>3</sup> is expected to reach the Lake to maintain the water level to at least 7.3 m. Without this subproject, only 96 million m<sup>3</sup> of water can reach the Lake through Sha River waterway and Tang irrigation canal. This volume is insufficient to satisfy the minimum water requirement for supporting the Lake ecosystem.

103. The designed water supply capacity of the Xidayang reservoir is 95 million m<sup>3</sup>. However, in the extreme drought year (assuming the inflows to the Reservoirs at 90% of guarantee rate) the Xidayang Reservoir can only supply 34 million m<sup>3</sup> of water to Baoding City which cannot meet the future demand of 95 million m<sup>3</sup>. After completion of the subproject, the Wangkuai reservoir can supply the Xidayang Reservoir about 75 million m<sup>3</sup>. Therefore, total available water for Baoding will be 109 million m<sup>3</sup>, which can satisfy the future water demand of Baoding city even in the extreme drought year. Moreover, recharging the Yimuquan aquifer with 29 million m<sup>3</sup> of water annually will slow down the drop of the groundwater table.

104. Without the subproject, even if all the wastewater in Baoding City is treated before it is discharged to the inner city rivers and the Fu River, the water quality in those water bodies does not meet Class IV (which is required for rivers) due to lack of natural flows to dilute the effluent. It is estimated that, by diverting clean water to Baoding inner city water bodies and the Fu River, the subproject will improve the water quality to Class IV or close to Class III.

105. Water from the Xidayang Reservoir to the Yimuquan aquifer for groundwater recharging can meet Class II of PRC surface water standard and will also be close to Class II of *Quality*

<sup>32</sup> Hebei Provincial Academy of Environmental Sciences. 2006. *Baiyangdian Lake Ecosystem and Environmental Assessment Report*. Hebei.

<sup>33</sup> PPTA Team. 2006. *Technical Assistance Consultant's Final Report for the Integrated Ecosystem Management and Environmental Protection of the Baiyangdian Lake Catchment Project*. Baoding.

*Standard for Ground Water* (GB/T14848-93). Therefore, that water is not likely to affect the water quality of the Yimuquan aquifer, considering that the water quality requirement of the Yimuquan aquifer is Class III of the PRC groundwater standard and that water is naturally purified in the process of penetrating into the ground.

106. **Solid Waste Management.** After rehabilitation of the ash storage, water pit, and waste dump site, near the Huanghuagou River, into an eco-theme park or for urban land use, no significant adverse impacts can be expected if wastewater and wastes from visitors and management staff are properly managed and disposed of.

#### **b. Summary Environmental Impacts of Category B Subprojects**

107. **Noise.** Noise generated in the WWTPs, WSS, and CED subproject activities comes from the operation of pumps and blowers, and is usually contained within the plants. Mitigation measures will include (i) selecting low-noise machine, (ii) locating high-noise equipment indoors, (iii) installing noise enclosures or buffers, (iv) locating influent and effluent pump stations in a semi-underground setting, and (v) establishing a greenbelt buffer around the plant, and between the office zone and treatment units.

108. **Odour.** During the operational phase, bar screens, settling and aeration tanks, and sludge processing units are all potential sources of offensive odours that can produce adverse environmental impacts on the neighbouring communities. Mitigation measures include (i) isolating the operational zone; (ii) promptly transporting sludge dredged from sewers to a designated sludge treatment facility or sanitary landfill for final disposal, or using sludge as agricultural fertilizer if chemical tests show the material complies with pollutant limits for sludge used as agricultural fertilizers specified in *Discharge Standards for Urban Waste Water Treatment* (GB18918-2002, SEPA); (iii) planting greenbelts around the facilities; and (iv) laying out the treatment facilities in a way that minimizes opportunities for odor to reach receptors.

109. **Overflow Risks.** To reduce risk from an accidental overflow, the WWTPs will have relevant standby equipment. Pumping stations will adopt dual-power supply lines, as well as proper operation and maintenance and process control that include emergency plans.

110. **Quality of Receiving Water.** After completion of Dingzhou WWTP, all its effluent will be reused for the Guohua Dingzhou Thermal Power Plant. Rest of the WWTPs will reuse some effluent for industrial and agricultural purposes. The remaining effluent will be discharged into nearby rivers—that currently receive untreated wastewater—or the Lake (Wenquancheng WWTP). With the proposed WWTP process technologies under this Project, the water quality after treatment will meet Level I-A of *Discharge Standards of Pollutants for Municipal Wastewater Treatment Plant* (GB18918-2002) and its amendment (2006).<sup>34</sup> Although the effluent from the Project WWTPs will comply with the requisite discharge standards but the receiving rivers will not be able to meet Class III–IV of the national standards (SEPA, GB3838-2002)<sup>35</sup> due to the sewage flowing in from several other sources of pollution. However, the

<sup>34</sup> Level I-A of the standard is applied to all WWTPs in Baiyangdian Basin. Level I-A specifies less than 50 mg/l for COD, less than 10 mg/l for BOD<sub>5</sub>, less than 10 mg/l for suspended solids, less than 5 mg/l when water temperature is above 12°C or 8 mg/l when water temperature is below 12°C for ammonia nitrogen and 0.5 mg/l for phosphor. Level I-A is the most stringent standard in the PRC that is applied when effluent is discharged into a river or lake with limited dilution capacity.

<sup>35</sup> According to *Environmental Quality Standards for Surface Water* of PRC, Class IV requires COD less than 30 mg/l, BOD<sub>5</sub> 6mg/l, NH<sub>3</sub>-N 1.5 and total phosphor 0.3 mg/l for rivers and 0.1 mg/l for lake and reservoir.

water quality in these rivers and the Lake will significantly improve compared with that without the Project.

111. **Sludge Disposal.** The PRC standards stipulate that a WWTP with capacity below 100,000 m<sup>3</sup> does not require sludge disposal facility, and that sludge can be used for agricultural purposes or for landfill if it complies with the relevant standards. In line with the standards, the sludge is scheduled to be used mostly as fertilizers. At the same time, the use of geotextile tube is proposed to store sludge that cannot be used as fertilizers. Recently, the geotextile tube technology has been widely applied to dewater and store sewage sludge and hazardous wastes, and has been approved as construction practical, technically and economically feasible, and environmentally acceptable.<sup>36</sup> The Baoding Municipal 11th Five-Year Environmental Protection Plan also instructs its counties to construct their own landfills. The sludge stored in geotextile tubes can be disposed in the respective landfills. Groundwater quality of the landfills and transportation methods will be monitored as described in the EMP.

112. **Control of Industrial Discharge to Sewers.** According to the biological oxygen demand (BOD) and COD ratio in individual effluent characteristics, most of the industrial waste streams leading to Project WWTPs will be biodegradable. In addition, enterprises discharging wastewater to the municipal sewers are required to meet *Discharge Standards for Municipal Wastewater* (MOC, CJ3082-1999). Thus, they are not likely to pose major toxic threat to micro-organisms and wastewater treatment processes. In the case of non-compliance, WWTPs will terminate the illicit discharge either by requesting the violator to voluntarily stop or by disconnecting the discharger's effluent pipe until compliance is confirmed. The IAs will monitor water quality in the municipal sewer systems in WWTP subproject areas at least twice a year.

113. **Hazards of Corrosion in Sewers.** Corrosive toxic gases and liquids may accumulate in sewers and result in sewer structural damages and leakages, as well as danger to life. Mitigation measures will include (i) development of a "confined space entry" protocol, (ii) reasonable spacing between service holes to allow access and inspections, (iii) ventilation of sewers to disperse gas and minimize the risks, and (iv) implementation of emergency response plans by coordinating with the associated city agencies.

114. **Chlorine Leakage at WWTPs and WSS.** Chlorine leakage can result in serious injury to workers and property damage. Detectors will be installed so that the chlorine feed system will automatically shut down when a leak is detected. When small amounts of chlorine leak in a chlorine workshop or warehouse and result in ambient chlorine concentration exceeding alarm limits, a ventilator will start up automatically. For large chlorine leaks, a chlorine scrubber system or an alkaline system can automatically start up to absorb the chlorine and contain the leak within the chlorine building. Other measures include minimizing the amount of chlorine stored on-site; installing alkaline recycling equipment (if a chlorine scrubber system is not installed); allocating a buffer zone around the chlorine warehouse and workshop; providing gas masks and oxygen tanks to workers; establishing workers operational safety and emergency procedures before plant start-up; and conducting periodic training and practice sessions on safe operational procedures.

115. No significant adverse environmental impact is expected during the operational phase for the two forestation and Anxin City UMF subprojects.

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<sup>36</sup> For more details, see Jack Fowler, Dewatering Sludge with Geotextile Tube, <http://www.geotube.com/PDF/tech%20docs/sewagesludge2.pdf>.

116. **Four New Subprojects.** Expansion of WWTPs, CSTC and Forestation subprojects. Environmental impacts of subprojects related to WWTP operations and forestation can mostly be summarized for matters such as air, noise, solid waste, effluent, and health, etc. Mitigation measures for these potential impacts can be easily achieved if effective and efficient measures as defined in the related EMPs as shown in the relevant Tables in the Appendixes are implemented.

## 2. Ecological Impacts

### a. Summary Ecological Impacts of Category A Subprojects

117. **Integrated Water Management Subproject.** Currently, the Wangkuai Reservoir releases water to Baiyangdian through Sha aqueduct, and Yueming and Xiaoyu Rivers. Starting in 2010, this route will be used exclusively by SNWTP. The Wangkuai-Xidayang Reservoir link-canal provides an alternative route to supply Baiyangdian Lake with water from Wangkuai Reservoir. Negative impacts of this subproject on the two reservoirs will be insignificant, because (i) the volume of water released from Wangkuai Reservoir remains unchanged, and the volume entering Xidayang Reservoir is immediately released downstream through Tang aqueduct; (ii) the water qualities in the two reservoirs are similar and both reservoirs meet class II of PRC Surface Water Quality; (iii) water temperatures in the two reservoirs are similar due to the short distance between them (approximately 14 km). The subproject will not have any negative impact on the original Sha River, because the river has been dried up since the construction of the Wangkuai Reservoir except during major flood years.

118. **Baiyangdian Lake.** IWM subproject will play an important role in maintaining the Lake's ecosystem. Without the subproject, the only other alternative is to supply water through the Sha River which is currently dried up. Inflow into the Lake will only be about 58 million m<sup>3</sup> through this route due to its high infiltration rate (conveyance efficiency is estimated to be only 30%) and 38 million m<sup>3</sup> from Xidayang Reservoir through Tang irrigation canal, which will not be able to maintain the Lake water to an acceptable level, i.e., 7.3 m. The proposed subproject will provide 128 million m<sup>3</sup> to the Lake annually, which is sufficient to maintain the water level above the minimum acceptable level of 7.3 m.

119. **Solid Waste Management Subproject.** The Huanghuagou River rehabilitation will create 12.9 ha of green space that will benefit the Baoding urban ecosystem and Baoding citizens by providing outdoor recreation opportunities.

120. **Four New Subprojects.** A) Sludge treatment centre subproject. It is expected that the environmental impacts created by the sludge treatment centre subproject will be minimal mainly due to the facility construction site is adjacent to the existing WWTPs and near-by landfill. B) WWTP Expansion and Forestation subprojects. It is estimated that minimal impact to the ecological impacts will be created by the Category B subprojects mainly due to the WWTP expansion are to be constructed at the space either within the plant. The ecological impact due to Forestation subproject enhances the overall ecological environment.

### b. Summary Ecological Impacts of Category B Subprojects

121. It is estimated that the forest cover will increase from 22.4% to 29.7% around the Angezhuang Reservoir area and from 10.5% to 15% around Baiyangdian Lake. The reforestation subprojects will prevent soil erosion and improve water conservation in both areas. However, improper use of pesticides for controlling forest pests may pose a threat to individuals,

wildlife, and both surface water and groundwater with their release into the environment (whether during application, mixing, loading, equipment cleaning, storage, transportation or disposal of pesticides). To prevent pollution due to pesticide use, the following mitigation measures will be adopted: (i) the local forest bureau in cooperation with the local EPB will develop limits and restrictions on the use of pesticides and conduct a training program for forest workers on how to properly use pesticides; and (ii) biological control of pests will be encouraged.

### 3. Socioeconomic Impacts

122. **Impacts on Irrigation.** Connecting the two reservoirs suggests the possibility of expanding the irrigation area. Expansion will benefit the farmers along the link-canal, which is one of the major poverty areas in Baoding Municipality. The existing water demand for irrigation is about 223 million m<sup>3</sup> (59 million m<sup>3</sup> for Tang irrigation area and 164 million m<sup>3</sup> for Sha irrigation area). Considering the increasing irrigation demand in the future, a total of 299 million m<sup>3</sup> of water (88 million m<sup>3</sup> water from Xidayang Reservoir, 144 million m<sup>3</sup> from Wangkuai Reservoir and 67 million m<sup>3</sup> from SNWTP) will be reserved for the irrigation in Sha and Tang areas. To ensure meeting the demand for irrigation water, the following measures will be implemented: (i) a plan including time frequency, amount of water, and responsible agencies for meeting the irrigation water demand will be proposed and implemented by the IA; (ii) two responsible persons from the Baoding agricultural and water resource bureaus each will be appointed to supervise the implementation; and (iii) annual public consultation will be conducted and the irrigation plan may be modified based on the consultation.

123. **User Fees.** User fees or wastewater tariff, CNY1.3/m<sup>3</sup> will be charged to finance WWTPs operation. The tariff may have a negative economic impact on the residents within the service area. However, considering the tariff and household income from the social surveys, it is estimated that the total tariff will be about 1% of the average household income. In ADB practice, the combined water and wastewater tariffs are considered affordable if they fall below 5% of the monthly household income; proposed tariffs are far below this threshold. For those at the lowest income level of CNY120–150 per capita per month, the charges represent approximately 4% of the household income and thus are affordable.

## E. Cumulative Effect Assessment

### 1. Pollution Sources in Baiyangdian Lake

124. This SEIA divides pollution sources into three categories: (i) point sources include urban and industrial wastewater; (ii) non-point sources include agricultural runoff, urban stormwater runoff, and livestock wastes; and (iii) in-Lake pollution sources include domestic wastewater and leachate from wastes in the in-Lake villages, in-Lake fish farms, and those associated with tourism.

125. Quantifying the relative importance of different sources is important, but difficult and prone to error, especially with the lack of necessary monitoring data. Different approaches to quantification used in this study were based on the calculation of driving parameters such as population, industrial output, agricultural yield, and so on.

126. **Total Generated Loads and Total Loads Reaching the Lake.** The estimated total present pollution loads generated by various sources are 633,635 tons/annum of COD, 92,741 tons/annum of ammonia nitrogen, 46,929 tons/annum of total phosphorous. The estimated

loads reaching Baiyangdian Lake are 20,702 tons/annum of COD, 2,103 tons/annum of ammonia nitrogen, and 349 tons/annum of total phosphorous.

127. **Percentage of Total Loads Reaching the Lake, by Source.** Comparing the contributions from different sources shows that the highest loads of COD, ammonia, and total phosphorous are generated by livestock, followed by agricultural runoff and rural domestic sources. However, the highest pollution load reaching Baiyangdian Lake comes from the in-Lake village sources (Table 6).

128. This estimation shows the importance of controlling urban, industrial, and in-Lake pollution sources that generate wastewater and leakage from wastes. In the past, control of pollution from in-Lake villages has had little effects. Under this Project, more efforts will be put on controlling in-Lake village pollution.

**Table 6: Percentage of Pollution Load Contributions, by Source**

Pollution Source		CODCr	NH <sub>3</sub> -N	TP
Point sources	Industries	50.6%	34.5%	5.1%
	Urban domestic wastewater			
	Rural domestic wastes			
Non-point sources	Agricultural runoff	12.5%	27.3%	12.6%
	Livestock			
	Urban runoff			
In-Lake pollution sources	In-Lake village wastewater	36.9%	38.2%	82.3%
	Leakage from in-Lake village wastes			
	Fish farm			
	In-Lake tourism			

CODCr = chemical oxygen demand, NH<sub>3</sub>-N = ammonia nitrogen, TP = total phosphorous.

Source: Xingouhuan Ltd. 2006. *Cumulative Effect Analysis for the Integrated Ecosystem Management and Environmental Protection of the Baiyangdian Lake Catchment Project*. Beijing.

## 2. Past, Present, and Future Projects for Improving the Basin

129. **Past and Present.** To improve the Basin's ecosystem, BMG has already put in efforts on wastewater treatment, soil erosion control, and eco-agricultural system improvement. Currently Baoding Municipality has 4 WWTPs in operation with a total capacity of 210,000 m<sup>3</sup>/day,<sup>37</sup> or, for about 15% of total sewage generated in the Municipality. Three more WWTPs are under construction with a total capacity of 230,000 m<sup>3</sup>/day, i.e., Phase II of Yingding (160,000 m<sup>3</sup>/day), Phase I of Dingzhou City (40,000 m<sup>3</sup>/day), and Gaobeidian City (30,000 m<sup>3</sup>/day)

130. **11th Five-Year Environmental Protection Plan.** To further improve Baiyangdian Lake, BMG has formulated the Municipal 11th Five-Year Environmental Protection Plan. According to the Plan, by 2010, the treatment of urban sewage in Baoding City will reach 100%, and sewage treatment for the 22 county cities and county-status cities will reach 60% (from the present zero percent). The plan includes rehabilitation of the Lake Wetland Reserve, and comprehensive utilization of flyash from the Baoding cogeneration plant.

131. **Baoding Environmental Rehabilitation Master Plan.** To improve the Basin's ecosystem, BMG has already put in efforts on wastewater treatment, soil erosion control, and eco-agricultural system improvement. Currently Baoding City has three WWTPs in service with

<sup>37</sup> Of the 4 WWTPs, 2 are located in Baoding City—Yinding and Lugang WWTP with a capacity of 80,000 m<sup>3</sup>/day each; one in Anxin with 20,000 m<sup>3</sup>/day; and one in Qingyuan with 30,000 m<sup>3</sup>/day.



a total capacity of 320,000 m<sup>3</sup>/day currently all under upgrade and modification to improve their treatment ability from Level 1B to 1A. (BERMP) with a planned investment of over \$1.0 billion, includes reforestation, water supply, and wastewater treatment projects. BERMP calls for setting up 23 WWTPs in counties, county-status cities, and towns surrounding and upstream of the Lake with a total capacity of 665,000 m<sup>3</sup>/day. Of the 23 WWTPs, 13 with a total capacity of 340,000 m<sup>3</sup>/day are under the ADB Project, which accounts for 51% of the planned capacity. The Plan also proposes various sanitary landfills for county cities, and reforestation and wastewater reuse projects.

132. **The 11th Five-Year Water Resource Development Plan.** In 2005, the number of people without access to safe drinking water stood at 3.70 million. The 11th Five-Year Water Resource Development Plan calls for reducing the number of people without access to safe drinking water to 2.88 million by 2010. The three water supply subprojects under the ADB loan project will contribute to the achievement of this objective.

133. **ADB Interventions.** The proposed ADB Project is part of the first phase under the BERMP. Although the contribution of the Project to the reduction of total loads into the Lake is only 10.5% for COD, 8.5% for ammonia nitrogen, and 6.2% for total phosphorous, the Project will have a demonstration effect for future undertakings of BEMRP and the 11th Five-Year Plan.

134. **Global Environment Facility Interventions.** The preparation GEF proposal for grant funding of for biodiversity conservation in the Basin is currently under way. The possible GEF-supported interventions are (i) biodiversity monitoring and management; (ii) public-private partnerships in the tourism sector to demonstrate the viability of attaining both commercial profit and biodiversity benefits within the context of protected area management and to showcase a sustainable, integrated ecosystem management approach; (iii) promotion of livelihood activities based on sustainable harvest and utilization of natural products; (iv) improving institutional coordination in managing the use of land, water, and other resources within the Basin; (v) improving awareness through a comprehensive environmental education program; and (vi) addressing non-point source pollution through “soft” interventions such as awareness-raising and strengthening of extension services, or “low-tech” solutions like composting and recycling.

### 3. Cumulative Effects and Mitigation Measures

#### a. Cumulative Effects

135. **Water Pollution Discharge.** By intercepting direct discharges of raw sewage into the rivers and lakes, and based on sewage volumes corresponding to full capacity of the WWTPs under the Project, the total reduction of pollution load is estimated as follows: COD using the dichromate reflux method, 36,785 m<sup>3</sup>/annum; total ammonia nitrogen, 3,188 m<sup>3</sup>/annum; TP, 347 m<sup>3</sup>/annum. Rehabilitation of the Huanghuagou waste dump will remove 30,410 m<sup>3</sup> of leachate from wastes and 730,000 m<sup>3</sup> of wastewater from the ash collecting system; the total reduction of pollutants in the SWM subproject is estimated as follows: COD using the dichromate reflux method, 305 m<sup>3</sup>/annum; suspended solids, 635 m<sup>3</sup>/annum; ammonia nitrogen, 11 m<sup>3</sup>/annum; and arsenic, 0.8 m<sup>3</sup>/annum.<sup>38</sup> Dewatered sludge cakes with less water content not only reduce quantity of sludge to increase the service life of the landfills, but also stabilize the quality of sludge.

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<sup>38</sup> Arsenic is from wastewater from the coal ash wet-pipe collection system.

136. **Water Quality.** The Project will significantly contribute to improving the water quality of the rivers and the Baiyangdian Lake. In the low water level season, only 3 of the 8 rivers have water flowing into the Lake. The water quality in 3 rivers will greatly improve after the implementation of the ADB Project (Table 7). In particular, the COD of the Fu River is expected to decrease from 165 mg/l to 54 mg/l. After the implementation of the Project and the projects planned in the BERMP, the COD concentration of water from the Xiaoyi River flowing into the Lake will meet the water quality requirement (Class IV) and that from the Fu River will be close to the water quality requirement (Class III).

137. The effluents from Dingzhou WWTP will be reused for Dingzhou Thermal Power Plant, and the effluents from Xiong and Anxin will be discharged into the local irrigation systems for agricultural use without impairing food safety.

138. **Cumulative Effects with South-to-North Water Transfer Project.** SNWTP will alleviate water shortage in the Baiyangdian Basin. SNWTP will supply 145 million m<sup>3</sup>/year of water into the Basin for agricultural and industrial uses which give the possibility of using Xidayang and Wangkuai Reservoirs for improving Lake's ecosystem.

139. SNWTP will exclusively use the Sha aqueduct. It is a man-made canal with intermittent water flow during irrigation season and before and during flood season. After the completion of SNWTP, Sha aqueduct will have constant water flow which may improve the environment of Sha aqueduct and groundwater aquifer downstream and along Sha aqueduct due to water infiltration from the aqueduct. The subproject and SNWTP will not have any negative impact on the Sha River, because the river has been dried up since the construction of the Wangkuai Reservoir except during major flood years.

**Table 7: Projection of Water Quality of Inflows into Baiyangdian Lake**

Pollutant	River	Without Project	With ADB Project	With ADB Loan Project + Projects in BEMRP and 11th Five-Year Plan	Limits (Water Quality Requirement)
Chemical oxygen demand	Chao	208.0	142.0	142.0	20 (III)
	Fu	165.0	54.0	24.0	
	Xiaoyi	171.0	115.0	24.0	30 (IV)
Ammonia nitrogen	Chao	27.2	21.5	21.5	1.0 (III)
	Fu	19.8	6.3	3.2	
	Xiaoyi	17.7	12.8	3.2	1.5 (IV)
Total phosphorous	Chao	1.5	1.1	1.1	0.2 (III)
	Fu	1.7	0.5	0.1	
	Xiaoyi	1.2	0.9	0.1	0.3 (IV)

Source: Xingouhuan Ltd. 2006. *Cumulative Effect Analysis for the Integrated Ecosystem Management and Environmental Protection of the Baiyangdian Lake Catchment Project*. Beijing.

140. **Catchment Ecosystem.** The measures described above, including the activities to be funded under the proposed ADB Project, will be implemented generally to restore the ecosystem balance in the Baiyangdian Basin, and specifically to bring about water quality improvements (reduction of pollution) and water quantity improvements (increased water inflows) in Baiyangdian Lake and its surrounding wetlands. The measures to be funded by GEF will complement and incrementally strengthen the overall goals of ecosystem balance and restoration by ensuring that the global benefits of biodiversity conservation are secured both at the "source" (Taihang Mountains) and the "sink" (Baiyangdian Lake). The GEF-funded interventions complement the loan-funded interventions and will help (i) secure the sustainable ecological functioning of the Baiyangdian Lake system, northern China's largest natural freshwater system; (ii) secure the global benefits of a critical migratory stopover point for

waterbirds in the East Asian-Australasian migratory flyway; (iii) ensure the sustainability of some of the last remaining natural forests and their endemic species in the Taihang Mountains; and (iv) showcase the sustainability of biodiversity conservation in a high-density production landscape with high levels of economic growth.

#### **b. Mitigation Measures**

141. Analysis of the existing situation and cumulative effects suggests that an integrated management approach is best for improving the Baiyangdian Basin ecosystem. At various meetings with stakeholders and relevant government authorities, the following mitigation measures were agreed upon and will be implemented by relevant authorities in Baoding.

142. **Institutional Coordination.** BMG, through BDRC and Baoding EPB, will submit a proposal to the provincial government for re-establishing the Baiyangdian Basin Leading Group, led by a vice provincial governor and composed of senior officials from the line departments and bureaus of the province and municipality. The departments and bureaus will involve the economics, finance, planning, water resource, environment, agriculture, and forestry sectors. The main responsibilities of the leading group will be to (i) formulate the integrated Basin management plan, (ii) coordinate various agencies in implementing the plan, and (iii) monitor and evaluate implementation.

143. **Capacity Building.** Baoding EPB will (i) reinvestigate the pollutant inventory, (ii) make every effort to strengthen its monitoring capacity to measure the impact of BERMP and ADB project implementation, and (iii) improve the capacity of integrated catchment management and planning by developing a geographic information system (GIS)-based environmental monitoring information and decision system with a river-lake catchment water quality models .

144. **Environmental Protection Plan of Baiyangdian Basin.** As suggested in the Baiyangdian Ecosystem Assessment Report, the Hebei Provincial Environmental Protection Bureau will work together with Baoding and Cangzhou Municipalities and relevant provincial government agencies to formulate a plan by employing an integrated Basin management approach. The plan will be based on the following sub-plans being prepared by relevant agencies such as municipal and provincial environmental protection bureaus, water resource bureaus, agricultural bureaus, forestation bureaus, tourism bureaus:

- (i) In-Lake Pollution Control Plan,
- (ii) Baiyangdian Fish Cultivation Plan,
- (iii) Pollution Control Plan of Baiyangdian Upper Watershed, and
- (iv) Ecological Rehabilitation Plan of Baiyangdian Basin.

## **VI. ECONOMIC ASSESSMENT**

### **A. Overall Environmental Economic Analysis for the Project**

145. The benefits from the whole Project will be reflected mainly in human welfare and environmental resources. Analyses show that the economic internal rate of return for the whole project is 17%, significantly higher than opportunity cost of capital of 12% set by ADB. The figure indicates that the benefits outweigh the costs substantially, even if some non-quantifiable benefits are excluded. Hence the Project's economic viability is justified.

## **B. Environmental Economic Analysis for the Two Category A Subprojects**

146. **Integrated Water Management Subproject.** This subproject will construct a link-canal from the Wangkuai Reservoir to Xidayang Reservoir with a diversion rate of 10 m<sup>3</sup>/second and length of 14.6 km. This is expected to reduce water losses through Sha River (Alternative I) which have been estimated at about 61 million m<sup>3</sup>/year due to high infiltration rate along its sandy route. At an economic price of about CNY1.4/m<sup>3</sup>, the estimated economic benefits due to reduction in water losses from this subproject is about CNY86 million/year. The reallocation of water resource, by releasing excess water from the two reservoirs during the rainy season, will also enable the recharging of the Yimuquan aquifer with clean water to maintain pressure within the aquifer and prevent it from the intrusion of polluted water from the Caohe drainage area during low watertable levels. The mitigation of this problem will bring about health benefits among affected communities accruing to reductions in the incidence of stomach and intestinal diseases which are unlikely to occur without the Project. An estimated 700,000 people in Baoding City and Li County are likely to benefit at a total economic value of about CNY26 million/year. The estimated EIRR for the subproject is 18.9%.

147. **Solid Waste Management Subproject.** The rehabilitation of the Huanghuangou River will improve the general environmental condition within the subproject area. The solid waste materials in the open field will be treated and the area will be land-filled. The existing moat will be dredged from which about 50,000 m<sup>3</sup> of sludge, which is highly polluted by industrial waste, will be removed and the whole area will be landscaped. These activities will significantly reduce dust pollution and contamination of surface and subterranean water with significant beneficial impacts on health and environment affecting about half a million people in Baoding City. A conservative estimate of about 136,000 tons of dust which annually affects Baoding City will be reduced once the rehabilitation is complete. At a cost of about CNY0.52/kg to reduce dust, the estimated economic benefits are about CNY71 million/year. Health benefits due to reductions in the incidence of stomach and intestinal diseases and contaminated drinking water (about CNY18.65 million/year) and respiratory ailments (about CNY 4.19 million/year) are also expected to accrue to the subproject. The estimated EIRR is 18.9%.

## **C. Environmental Economic Analysis for the Four New Category B Subprojects**

148. In addition to the forestation subproject, benefits from other three newly-added subprojects will be reflected mainly in environmental resources and human welfare. Analyses show that the economic internal rate of return (EIRR) for the whole project is 12.9%, higher than opportunity cost of capital of 12% set by ADB. The figure indicates that the benefits outweigh the costs substantially, even if some non-quantifiable benefits are excluded. Hence the Project's economic viability is justified.

149. The economic analysis is carried out for each newly added subproject and for all three newly added subprojects as a whole. The general principle for economic analysis is that the economic benefits of each subproject and the whole must be greater than the economic costs including investment and O&M costs. The investment in WWPTs can improve the quality of water in the river network the treated wastewater is drained into. The improvement of water could help decrease the incidence rate of stomach and intestinal diseases by 5% and hepatitis A by 0.6%. Therefore, the economic benefits resulting from reduction in medical costs are expected to be substantial. Two approaches are used to evaluate the economic viability: least cost analysis and EIRR. The least-cost analysis for each subproject indicated that the chosen

technology exhibited the least cost compared with other technologies available. The EIRRs for each subproject and all three newly-added subprojects are presented below.

**Table 8: EIRRs for Four New Subprojects**

Subproject	EIRR (%)	Benchmark (%)
Li County Wastewater Treatment Plant Phase II	14.9	12.0
Qingyuan County Wastewater Treatment Plant Phase II	14.3	12.0
Centralized Sludge Treatment Center	16.6	12.0
Baiyangdian Upstream Forestation	12.0	12.0
Whole Project	14.7	12.0

## **VII. ENVIRONMENTAL MANAGEMENT PLAN**

### **A. Objectives**

150. The objective of preparing an EMP is not only to propose appropriate mitigation measures, but also to recommend establishment of institutions or mechanisms to monitor and ensure compliance with environmental regulations and implementation of the proposed mitigation measures. Such institutions and mechanisms will seek to ensure continuously improving environmental protection activities during preconstruction, construction, and operation in order to prevent, reduce, or eliminate adverse impacts.

An EMP includes (i) objectives; (ii) mitigation measures; (iii) implementing organization and responsibilities; (iv) inspection, monitoring, and reporting; and (v) mechanism for feedback and adjustment. EMP will be reviewed and updated at the end of the detailed design in order to be consistent with the final design.

### **B. Mitigation Measures**

151. Mitigation measures are defined in the EIAs and IEEs and summarized in Table A3.1 and Table A3.2 of Appendix 3.

### **C. Implementing Organization and Responsibilities**

152. PMO will be responsible for setting up the environmental management system, consisting of inspection, monitoring, reporting, and initiating corrective actions or measures. In the design stage, PMO and IAs will pass the EMPs to the DIs (design institutes) to incorporate mitigation measures into the detailed designs. EMPs will be updated at the end of the detailed design, and finally passed on to selected contractors. To ensure that contractors comply with the EMP's provisions, the PMO and IAs will prepare and provide the following specification clauses for incorporation into the bidding procedures: (i) a list of environmental items to be budgeted by the bidders in their proposals, (ii) environmental clauses for contract conditions and specifications, and (iii) the translated EMPs for compliance. A unit responsible for environmental

protection will be established under PMO before construction starts, and environmental supervision companies (ESC) contracted by the PMO will be responsible for inspecting, monitoring, and evaluating implementation of the mitigation measures.

153. Environmental training will be essential for IAs and contractors to implement EMPs. PMO will organize training programs covering (i) environmental laws, regulations, and policies; (ii) implementation of mitigation measures, (iii) handling of environmental conflicts with residents and schools near the facility area; (iv) environmental technologies and procurement; (v) facility maintenance and operation; (vi) environmental monitoring and supervision; and (vii) documentation and reporting. The cost of training is shown in Appendix 3.

#### **D. Inspection, Monitoring, and Reporting**

154. PMO will recruit one or more ESCs to conduct internal environmental inspections to ensure that environmental mitigation measures are properly implemented. Inspections or audits will mainly cover construction activities, but will also review the affected environment. They will be conducted weekly during the construction period. Inspections or audit activities and observations will be well-documented, and the contractors and IAs will be informed of the outcomes. Baoding municipal and local county EPBs will be responsible for regular and random external environmental monitoring activities (see Tables A3.3 and A3.4 for details) before, during, and after construction, as well as in the event of emergencies.

155. Annual inspection and monitoring reports will be prepared and submitted to PMO every month and to relevant EPBs every 6 months during construction. The results of environmental inspection and monitoring will be used for assessing the (i) extent and severity of the environmental impacts against predicted impacts, (ii) performance or effectiveness of the environmental protection measures or compliance with pertinent rules and regulations, (iii) trends in impacts, (iv) overall effectiveness of the project EMPs, and (v) need for more mitigation measures.

156. To ensure proper and timely implementation of the EMP and adherence to agreed-upon environmental covenants, the PMO will submit to ADB semi-annual reports on environmental performance based on the monitoring and audits. Moreover, within 3 months after each subproject completion, or no later than 1 year with Baoding EPB permission, environmental acceptance monitoring and audit reports of each completed subproject will be (i) prepared by a qualified environmental monitoring institute in accordance with the PRC regulation on Environmental Check-and-Acceptance of Project Completion (SEPA, 2001); (ii) reviewed for approval of the official start of individual subproject operation by Baoding EPB, and (iii) finally reported to ADB. The environmental acceptance reports of the completed subproject will indicate the timing, extent, and effectiveness of completed mitigation and of maintenance, as well as point out the need for further mitigation measures and monitoring during operations.

#### **E. Mechanism for Feedback and Adjustment**

157. On the basis of the inspection and monitoring reports, Baoding EPB will decide whether (i) further mitigation measures are required as corrective action, or (ii) some improvement in environmental management practices is required. If inspection reveals substantial deviation from EMPs or any changes made to any of the subprojects that may cause substantial adverse environmental impacts or increase the number of affected people, PMO should consult with Baoding EPB and ADB immediately and form an EIA team to conduct additional environmental

assessment and, if necessary, further public consultation. The revised EIA reports should be submitted to Baoding EPB for review and approval and then to ADB.

### VIII. PUBLIC CONSULTATIONS AND DISCLOSURE

158. Two rounds of public consultations with various groups of stakeholders were conducted. They included (i) group discussions with villagers and their leaders, (ii) meetings with various government officials, and (iii) an interview survey using questionnaires.

159. The first public consultation was conducted by the institutes for preparing EIA reports of the individual subprojects during May–November 2006,<sup>39</sup> with 820 stakeholders, 114 of whom were for the IWM subproject and 35 for the SWM subproject. The primary objective of the first round consultation was to disclose information to the public and gather information on potential concerns about the two subprojects. In the first round, a concise project description and a questionnaire in plain language were distributed to the public. A summary of the main EIA/IEE findings, proposed mitigation measures, relevant project information, and the contact telephone lines of organizations responsible for the proposed project to achieve its environmental objectives and sustainability were prepared and distributed to the public. In general, the public expected the Project to improve the environment and ecosystem of Baiyangdian Lake, and promote social and economic development. Hence, most of the stakeholders (87%–100%) support the individual subprojects. Main findings of the first public consultation regarding the two category A subprojects are summarized as follows.

160. **Integrated Water Management Subproject.** The public consultation focused mainly on the project-affected Sha irrigation area, the two-reservoir connection area, and beneficiaries from Baoding Municipality and in-Lake villages. The major findings follow: (i) more than 60% of the people surveyed learned about the proposed subproject through the TV, newspapers, the internet, etc.; (ii) 93% expected social, economic, and quality-of-life improvements from the subproject and, therefore, supported it; most of the people believed that the quality and supply of water from the Lake would improve; and (iii) of the respondents affected by land occupation in the new construction section, 60% agreed to have their land taken or house removed, if that was necessary. The remaining 40% were concerned about their future livelihood and agreed, subject to conditions that are reasonable. However, in the Sha irrigation area, most of the people surveyed expressed concern that water diversion may reduce their water for irrigation. In the proposed link-canal area, most people expressed concern about noise, airborne dust, and waste disposal and soil erosion during construction. Affected persons within 100 m from the alignment and temporary construction access roads demanded appropriate compensation for the noise impacts.

161. **Solid Waste Management Subproject.** In general, the stakeholders were positive about the subproject and believed it would improve the water quality of Huanghuagou River and air quality in the area, and improve the Baoding City image and hence promote economic development. However, the scavengers on the dump site felt that their livelihood would be affected. The EIA suggested that adequate compensation to the scavengers is necessary.

162. The second round of public consultations from 12 to 23 October 2006 consisted of a survey, consultation conferences, and internet survey. The primary objective of the second round was to communicate the preliminary EIA findings from the individual draft EIA reports and the proposed mitigation measures, and to gauge public acceptance. Opinions and concerns

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<sup>39</sup> Some category B subprojects have been delayed and their first public consultations were conducted in November 2006 even later than the second round of public consultation for two category A subprojects.

gleaned are as follows: (i) most of the people consulted knew about the proposed subproject through the media, conferences, public meetings, etc., and were aware of the environmental assessment work and resettlement planning; (ii) most people support the subproject and expect social and economic development and improvements in the quality of life as a result of its implementation; (iii) most of the people surveyed were satisfied with the mitigation measures proposed to address the anticipated adverse environmental impacts; and (iv) fair and prompt payment for resettlement and rehabilitation once again emerged as the most common concern of those surveyed.

163. The public concerns and the following mitigation measures will be incorporated in FSRs and EMPs.

- (i) Total of 299 million m<sup>3</sup>/year of water (88 million m<sup>3</sup>/year from Xidayang, 144 million m<sup>3</sup>/year from Wangkuai and 67 million m<sup>3</sup>/year from the SNWTP) will be reserved for irrigation in Sha and Tang irrigation areas.
- (ii) Land acquisition and resettlement were the concerns of most respondents, especially those whose property may be acquired when the two reservoirs are connected. It was found that most of them knew little or nothing about resettlement or compensation policies and were worried about the transparency and fairness of these policies. The IAs have prepared resettlement plans (RPs) that are in compliance with relevant state and provincial policies. A resettlement office will be set up within each IA to administer the RPs. That office will make the RPs open and transparent to all relevant households. The resettlement office will also ensure that compensation is paid on time and in full to the households that will actually be relocated or whose land will be acquired.
- (iii) "No Blowing of Horns" signs will be set up near villages to minimize the noise impacts.
- (iv) The families severely affected by blasting will be provided temporary shelters away from the tunnel construction site or given appropriate compensation, depending on their desire.
- (v) Soil erosion was one of the main public concerns. Therefore, an SEPP including a vegetation restoration plan to prevent soil erosion during the construction period was prepared by the IA of the IWM subproject

## IX. CONCLUSIONS

### A. Project Risks

164. The main project risks are (i) ineffective organizational structures and inadequate capacity of the IAs, which could result in inefficient project implementation; (ii) delays in providing the counterpart funding for BERMP; (iii) unforeseen land acquisition and resettlement issues, which could constrain the efficient implementation of the project works and restoration of the livelihood of the affected peoples; (iv) accidental discharge of Tang County WWTP and Baoding Yingdingzhuang WWTP into the canal; and (v) potential adverse environmental impacts due to the construction of new ash storage. Several measures have been identified to mitigate the project risks: (i) appointment of project implementation and monitoring consultants for Baoding and local county EMCs, (ii) strong support from higher levels of government



(notably at the provincial level) for project financing<sup>40</sup> (iii) EMP monitoring and mitigation arrangements, (iv) EMP environmental management training, (v) specific assurances from BMG, and (vi) ADB project reviews.

165. Assurances and covenants required for environmental aspects are:

- (i) BMG will submit a proposal to re-establish the Baiyangdian Basin Lading Group to secure financing and for implementing the BERMP. Leading group will be chaired by an executive mayor and co-chaired by vice mayors.
- (ii) BMG will ensure that the IAs build, operate, maintain, and monitor the project facilities in strict conformity with (a) all applicable laws and regulations, including national and local regulations and standards for environmental protection, health, labour, and occupational safety; and (b) ADB's *Environment Policy* (2002) and the environmental mitigation and monitoring measures included in the approved project EIAs and EMP.
- (iii) BMG will ensure that the IAs submit monthly monitoring reports to PMO, until loan closure, which will prepare and submit semi-annual environmental reports to ADB in an acceptable format.

## **B. Benefits**

166. The Project will benefit the environment and the health of the people in the project area.

- (i) After completion of WWTPs and associated sewer networks, total pollution loads into the Lake will be reduced by about 10.5% for COD, 8.5% for ammonia nitrogen, and 6.2% for total phosphorous.
- (ii) Health status will be improved significantly after the completion of the WWTPs and WSS with upgraded sanitation and hygiene conditions for residents within the sewer service area and residents near the rivers and the Lake (about 1.12 million people) and clean water for 260,000 people.
- (iii) After all losses are deducted, the IWM subproject will replenish the Lake with 128 million m<sup>3</sup> of clean water annually to maintain its water level above the minimum requirement of 7.3 m. IWM subproject will also raise the water quality in water bodies and Fu River within Baoding's inner city rivers from worse than class V up to class IV or close to class III. In addition, 29 million m<sup>3</sup> will be used to recharge the Yimuquan aquifer.
- (iv) The CED subproject will benefit local air quality and reduce CO<sub>2</sub> emissions.
- (v) The two reforestation subprojects will improve the ecosystem of Baiyangdian Basin significantly.
- (vi) UFM subproject will improve flood protection for Anxin City (population 51,000) up to a flood occurrence of once in 50 years.
- (vii) SWM in Huanghuagou River area will eliminate one of the major dust sources and improve surface and groundwater quality in the surrounding area.
- (viii) Many socioeconomic benefits will result from the Project: job opportunities, tourism development, and improved livelihood of local farmers who can bring forestry or agro-forestry products to markets and provide tourism services.

<sup>40</sup> Currently, CNY1.1 billion has been secured for implementing the BERMP. The major funding sources are state bonds, state and provincial sector-specific funding programs, provincial government, bilateral cooperation agencies and international funding institutions such as ADB. A detailed financing plan for implementing ADB projects has been proposed by BMG (also see Memorandum of Understanding: Loan Fact-Finding Mission of the Project, 6–16 March 2007).

### **C. Potential Adverse Impacts and Associated Mitigation Measures**

167. An unavoidable negative impact will be the acquisition of 26 ha of cultivated land and 210 ha of uncultivated land. This requirement will affect 665 households or 2,810 people. Compensation is specified in RPs that meet the PRC and ADB policy requirements.

168. During construction, dust from construction sites, odour from old waste excavation, dredged river silt, noise from power mechanical equipment, wastewater, solid wastes, and construction traffic are the major adverse impacts. Good housekeeping and mitigation measures have been recommended. With their implementation, the impacts will become insignificant.

### **D. Use of Irreplaceable Resources**

169. The Project will result in the permanent loss of approximately 27.2 ha of cultivated land or woodland and 1.67 ha uncultivated land, and associated habitats. No rare, threatened, or protected species have been recorded at the two subproject sites.

### **E. Follow-Up Monitoring and Environmental Management Requirements**

170. EMPs have been developed for the design, construction, and operation phases of the two subprojects. The plans include institutional arrangements and enhancements for implementing the mitigation measures (to be developed in greater detail as the Project progresses) and undertaking monitoring.

### **F. Conclusion**

171. The proposed ADB Project—Integrated Ecosystem and Water Resources Management in Baiyangdian Basin—will help BMG to achieve its wastewater management objectives set for 2010, which include attaining class III water quality in Baiyangdian Lake, and class IV water quality in urban inland rivers. The proposed loan Project is part of the first phase of the BERMP and reduces pollution load entering the Lake by approximately 10%. The Project will have a demonstration effect for future undertakings by the BMG.

172. The overall findings of the SEIA and EIAs/IEEs are that negative impacts on air, water, and the acoustic environment are expected, especially during construction. In general, these impacts will be temporary and localized. The proposed mitigation measures are prescribed conceptually in the SEIA. These measures will be developed into full EMPs for individual subprojects during the detailed design and construction phases. EMPs will be implemented by IAs; monitored and supervised by professional environmental specialists/companies, local environmental monitoring stations; and reported to PMO, Baoding and Hebei EPBs, and ADB. Any adverse environmental impacts associated with the Project will be prevented, eliminated, or minimized to an acceptable level if the EMPs proposed under the SEIA are effectively implemented, particularly the establishment of the mechanism and institutions for continuous improvement of environmental mitigation measures.



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## WATER BALANCE: SCHEMATIC DIAGRAMS

Figure A2.1: Current River Network and Water Balance (Guarantee Rate = 50%)

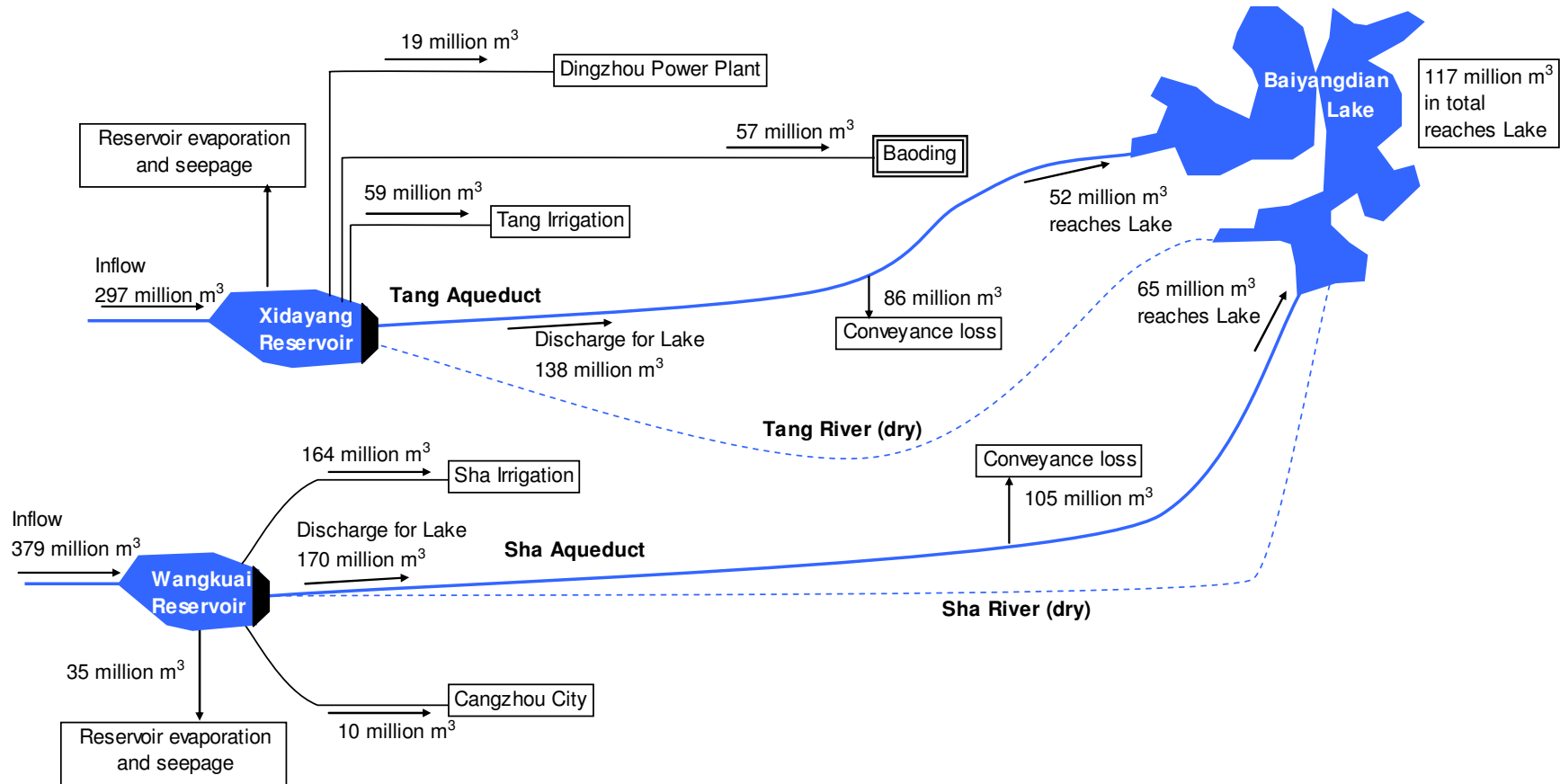


Figure A2.2: Water Balance for Alternative I (Guarantee Rate = 50%)

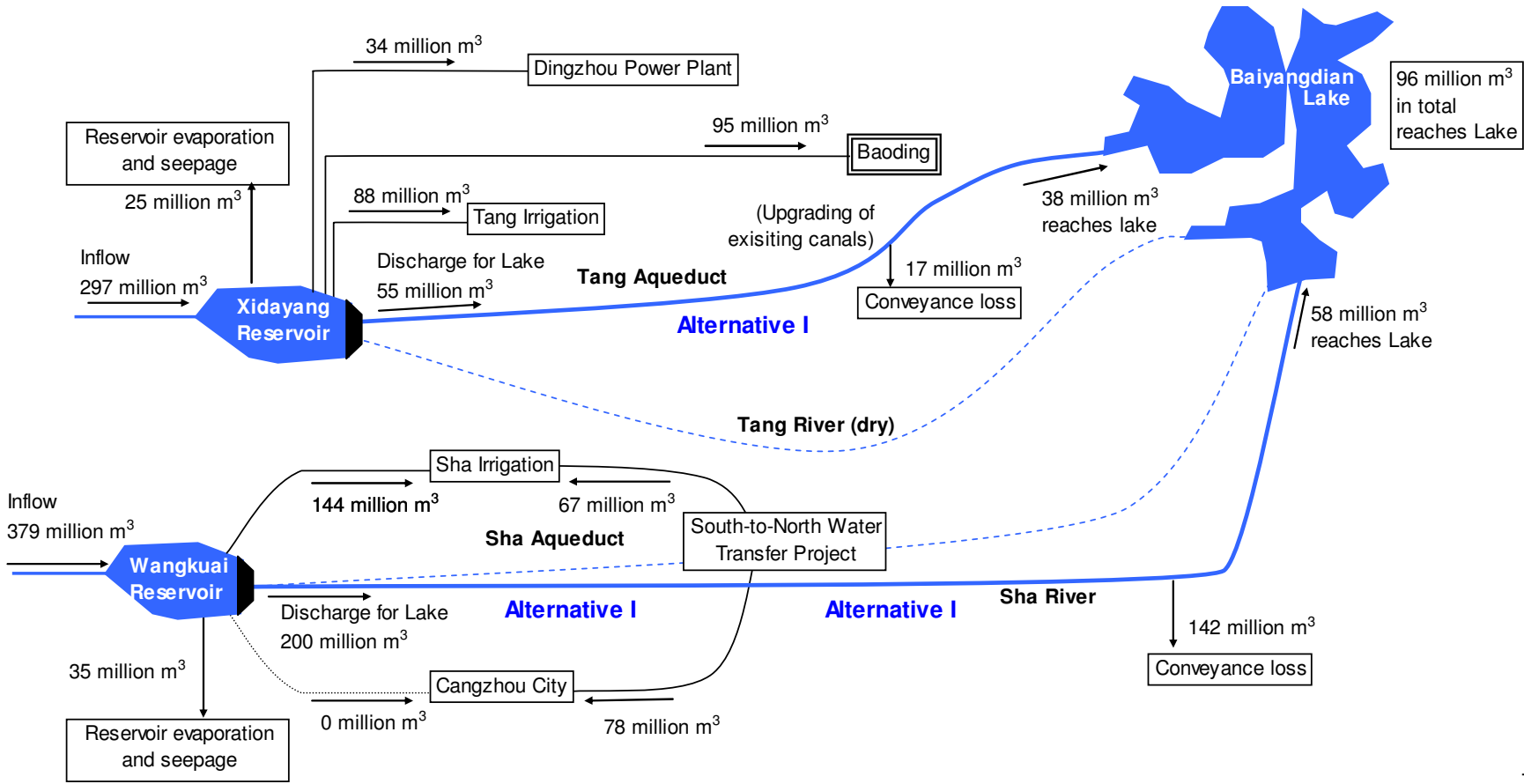
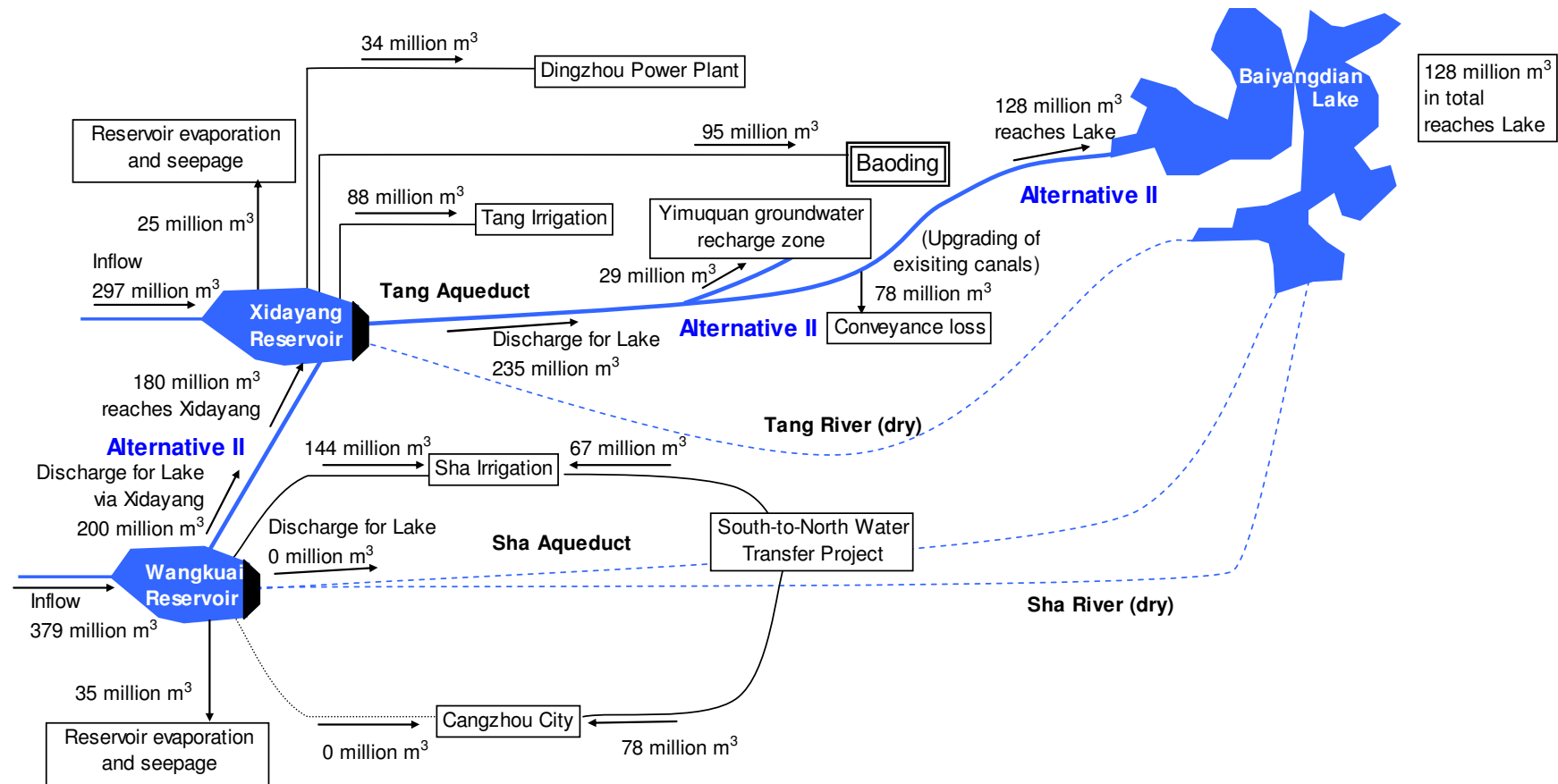




Figure A2.3: Water Balance for Alternative II (Guarantee Rate = 50%)



**SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT**  
**INTEGRATED ECOSYSTEM AND WATER RESOURCES MANAGEMENT IN THE**  
**BAIYANGDIAN BASIN PROJECT**

**PEOPLE'S REPUBLIC OF CHINA**

**ENVIRONMENTAL MANAGEMENT PLAN**

**Updated in March 2015**



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## **A. Objectives**

1. The objective of establishing an environmental management plan (EMP) is not only to propose appropriate mitigation measures, but also to recommend the establishment of institutions or mechanisms to monitor and ensure compliance with environmental regulations and implementation of the proposed mitigation measures. Such institutions and mechanisms will seek to ensure continuously improving environmental protection activities during project preparation, construction, and operation so as to prevent, reduce, or eliminate adverse impacts.

2. This updated EMP includes (i) objectives, (ii) summary of potential impacts, (iii) mitigation measures, (iv) environmental monitoring, (v) planned public consultation, (vi) responsibilities and implementing authorities, (vii) institutional strengthening and training, (viii) reporting and supervision, (ix) work plan, (x) procurement and cost estimation, and (xi) mechanisms for feedback and adjustment for the original subprojects and 4 new subprojects. The EMP will be reviewed and updated at the end of the detailed design to ensure consistency with the final detailed design.

## **B. Summary of Potential Impacts and Mitigation Measures**

3. Potential impacts of the subprojects during the construction and operation phases, as identified by the environmental impact assessment (EIA) reports, as well as corresponding mitigation measures designed to minimize the impacts are summarized in Tables A3.1, for the category A subprojects, A3.2 for the original and new category B. The mitigation measures will be incorporated into tender documents (where appropriate), construction contracts, and operational management plans, and will be implemented by contractors and implementing agencies (IAs) under the supervision of the Baoding Municipal Project Management Office (PMO) and local (county) or Baoding Municipal Environmental Protection Bureau (EPBs). The effectiveness of the measures will be evaluated on the basis of the results of environmental monitoring to determine whether they should be continued or improved. Improvements need to be confirmed through stipulated environmental management procedures.

4. Resettlement plans (RPs) were prepared to ensure proper resettlement of the affected persons and to prevent deterioration of affected persons' quality of life. Details of the required actions are in the individual subproject RPs.

**Table A3.1: Summary of Potential Impacts and Mitigation Measures for Category A Subprojects**

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
1. Preconstruction							
1.1 Siting, alignment, and alternatives	IWM: Selection of alignment for water diversion	The recommended alignment for each subproject was selected from various alternatives so as to minimize adverse impacts on the environment.	DI and EIA institute, the IA for the water diversion subproject	B-EPB, PMO	50	20	70
	SWM: Treatment process selections	Rehabilitation of illegal existing dumping site: on-site rehabilitation, relocation and land utilization, and incineration technology were compared, and the relocation and land utilization alternative was selected.	DI/EIA institute/the IA for the water diversion subproject	B-EPB, PMO		30	30
1.2 Public involvement	Lack of public awareness, project appreciation, and participation	Public consultation has been conducted on environmental issues, poverty, and resettlement during the project design and EIAs/IEEs preparations.	EIA institutes, IAs	B-EPB, PMO	30	20	50
1.3 Accessibility	Loss of access	To avoid loss of access to farmers' fields, neighbours, and local villages due to construction of the water diversion canal, include in the design pedestrian crossings, with exact locations determined through discussions with local village committees.	DIs, IA	PMO	5		
1.4 Agricultural activity	IWM: Irrigation	Consider in the preliminary and detailed design the possibility of connecting future irrigation system to the water diversion system. .	DI, IAs	BWRB, PMO	5		
1.5 Bidding and preparation for construction	Compliance with EMP	(i) To ensure environmental credibility among contractors, prepare environmental prequalification clauses and specifications to be included in the prequalification package to contractors. (ii) Include an environment section in the terms of reference for bidders. (iii) Prepare environmental contract clauses for contractors, namely the special conditions (e.g., reference EMP and monitoring table). (iv) Prepare covenants for loan agreement as defined in the EMP.	IAs with assistance from environmental consultants	PMO	20	15	

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
	Environmental conflicts	(i) Establish a complaint and information office before starting the construction. (ii) Ensure that staff at the office is well-trained to handle crisis situations or conflicts with residents due to distress from environmental impacts.	Contractors, IAs	PMO	60	40	
	Lack of capacity for implementing EMP	Invite environmental specialists and/or officials from B-EPB or/and HEPB to provide training on implementation and supervision of environmental mitigation measures to relevant persons.	PMO		Included in the training program (Table A3.7)		
	Loss of land and property	(i) Establish a resettlement office comprising local government officials to manage the resettlement process. (ii) Conduct community consultation programs and ensure information on entitlement based on the Land Administration Law is disseminated. (iii) Ensure that all relocation and resettlement activities are reasonably completed before construction starts on any of the subprojects.	IAs	PMO, local county governments, BMG	Included in RPs		
<b>2. Construction Phase</b>							
2.1 Water	Wastewater from construction camps	(i) To avoid contamination of the surrounding areas, collect sewage and other wastewater from construction, camps and treat them in septic tanks before discharge. (ii) Divert effluent from septic tanks to nearby grassland or for agricultural irrigation.	Contractors	IAs, PMO, C-EPB, B-EPB	188	50	
	Wastewater from vehicle and equipment maintenance and cleaning	Properly identify the vehicle and/or equipment wash area with signs and locate it away from drainage facilities and watercourses. It must be paved with concrete or asphalt and have a berm to contain runoff. It must be equipped with a sediment tank to collect and dispose of wash water. All vehicles and equipment that regularly enter and leave the construction site must be cleaned off-site.	Contractors	IAs, PMO, C-EPB, B-EPB	165	200	
	Spill of hazardous and harmful construction materials	Prepare and apply a construction materials handling protocol (e.g., storage away from watercourses and provision of retention areas to contain accidental spills of toxic, hazardous, and harmful construction materials such as caustic and acidic substances, oil and	Contractors	IAs, PMO, C-EPB, B-EPB	5	5	

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
		petroleum products, and asphalt materials) to prevent soil and surface water/groundwater pollution.					
	Water pollution due to soil erosion	(i) Construct intercepting ditches and chutes to prevent outside runoff entering the disposal and excavation sites, and divert runoff from sites to existing drainage system or sediment ponds. (ii) Provide temporary sediment tanks to control soil and muddy flow and reinstate land promptly to reduce soil and sandy runoff	Contractors	IAs, PMO, C-EPB, B-EPB, LWRB, BWRB	400	5	
2.2 Air	Generation of dust	(i) Cover vehicles delivering granular, fine materials and excavated wastes to the sites. (ii) Build materials storage sites 300 m from residential areas and cover them with canvas or spray with water. (iii) Spray water on construction sites and access roads twice a day. (iv) Keep all roads and pavements used by vehicles of the contractors or any subcontractor or supplier clean and clear of all dust, mud, or extraneous materials dropped by their vehicles. Such cleaning must be completed regularly.	Contractors	IAs, PMO, C-EPB, B-EPB	293	50	
	Emissions from vehicles and equipment	(i) Ensure that vehicle emissions are in compliance with PRC-GB18352-2005, GB17691-2005, GB 11340-2005, GB3847-2005, and GB18285-2005. (ii) Ensure that equipment and machinery emissions are in compliance with PRC-GB16297-1996. (iii) Initiate a regular inspection and certification system.	Contractors	IAs, PMO, C-EPB, B-EPB	10	20	
	SWM: Odor impacts during wastes excavation and silt dredging	(i) Avoid excavation activities during windy times. (ii) Set up anti-dust fences. (iii) Before excavation, the IA and contractor will come to an agreement with residents nearby and may give compensation to those most severely affected (iv) Avoid setting up temporary storage sites for dredged silt within 200 m of residential areas. (v) Minimize on-site storage time of dredged silt from Huanghuagou River.	Contractors	IAs, PMO, B-EPB		10	
2.3 Noise	Noise from vehicles,	(i) Ensure that noise levels from equipment and machinery strictly conform to PRC-GB 12523-90.	Contractors	IAs, PMO, C-EPB, B-EPB	5	5	

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
	plant, and equipment	(ii) Provide adequate routes to keep large trucks away from residential areas. (iii) At construction sites within 480 m of the nearest habitation, stop noisy construction work between 2200 and 0600 hours.					
	IWM: Noise from blasting operation	(i) Using a pre-established schedule and approval process, carry out blasting only with permission of the contractor chief engineer., (ii) Use blasting mats to reduce noise levels and flying debris during blasting. (iii) Give appropriate compensation to the most severely affected residents within 150 m from the tunnel (about 71 families).	Contractors	IAs, PMO, C-EPB, B-EPB	650		
2.4 Solid wastes	SWM: Sediments from Huanghua-gou River	Send all dredged sediments to the Baoding sanitary landfill.	Contractor	IAs, PMO, B-EPB		In-cluded in the con-struction costs	
	Excavated wastes	(i) Huanghuagou dump site will be sent to Baoding sanitary landfill. (ii) Upgrade the daily disposal capacity of the landfill to 1,300–1,500 t/d.				14,000	
	Domestic waste from workers' camps	(i) Provide multicompart ment collection bins to facilitate the reuse, recycling, and composting of solid waste. (ii) Store wastes away from water bodies and regularly haul them to a suitable landfill or designated dumping site. (iii) Require the contractors to provide appropriate waste storage containers. (iv) Where appropriate, sign agreements with local villages for waste disposal, through village facilities. These arrangements are to be made prior to commencing works.	Contractors	IAs, PMO, C-EPB, B-EPB	75.2		
2.5 Soil erosion and ecology	IWM: Disposal of excavated earth and rock	(i) Where necessary, build retaining walls for strip and stockpiled topsoil before dumping. (ii) Construct intercepting ditches and chutes to prevent outside runoff from entering disposal sites, and divert runoff from sites to existing drainage system or ponds.	Contractors	IA, PMO, C-EPB, B-EPB	Include in SEPP		



Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
		(iii) Rehabilitate the disposal sites into grassland, woodland, or farmland after closing.					
	Borrow sites	(i) Strip and stockpile topsoil. (ii) Build interception ditches and chutes to reduce erosion from borrow pits. (iii) Restore or revegetate the borrow sites into grassland, woodland, or farmland after closing.	Contractors	IAs, PMO, C-EPB, B-EPB	Include in SEPP		
	IWM: Vegetation	(i) In compliance with the PRC's forestry law, the IA will undertake compensatory planting of an equivalent or larger area of affected forest trees. (ii) For revegetation, select species that are suitable for this area and have the most appropriate attributes to survive and serve their designated functions. (iii) Where possible, restore all disposal sites and borrow sites to productive agricultural land or grass and woodland. (iv) Maintain new plantings during the operation period.	Contractors	IA, PMO, C-EPB, B-EPB	Include in SEPP		
	SWM: Rehabilitation of the dump site and ash storage	(i) Use the dumped construction wastes and demolished earth from the retaining dams of ash storage as fills to rehabilitate the pits and storage. (ii) Use construction waste generated in Baoding municipality to minimize the amount of earth excavation.	Contractors	IA, PMO, B-EPB		Include in construction cost	
	IWM: Farmland	(i) Have the acquisition of prime farmland approved before construction starts. (ii) Reclaim the same amount of farmland to replace the prime land permanently occupied by the Project, or pay the compensation fee for reclaiming, according to PRC regulations.	Contractors	IA, PMO, BMG	Included in RP		
2.6 Social	Resettlement	IWM: Compensate all affected persons and resettle them in a timely and adequate manner, in accordance with the resettlement plans. SWM: Give adequate compensation to scavengers that may lose their livelihood.	Contractors	IA, PMO, B-EPB	Included in RP		
	Traffic jam or block	(i) Build interim roads. (ii) Select transport routes to reduce disturbance to regular traffic. (iii) Divert traffic at peak traffic hours, and reinstate	Contractors, IAs	PMO, B-EPB, Traffic authorities	Include in construction cost	Include in construction cost	

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
		the area to its original condition on completion of construction.					
	IWM: Cultural heritage	(i) Preserve cultural heritage sites and items, where identified. In accordance with PRC regulations, no person shall destroy, damage, deface, conceal, or otherwise interfere with a relic. (ii) If an important site is unearthed, stop work immediately and promptly refer the matter to the county, municipal, provincial, or state level agencies for evaluation and decision on appropriate actions.	Contractors	IA, PMO, Baoding Cultural Heritage Bureau or/and Provincial Cultural Heritage Bureau			
	IWM Safety of children	(i) Set up warning signs where the canal construction is closed to the villages. (ii) Set up temporary plastic fences where necessary.	Contractors	IA, PMO	Included in the construction cost		
	SWM: Worker health and safety-- Excavation of the existing waste and dredging of silt from Huanghua-gou river	(i) Construct a fence of reinforced concrete around the excavation site to prevent uncontrolled access of scavengers/people and livestock. (ii) Instruct workers to wear at least gloves and a mask to reduce exposure to waste and hence reduce potential risks to their health.	Contractors	IA, PMO, Baoding Health Department, B-EPB			
<b>3. Operation Phase</b>							
	Insufficient environmental management capacity	Conduct training for environmental management and develop facility and staff setup.	PMO	BMG	Included in the training program (Table A3.7)		
	IWM: Safety of children	(i) Set up warning signs where the canal is close to the villages. (ii) Set up guardrails where necessary.	IA	PMO	Included in the construction cost		
	IWM: Wastewater from the manage-	(i) To avoid contaminating the surrounding areas, collect wastewater from management offices and treat it using a septic tank before it is	IA	L-EPB	Included in the construct-		

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY '000) <sup>a</sup>		
					IWM	SWM	Subtotal
	ment office	(ii) discharged. . Do not allow effluent from septic tanks to flow into the canal. Divert it to nearby grassland or for irrigation.			ion cost		
	IWM: Solid waste from management office	The domestic solid wastes from the management office will be collected and sent to nearby landfill.	IA	L-EPB B-EPB	Included in the main project operation cost		
	IWM: Disposal of dredged silt	(i) Carry out chemical tests to determine whether the quality of sludge complies with pollutant limits for sludge used as agricultural fertilizers specified in Discharge Standards for Urban Waste Water Treatment (GB18918-2002, SEPA). (ii) Use dredged silt as agricultural fertilizer if it meets the standards. If not, send it to the landfill or treat it with the use of geotextile tube technology.	IA	L-EPB B-EPB	Included in the main project operation cost		
	IWM: Agricultural irrigation	(i) Have the IA propose and implement a plan. to ensure that water for irrigation is available. (ii) Appoint two responsible persons, one each from Baoding agricultural bureau and water resource bureau, to supervise implementation of the plan. (iii) Conduct annual public consultation and modify the irrigation plan if necessary.	IA	BWRB	Included in the government budgets		
	IWM: Preventing Illegal discharges to the diversion canal	(i) Regularly monitor the effluent from industrial sources and WWTPs along the canal. (ii) Maintain the wastewater treatment facilities.	C-EPBs, facility owners/ operators	L-EPB B-EPB	Included in local EPB and facility operation cost		

B-EPB = Baoding Municipal Environmental Protection Bureau, BMG = Baoding municipal government, BWRB = Baoding Water Resource Bureau, DI = design institute, IA = implementing agency, IWM= integrated water management, LEPB = local environmental protection bureau, PMO = project management office, SWM = solid waste management.

<sup>a</sup>. Indicative cost ; will be finalized at a later stage.

Sources: PPTA consultants' individual environmental impact assessment reports (IAs, 2006) and the *Cumulative Effect Assessment Report*. Beijing. 2006.

**Table A3.2: Summary of Potential Impacts and Mitigation Measures for Category B Subprojects**

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
1. Preconstruction									
1.1 Siting, alignment, and alternatives	Site/alignment selections	The recommended sites/pipeline routes for the individual subprojects were selected from various alternatives so as to minimize adverse impacts on the environment.	DIs and EIA institutes, IAs	B-EPB, PMO	126	6	2	24	38
	<b>WWTPs:</b> Treatment process selections	Two or three alternatives were evaluated considering wastewater characteristics, management requirements, impact on environment, cost, sludge disposal, etc.	DI/EIA institutes and the IAs	B-EPB, PMO	26				26
	Public consultations	Public consultations have been conducted on environmental issues, poverty, and resettlement during the project design and preparation of IEEs.	EIA institutes, IAs	B-EPB, PMO	26	6	2	4	38
	<b>WWTPs:</b> Effluent disposal and reuse	Consider effluent reuse for irrigation and other possible use in the design.	DIs, IAs	PMO	13				13
1.2 Bidding and construction preparation	Compliance with EMP	(i) To ensure environmental credibility among contractors, prepare environmental prequalification clauses and specifications to be included in the prequalification package to contractors. (ii) Include an environment section in the terms of reference for bidders. (iii) Prepare environmental contract clauses for contractors, namely, the special conditions, (e.g., reference EMP and monitoring table). (iv) Prepare covenants for loan agreement as defined in the EMP.	Environmental consultants contracted by IAs	PMO, B-EPB	26	6	2	4	38
	Environmental crisis	(i) Establish a complaint and information office or appoint a responsible person before starting the construction. (ii) Ensure that staff at the office is well-trained to handle crisis situations or conflicts with residents due to distress from environmental impacts.	Contractors	IAs, PMO	130	30	10	10	180

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
	Inadequate capacity for implementing EMP	Invite environmental specialists and/or officials from B-EPB or/and HEBP to provide training on implementation and supervision of environmental mitigation measures to relevant persons.	PMO	BPLG	24	4.8	1.8	3.6	34
	Loss of land and property	(i) Establish a resettlement office comprising local government officials to manage the resettlement process. (ii) Conduct community consultation programs and ensure information about entitlement based on the Land Administration Law is disseminated. (iii) Ensure that all relocation and resettlement activities are reasonably completed before construction of any subproject starts.	IAS	PMO	Included in the RP				
2. Construction Phase									
2.1 Water	Wastewater from construction camps	To prevent contamination of the surrounding areas, collect sewage and other wastewater from construction camps and treat them in septic tanks before discharge. .	Contractors	IAS, PMO, B-EPB	680	150	50		850
	Spill of hazardous and harmful construction materials	Prepare and apply a construction materials handling protocol (e.g., storage away from watercourses and provision of retention areas to contain accidental spills of such toxic, hazardous, and harmful construction materials as caustic and acidic substances, oil and petroleum products, and asphalt materials) to prevent soil and surface water/groundwater pollution.	Contractors	IAS, PMO, B-EPB	65	15	5		85
	Water pollution due to soil erosion	Construct intercepting ditches and chutes to prevent outside runoff from entering disturbed sites, and divert runoff from sites to existing drainage system or settlement ponds.	Contractors	IAS, PMO, B-EPB	Included in the construction budgets				
2.2 Air	Generation of dust	(i) Cover vehicles delivering granular and/or fine materials to the sites. (ii) Locate materials storage sites 300 m from residential areas and cover them with canvas or spray with water.	Contractors	IAS, PMO, B-EPB	620	60	30		480

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
		(iii) Spray water on construction sites and access roads twice a day. (iv) Keep all roads and pavements used by vehicles of the contractors or any subcontractor or supplier clean and clear of all dust, mud, or extraneous materials dropped by their construction vehicles. Such cleaning must be completed regularly.							
	Emissions from vehicles and equipment	(i) Ensure that vehicle emissions are in compliance with PRC-GB18352-2005, GB17691-2005, GB 11340-2005, GB3847-2005, and GB18285-2005. (ii) Ensure that emissions from equipment and machinery are in compliance with PRC-GB16297-1996. (iii) Initiate a regular inspection and certification system.	Contractors	IAs, PMO, B-EPB, HEPB	65	15	5	10	95
2.3 Noise	Noise from vehicles, plant, and equipment	(i) Ensure that noise levels from equipment and machinery strictly conform to PRC-GB 12523-90. (ii) Provide adequate route for large trucks to keep them away from residential areas. (iii) At construction sites within 500 m of the nearest habitation, do not allow noisy construction work between 2200 and 0600 hours.		IAs, PMO, B-EPB	65	15	5	10	95
	Noise prevention measures	(i) Design and set in place noise attenuation structures for specific operations.	Contractors	IAs, PMO, B-EPB	Included in the construction budgets				
2.4 Solid wastes	Domestic waste from workers' camps	(i) Provide multicompartiment collection bins to facilitate the reuse, recycling and composting of solid waste. (ii) Store wastes away from water bodies and regularly haul them to a suitable landfill or a designated dumping site. (iii) Make the contractors provide appropriate waste storage containers. (iv) Sign agreements with local villages for waste disposal, where appropriate,	Contractors	IAs, PMO, B-EPB	205	15	5	35	120

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
		through village facilities. These arrangements are to be made before the works start.							
2.5 Soil Erosion and ecology	All subprojects : Disposal of excavated earth and rock	(i) Strip and stockpile topsoil. Build retaining walls where necessary before dumping. (ii) Provide temporary detention ponds or containment to control silt runoff. (iii) Construct intercepting ditches and chutes to prevent outside runoff from entering disposal sites, and divert runoff from sites to existing drainage system or ponds. (iv) Preserve existing vegetation where no construction activity is planned, or temporarily to preserve vegetation where activity is planned for a later date; (v) Apply measures for temporary soil stabilization— covering with plastic film, geotextiles, or similar materials— to slopes of flood control embankment if permanent protection works cannot be carried out in time during the rainy season; (vi) Rehabilitate the disposal and borrow sites into grassland, woodland, or farmland after closing.	Contractors	IAs, PMO, B-EPB, BWRB	Included in the construction budgets				
	Vegetation	(i) In compliance with the PRC's forestry law, make the IAs undertake compensatory planting of an equivalent or larger area of affected forest trees. (ii) For revegetation will, select species that are suitable for the area and have the most appropriate attributes to survive and serve their designated functions. (iii) Restore all disposal sites and borrow sites, where possible, to productive agricultural land or grass and	Contractors, IAs	PMO, B-EPB, BWRC	Included in the construction budgets				

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
		woodland. (iv) Maintain new plantings during the operation period.							
	Wild animals	(i) To mitigate the impacts on wild animals, conduct education programs for protecting wild animals for workers or farmers hired for tree planting. (ii) Impose fines for hunting wild animals, according to the PRC legislation for protecting wildlife.	Contractors, IAs	PMO, B-EPB, Baoding Municipal Forest Bureau				10,000	
	Farmland	(i) Have the acquisition of prime farmland approved before construction starts. (ii) Reclaim the same amount of farmland to replace the prime land permanently occupied by the Project, or pay the compensation fee for reclamation, according to PRC regulations.	IAs	PMO, B-EPB, Baoding Agricultural and Forestry Bureau	Included in RP budgets				
2.6 Social	Resettlement	Compensate all affected persons and resettle them in a timely and adequate manner, in accordance with the resettlement plans.	IAs	PMO, BMG	Included in RP budgets				
	Traffic jam or block	(i) Build interim roads. (ii) Select transport routes to reduce disturbance to regular traffic. (iii) Divert traffic at peak traffic hours, and reinstate the area to its original condition on completion of construction.	Contractors, IAs	PMO, B-EPB, Traffic authorities	Included in the construction budgets				
	Cultural heritage	(i) Preserve cultural heritage values where identified. In accordance with PRC regulations, no person shall destroy, damage, deface, conceal, or otherwise interfere with a relic. (ii) If an important site is unearthed, stop work immediately and promptly refer the matter to the county, municipal, provincial, or state level agencies for evaluation and decision on appropriate actions.	Contractors	IA, PMO, Baoding Cultural Heritage Bureau or/and Provincial Cultural Heritage Bureau					



Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
3. Operation Phase									
3.1 Water	WWTPs: Effluent minimization	(i) In the future, give serious consideration to recycling or reclamation. (ii) Levy a wastewater treatment fee through the water bill to encourage residents and industries to save water and hence reduce the amount of wastewater they generate.	IAs, BMG						
	WWTPs: Malfunctioning and sewerage overflow	(i) Provide standby equipment at pumping stations. (ii) Use dual power supply. (iii) Set up operation and maintenance manuals and provide adequate training to operators to ensure proper operation and maintenance of the facilities. (iv) Set up appropriate communication protocols, both internally and externally for the local EPB and health authorities and other agencies as determined to be suitable. (v) Develop clear risk-based strategies to protect public health, including appropriate warning signs and water sampling regimes, as well as a public information strategy for nearby residents and businesses.	IAs	C-EPBs, B-EPB	65,000				
	WWTPs: Illegal industrial discharges	(i) Develop industrial pollution control and management plans; require adequate treatment of industrial wastes before their discharge into the sewer system. (ii) Set up systems for efficient industrial wastewater monitoring and strict enforcement of standards for industrial discharges. (iii) Select adequate process control of WWTPs	IAs, C-EPBs	B-EPB	Included in the C-EPB's budgets				
	WWTPs: Effluent impact on	(i) Have a licensed consultancy company conduct a project environmental acceptance audit	Licensed environmental consultant	C-EPBs, B-EPB	650				650

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
	water receiving bodies	before the formal operations to ensure the effluents meet class A of PRC WWTP discharge standards (GB18918-2002, SEPA, 2002). (ii) Set up and carry out a program for monitoring effluents.	companies contracted by IAs, IAs						
	<b>WWTPs:</b> Public and workers' health	(i) Allow only authorized personnel to have access to sewer manholes, pump stations, and the treatment plant. (ii) Build fences around the treatment plant sites for security. (iii) Inoculate the staff against wastewater-borne diseases. (iv) Require all personnel on site to wear appropriate clothing. (v) Build adequate ablutions and change facilities to promote appropriate occupational health and safety (OHS). (vi) Incorporate automatic facilities to remove sludge from the storage tank. (vii) Supply fresh water for wash down. (viii) Incorporate telemetry to monitor power or mechanical plant failure and performance.	IAs	C-EPBs, B-EPB, Local Health Bureaus	1,300				1300
3.2 Air	<b>WWTPs:</b> Odor	(i) Provide buffer for facilities and vegetation around the WWTPs. (ii) Enclose potential odor sources such as the inlet works, the screens, septic tank, and the sludge dewatering area. (iii) Avoid storing dewatered sludge in WWTPs. (iv) Transport and haul in enclosed vehicles to landfill for final disposal. (v) Ensure adequate WWTP layout to minimize odor to potential receptors.	IAs	C-EPBs, B-EPB	6500 as investment in construction budgets and 1950 as annual operation costs				
	<b>WWTPs, WSS, CE:</b> Emission from the heating boilers	Install dust removers for heating boilers so that emissions meet class II Emission Standard for Air Pollutants for Coal-Burning, Oil-Burning and Gas-Fired Boiler in phase II (GB13271-2001, SEPA, 2002).	IAs	C-EPBs, B-EPB	1,300	300			1600

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
3.3 Noise	<b>WWTPs, WSS, CE:</b> Noise from the pump and equipment operation	(i) Select low-noise equipment. (ii) Install high-noise equipment indoors. (iii) Construct pumping stations in semiburied structures. (iv) Plant trees around WWTPs and use noise barriers if necessary. (v) Ensure proper WWTP layout to minimize noise impact on potential receptors.	IAs	C-EPBs, B-EPB	Included in design and construction budgets				
3.4 Solid wastes	<b>WWTPs, WSS:</b> Sludge	To avoid unacceptable impacts, all the sludge will be stored in geotextile tube or geotube which has a minimal impact on environment. All treated sludge will be transferred to Baoding Municipal Landfill for dump. The capacity of landfill has been assessed and can satisfy the demand.	IAs	C-EPBs, B-EPB	260	60			320
3.5 Ecology	<b>WWTPs, WSS, CE:</b> Impact of plants	Ensure no less than 30% space for landscaping/vegetation within the WWTPs, WSS, geothermal heating supply plant.	IAs	C-EPBs, B-EPB	Included in the construction budgets				
3.6 Environmental risks	<b>WWTPs</b> and sewer networks construction not in close coordination cause potential operation problem.	Ensure WWTPs and sewer networks design and construction are closely coordinated.	DIs, city planners	C-EPBs and Local city planning bureaus	Included in the design contract				
	<b>WWTPs:</b> Corrosive and foul gases in sewers	(i) Install inspection and control devices in potential hazardous areas. (ii) Provide adequate space within the service holes to monitor or track hazardous sources. (iii) Provide better ventilation to minimize hazard. (iv) Prepare emergency response plans.	IAs	LEPBs, B-EPB, local health bureaus	Included in the construction budgets				
	<b>WWTPs, WSS:</b>	(i) Install alarm device and adsorption facility.	IAs	C-EPBs, B-EPBs and	Included in the construction				

Impact Factor	Potential Impacts and/or Issues	Mitigation Measures	Implementing Agency	Supervising Agency	Budget (CNY 1,000) <sup>a</sup>				Subtotal (CNY '000)
					WWTPs	WSS	CE	Reforestation	
	Chlorine gas disinfection leak accident	(ii) Control storage volume. (iii) Provide buffering zone. (iv) Equip workers with personal protection gear (v) Develop emergency response plans.		local health authorities	budgets and operation costs				
	<b>WWTPs, WSS, CE:</b> Leaking or bursting of pipes	(i) Provide adequate supervision and management. (ii) Enhance operation monitoring. (iii) Provide emergency response plans.	IAs and local public utility bureaus/companies	Local government, C-EPBs, B-EPB	130	30	10		170
	<b>WWTPs, WSS, CE:</b> Facility incidents	(i) Regularly maintain environment facilities. (ii) Prepare emergency response plans.	IAs	C-EPBs, B-EPB	130	30	10		170
	Insufficient environmental management capacity	Conduct training for environmental management and develop facility and staff setup.	IAs	C-EPBs, B-EPB	Included in the training program				

B-EPB = Baoding Municipal Environmental Protection Bureau, PMO = Project Management Office, BWRB = Baoding Water Resource Bureau, CE = clean energy subproject, DI = design institute, IA = implementing agency, IEE = initial environmental examination, LEBP = local environmental protection bureau, RP = resettlement plan, WSS = water supply subproject, WWTP = wastewater treatment plants and associated pipes.

<sup>a</sup>. Indicative cost; will be finalized at a later stage.

Sources: PPTA Consultants' individual environmental impact assessment reports (IAs, 2006) and the cumulative effect assessment report.

### C. Environmental Monitoring and Inspection

5. An environmental monitoring program is presented in Tables A3.3 and A3.4. The program considers the scope of monitoring, environmental media, monitoring parameters, time and frequency, and implementing and supervising agencies. Monitoring will follow the methodology prescribed in the national standard methods for monitoring pollutants. Other associated standards are national environmental quality standards and pollutant discharge/emission standards.

6. **Internal Monitoring and Inspection.** During construction, PMO will recruit environmental supervision companies (ESC) for conducting internal environmental monitoring and inspections to ensure that environmental mitigation measures are properly implemented. Inspections or audits, to be conducted every week, will mainly cover construction activities, but will also review the affected environment. Inspection or audit activities and observations will be well-documented, and the contractors and IAs will be informed of the outcomes. During operation periods, IAs/operators will be responsible for internal monitoring and report to C-EPBs and B-EPB.

7. **External Monitoring and Inspection.** Local environmental monitoring stations (LEMSs) under C-EPBs will be responsible for undertaking regular and random environmental monitoring and inspection activities before, during, and after construction, as well as in the event of emergencies. Some LEMSs/C-EPBs may not have enough qualified staff, monitoring equipment, and technical capability. Baoding Environmental Monitoring Center (BEMC)<sup>1</sup> under B-EPB will assist the LEMSs/C-EPBs. Alternatively, C-EPBs may recruit certified laboratories to do the monitoring.

8. **Environmental Acceptance Monitoring and Audit of the Completion of the Individual Subprojects.** Within 3 months after completion of each subproject, or no later than 1 year with B-EPB permission, environmental acceptance monitoring and audit reports of project completion will be (i) prepared by a qualified environmental institute in accordance with the People's Republic of China (PRC) regulation on *Environmental Check-and-Acceptance of Project Completion (SEPA, 2001)*, (ii) reviewed for approval by B-EPB, and (iii) finally reported to Hebei Provincial Environmental Protection Bureau (HEPB) and Asian Development Bank (ADB).

9. Environmental monitoring including environmental benefits monitoring will be incorporated in the project performance management system (PPMS) indicators. PMO, with assistance from the IAs, will analyze and consolidate the data. PPMS design will allow adequate flexibility to adopt remedial action regarding project design, schedules, activities, and development impacts. At the beginning of the Project, PMO, IAs, and consultants will develop comprehensive PPMS procedures to systematically generate data on inputs and outputs of the project components and agree on environmental and related social economic indicators to be used to measure project impacts. PMO and the IAs will refine PPMS framework, confirm achievable goals, firm up monitoring and recording arrangements, and establish systems and procedures no later than 6 months after loan effectiveness.

10. The monitoring results will be used to evaluate the (i) extent and severity of environmental impacts compared with the predicted impacts, (ii) performance of the

<sup>1</sup> BEMC has qualified staff with monitoring equipment and technical capability for monitoring the aquatic, air, and physical environment (noise and vibration), sediment, soil and ecology (including solid waste), and traffic conditions.

environmental protection measures or compliance with related rules and regulations, (iii) trends of impacts, and (iv) overall effectiveness of the project EMP. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. Modification of measures required by the EMPs will be performed, if necessary. C-EPBs, B-EPB and PMO play critical roles in this feedback and adjustment mechanism as shown in Figure A3.1.

11. Environmental monitoring costs included in Tables A3.3 and A3.4 are to be included in the project contracts and counterpart budgets. Before implementing the monitoring plan, responsible agencies will present a further detailed breakdown of the estimated budget. During project implementation, the costs can be adjusted based on actual requirements.

**Table A3.3: Environmental Monitoring Program for Category A Subprojects**

Item	Parameters	Location	Implementing	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>		Subtotal (CNY '000)
						IWM	SWM	
1. Construction								
1.1 Surface water	pH, conductivity, SS, NH <sub>3</sub> N, TN, TP, BOD <sub>5</sub> , COD <sub>Cr</sub> , heavy metals, oils	SWM: Minimum of 2 locations, one upstream, one downstream	Internal monitoring:  Contractors, IAs, BMPO	PMO	SWM: Once immediately before starting dredging (developing comparison sample), second time during dredging. One sampling each day for 3 consecutive days each time		6	6
			External monitoring:  LEBP or/and BEMC	B-EPB	SWM: Once before, during and after dredging One sampling each day for 3 consecutive days at each time		6	6
1.2 Air	IWM TSP, PM <sub>10</sub> SWM: TSP and odor	IWM: two monitoring sites along the reservoir connection/tunnel section, one in the Yimuquan groundwater recharging area	Internal monitoring:  Contractors, IAs, BMPO	C-EPBs, B-EPB	Twice a year. Two samplings 1 day at one location each time	18	10	28
		SWM: one site downwind of the dump site, and one site downwind of the ash storage	External monitoring:  LEMSs or/and BEMC	C-EPBs, B-EPB	Once a year. Two samplings 1 day at one location each time	6	0.4	6.4
1.3 Noise	Leq (dB(A))	IWM: four communities along the two reservoir connection sections: Zhujiayu, Weizichun, Zhuangjiazhuang, Nanjiazhuang villages one site in the upgrading section of the canal: Nanyaoshan village one site in the Yimuquan water recharging area  SWM: four sites along the construction boundaries of the waste dump site and ash storage site each	Internal monitoring:  Contractors, IAs, PMO	C-EPBs, B-EPB	Random, but at least once a month, 1 day each time	72	20	92
			External monitoring:  LEMSs or/and BEMC	C-EPBs, B-EPB	Random, but at least four times a year, a day each time and two samples each day: once during daytime, once during night time	24	6.5	30.5

Item	Parameters	Location	Implementing	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>		Subtotal (CNY '000)
						IWM	SWM	
1.4 Soil and vegetation	Inspect quality of preventive works. Inspect vegetation survival and coverage rate. Site survey and/or standard measurement of soil erosion during rainy season.	IWM: two-reservoir connection section	Internal monitoring:	C-EPBs, B-EPB	Four times a year Spot check	40		40
			Contractors, IAs, PMO					
			External monitoring:	C-EPBs, B-EPB	Once a year Spot check	10		10
			LEMSs or/and BEMC					
2. Environmental Check-and-Acceptance of Project Completion (normally 3 months after project completion according to PRC regulation)								
2.1 Surface water quality	pH, conductivity, SS, NH <sub>3</sub> N, TN, TP, BOD <sub>5</sub> , COD <sub>Cr</sub> , heavy metals, oils	IWM: the outlets of Wangkuai and Xidayang reservoirs, Tang River, Tang aqueduct, Fuhe water control section, entrance of Baiyangdian Lake, entrance of Yimuquan recharging facility, Baoding inner city rivers	Licensed environmental institutes	B-EPB	Only once for the whole auditing period. One sampling each day for 3 consecutive days at each location during the audit.	8		8
2.2 Air	PM <sub>10</sub> , TSP, odor	SWM: One in the original waste dump site and one in the original ash storage site	Licensed environmental institutes	B-EPB	Only once for the whole auditing period Two samplings 1 day at one location		10	10
2.3 Soil and vegetation	Inspect quality of preventive works Inspect vegetation survival and coverage rate Site survey and/or standard measurement of soil erosion during rainy season.	IWM: two-reservoir connection section	Licensed environmental institutes	B-EPB and BWRB	Once for the whole auditing period. Spot check	5		5
3. Operation								
3.1 Surface water quality	pH, conductivity, SS, NH <sub>3</sub> N, TN, TP, BOD <sub>5</sub> , COD <sub>Cr</sub> , heavy metals, oils	IWM: the outlets of Wangkuai and Xidayang reservoirs, Tang River, Tang aqueduct, Fuhe water control section, entrance of Baiyangdian Lake, entrance	Internal monitoring:  Contractors, IAs, PMO	C-EPBs, B-EPB	Once monthly during the water diversion period of the year (about 8 months) One sampling each day for 3 consecutive days at each location.	64		



Item	Parameters	Location	Implementing	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>		Subtotal (CNY '000)
						IWM	SWM	
		of Yimuquan recharging facility, Baoding inner city river.	External monitoring:  BEMC	C-EPBs, B-EPB	Twice during the water diversion period of the year One sampling each day for 3 consecutive days at each location.			
3.2 Air	PM <sub>10</sub> , TSP, odor	SWM: One in the original waste dump site and one in the original ash storage site	Internal monitoring:  Contractors, IAs, PMO	B-EPB	Twice a year. Odor will be monitored only in first 2 years after completion of the project Two samplings 1 day at one location		20	
			External monitoring:  BEMC	B-EPB	Once a year. Odor will be monitored only in first 2 years after completion of the project Two samplings 1 day at one location		10	
3.3 Soil and vegetation	Inspect quality of preventive works Inspect vegetation survival and coverage rate. Site survey and/or standard measurement of soil erosion during rainy season.	IWM:two-reservoir connection section	Internal monitoring:  Contractors, IAs, PMO		Once a year Spot check	10		
			External monitoring:  LEMS or BEMC	B-EPB and BWRB	Every second year Spot check	5		
Total					Total monitoring cost during the construction: Annual monitoring cost during the operation:			

B-EPB = Baoding Municipal Environmental Protection Bureau, BMEC = Baoding Municipal Environmental Monitoring Center, BOD<sub>5</sub> = -5-day biochemical oxygen demand, PMO = Project Management Office, BWRB = Baoding Water Resource Bureau, COD = -chemical oxygen demand, IA = implementing agency, LEBP = local environmental protection bureau, LEMS = local environmental monitoring station, L<sub>eq</sub> = equivalent continuous noise level, NH<sub>3</sub>-N = ammonia nitrogen, pH = -measure of acidity and alkalinity, PM<sub>10</sub> = particular matter smaller than 10 micrometers, TN = total nitrogen, TP = total phosphor, TSP = total suspended particles, IWM=- integrated water management subproject, SWM = solid waste management subproject.

<sup>a</sup> Indicative cost; will be finalized at a later stage.

Sources: PPTA consultants' environmental impact assessment reports (IAs, 2006) and the cumulative effect assessment report, Beijing, 2006.

**Table A3.4: Environmental Monitoring Program for Category B Subprojects**

Item	Parameters	Location	Implementing Agency	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>				Subtotal (CNY '000)
						WWTPs	WSS	CE	Reforestation	
1. Construction										
1.1 Surface water	WWTPs: pH, conductivity, SS, NH <sub>3</sub> N, TN, TP, BOD <sub>5</sub> , COD <sub>Cr</sub> , oils	Minimum 2 locations, one upstream, one downstream near the construction site	Internal monitoring: contractors, IAs, BMPO	PMO	Once monthly, and one sampling each day each time	312				312
			External monitoring: LEBP or/and BEMC	B-EPB	Once monthly, and one sampling each day each time	312				312
1.2 Air	WWTPs, WSS, CE: TSP, PM <sub>10</sub>	Two monitoring locations for each construction site	Internal monitoring: contractors, IAs, BMPO	C-EPBs, B-EPB	Twice a year. Two samplings 1 day at one location each time.	130	30	10		170
			External monitoring: LEMSs or/and BEMC	C-EPBs, B-EPB	Once a year. Two samplings 1 day at one location each time	65	15	5		85
1.3 Noise	Leq (dB(A))	Two or three residences near the construction sites	Internal monitoring: contractors, IAs, PMO	C-EPBs, B-EPB	Random, but at least once monthly, 1 day each time and two samples each day: once during daytime, once during night time.	312	72	24		408
			External monitoring: LEMSs or/and BEMC	C-EPBs, B-EPB	Random, but at least four times a year.1 a day each time and two samples each day: once during daytime, once during night time	104	24	8		138
1.4 Soil and vegetation	Inspect quality of preventive works Inspect vegetation survival and coverage rate. Site survey and/or standard measurement of soil erosion	All sites	Internal monitoring: contractors, IAs, PMO	C-EPBs, B-EPB	Four times a year Spot check	260	60	20		340
			External monitoring: LEMSs or/and BEMC	C-EPBs, B-EPB	Once a year Spot check	65	15	5		10

Item	Parameters	Location	Implementing Agency	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>				Subtotal (CNY '000)
						WWTPs	WSS	CE	Reforestation	
	during rainy season.									
<b>2. Environmental Check-and-Acceptance of Project Completion (normally 3 months after the project completion according to PRC regulation)</b>										
2.1 Surface water quality	<b>WWTPs:</b> pH, conductivity, SS, NH <sub>3</sub> N, TN, TP, BOD <sub>5</sub> , COD <sub>Cr</sub> , oils	Minimum 2 locations, one upstream, one downstream near WWTPs	Licensed environmental institutes	B-EPB	Only once for the whole auditing period. One sampling each day for 3 consecutive days at each location during the audit.	26	6	2		34
2.2 Air	<b>WSS, CE:</b> PM <sub>10</sub> , TSP, SO <sub>2</sub> <b>WWTPs:</b> PM <sub>10</sub> , TSP, SO <sub>2</sub> , NH <sub>3</sub> , H <sub>2</sub> S, odor	Two locations each site	Licensed environmental institutes	B-EPB	Only once for the whole auditing period Two samplings 1 day at one location	78	15	5		108
2.3 Sludge	<b>WWTPs:</b> water content, Zn, Cr, Cd, Pb, Cu, Hg	All WWTPs	Licensed environmental institutes	B-EPB	Only once for the whole auditing period Two samplings 1 day at each WWTP	26				26
2.4 Inflows and effluents	<b>WWTPs:</b> COD <sub>Cr</sub> , BOD <sub>5</sub> , SS, NH <sub>3</sub> -N, PO <sub>3</sub> <sup>3-</sup> , oil, fecal coliform	All WWTPs	Licensed environmental institutes	B-EPB	Only once for the whole auditing period, 1 day at each location	26				26
2.5 Soil and vegetation	Inspect quality of preventive works Inspect vegetation survival and coverage rate. Site survey and/or standard measurement of soil erosion during rainy season	All sites	Licensed environmental institutes	B-EPB and BWRB	Once time for the whole auditing period. Spot check	65	15	5		95
<b>3. Operation</b>										
3.1 Surface water	<b>WWTPs:</b> pH, conductivity, SS, NH <sub>3</sub> N, TN, TP, BOD <sub>5</sub> , COD <sub>Cr</sub> , oils	Receiving rivers downstream of WWTP outfall	Internal monitoring: contractors, IAs, PMO	C-EPBs, B-EPB	Once monthly and 1 day each time	312				
			External monitoring:	C-EPBs, B-EPB	Four times a year and 1 day each time	106				106

Item	Parameters	Location	Implementing Agency	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>				Subtotal (CNY '000)
						WWTPs	WSS	CE	Reforestation	
3.2 Waste-water	<b>WWTPs:</b> COD <sub>Cr</sub> , BOD <sub>5</sub> , SS, NH <sub>3</sub> -N, PO <sub>4</sub> <sup>3-</sup> , oil, fecal coliform	Inflows and effluents	BEMC							
			Internal monitoring: contractors, IAs, PMO	C-EPBs, B-EPB	Once daily, or/and real time monitoring (RTM)	RTM included in the construction cost, operation cost about 40				
			External monitoring: BEMC	C-EPBs, B-EPB	Twice a year, 1 day each time	4				4
3.3 Air	<b>WSS, CE:</b> PM <sub>10</sub> , TSP, SO <sub>2</sub> <b>WWTPs:</b> PM <sub>10</sub> , TSP, SO <sub>2</sub> , NH <sub>3</sub> , H <sub>2</sub> S, odor	Two locations for each WWTP	Internal monitoring: contractors, IAs, PMO	C-EPBs, B-EPB	Twice a year. Odor will be monitored only in first 2 years after completion of the project Two samplings 1 day at one location	130	18	6		154
			External monitoring: BEMC	B-EPB	Once a year. Odor will be monitored only in first 2 years after the completion of the project Two samplings 1 day at one location	65	9	3		77
3.4 Noise	<b>WWTPs, WSS, CE:</b> Leq (dB(A))	Minimum four locations for each site around boundary and sensitive receptors	Internal monitoring: Contractors, IAs, PMO	C-EPBs, B-EPB	Every second month, and once during daytime, once at night each time	130	30	10		170
			External monitoring: BEMC	B-EPB	Four times a year, and once during daytime, once at night each time	87	20	3.5		100.5
3.5 Sludge	<b>WWTPs:</b> water content, Zn, Cr, Cd, Pb, Cu, Hg	All the WWTPs	Internal monitoring: contractors, IAs, PMO	C-EPBs, B-EPB	Twice a year, 1 day each time	50				50
			External monitoring: BEMC	B-EPB	Once a year, 1 day each time	25				25
3.6 Soil and vegetation	Inspect quality of preventive works Inspect	All the sites	Internal monitoring: contractors, IAs,		Once a year Spot check	65	15	5	10	95

Item	Parameters	Location	Implementing Agency	Supervising Agency	Time and Frequency	Budget (CNY '000) <sup>a</sup>				Subtotal (CNY '000)
						WWTPs	WSS	CE	Reforestation	
	vegetation survival and coverage rate. Site survey and/or standard measurement of soil erosion during rainy season.		PMO							
			External monitoring: LEMS or BEMC	B-EPB and BWRB	Every second year Spot check	32.5	7.5	2.5	5	47.5

B-EPB = Baoding Municipal Environmental Protection Bureau, BMEC = Baoding Municipal Environmental Monitoring Center, BOD<sub>5</sub> = 5-day biochemical oxygen demand, PMO = project management office, BWRB = Baoding Water Resource Bureau, COD = chemical oxygen demand, IA = implementing agency, LEBP = local environmental protection bureau, LEMS = local environmental monitoring station, L<sub>eq</sub> = equivalent continuous noise level, NH<sub>3</sub>.N = ammonia nitrogen, pH = measure of acidity and alkalinity, PM<sub>10</sub> = particular matter smaller than 10 micrometers, TN = total nitrogen, TP = total phosphorus, TSP = total suspended particles, IWM= integrated water management subproject, SWM = solid waste management subproject.

<sup>a</sup> Indicative cost; will be finalized at a later stage.

Sources: PPTA consultants and individual environmental impact assessment reports (IAs, 2006) and the EIA reports for the bundle project.



## **D. Public Consultation**

### **1. Public Consultation during Project Preparation**

12. Various public consultations were conducted in the course of preparing the feasibility study reports (FSRs) and EIAs. During FSR preparation, the Baoding Municipal Government (BMG) and relevant county and township governments were consulted to assist in selecting the alignment for the water diversion subproject and the sites for the WWTPs and WSs. During EIA/IEE preparation and the project preparatory technical assistance (PPTA), public consultations with various groups of stakeholders were conducted from May to November 2006. The main focus was to assess the environmental impacts of the proposed subprojects on nearby residents, and mitigation measures and also resettlement issues. The activities were carried out in accordance with *PRC Provision of Public Consultations for Environmental Impact Assessment* (SEPA, 2006), and ADB's *Environment Assessment Guidelines*.

### **2. Future Public Consultation Plan**

13. Future plans for public involvement during the design, construction, and operation phases were developed during project preparation. The plans include public participation in (i) monitoring impacts and mitigation measures during the construction and operation stages, (ii) evaluating environmental and economic benefits and social impacts, and (iii) interviewing the public after the individual subprojects are completed. The plans comprised several types of public involvement, e.g., site visits, workshops, investigation of specific issues, interviews, and public hearings (Table A3.5).

14. Public participation plans are part of the project implementation and management plan. The IAs are responsible for public participation during project implementation. They will establish an environmental management unit (EMU) for supervising implementation, continuing public consultation, monitoring progress, and responding to grievances. The staff at the offices will be well-trained to handle crisis situations or conflicts with residents due to distress from environmental impacts. Costs of public participation activities during project construction are included in the project funding. The costs are estimated as CNY3,000 for each expert workshop, CNY20,000 for each public investigation on a particular issue, CNY10,000 for each resettlement survey, CNY5,000 for each public workshop, and CNY6,000 for each press conference. Costs of public participation activities during operation will be covered by the IAs. In addition, the established feedback mechanisms (Figure A3.1) will ensure timely feedback and measures to address any concerns raised by the project-affected communities.

## **E. Responsibility for Implementation**

15. The EMPs will ensure effective implementation of the identified mitigation measures. During project preparation and implementation, various organizations with different environmental management responsibilities—B-EPB, PMO, C-EPBs, IAs, design institutes (DIs), EIA consulting companies and contractors—will be involved in the EMPs. PMO, IAs, and contractors will each nominate dedicated, trained, and qualified environment specialists to undertake environmental management activities and ensure effective EMP implementation. Environmental consultants will assist the PMO and IAs in preparing semi-annual EMP progress reports and carrying out training programs. Table A3.6 shows the environmental responsibilities in different phases of the Project.

**Table A3.5: Public Consultation Plan**

Organizer	Approach	Times	Subjects	Participants
1. Project Preparation				
IAs, PMO, EIA consulting institutes and DIs	Public consultation	At least once	Project priority, effects, attitudes toward the two subprojects, and suggestions Comments and recommendations of the public	Residents within construction area
PPTA team	Expert workshop	At least once		Specialists from various sectors
	Questionnaires	At least once		Representatives of residents and social sectors
	Site visits, and public consultation	At least twice		
2. Construction				
IAs, PMO	Public consultation and site visits	At least once a year	Adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Residents within construction area
	Expert workshop or press conference	At least once	Comments and suggestions on mitigation measures, public opinions	Experts from various sectors, media
	Public workshop	At least once a year	Adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Representatives of residents and social sectors
	Survey on resettlement	As required by relevant resettlement plans	Comments and suggestions	People affected by resettlement and relocation
3. Test Operation				
IAs	Questionnaires Site visits	At least once during the test operation	Comments and suggestions on operational impacts, public opinions	Representatives of residents and social sectors
4. Operation				
IAs, PMO	Public consultation and site visits	At least once	Effects of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to project sites
	Public workshop	As needed based on public consultation	Effects of mitigation measures, impacts of operation, comments and suggestions	Representatives of residents and social sectors
	Expert workshop or press conference	As needed based on public consultation and workshop	Comments and suggestions on operational impacts, public opinions	Experts from various sectors, media
	Public satisfaction survey	At least once	Comments and suggestions	Project beneficiaries

PMO = project management office, EIA = environmental impact assessment, IA = implementing agency, PPTA = project preparatory technical assistance.

Sources: Environmental impact assessment reports, IAs, 2006.



**Table A3.6: Environmental Responsibility**

<b>Phase</b>	<b>Responsible Agency</b>	<b>Environmental Responsibility</b>
Preparation	Environmental institutes PMO, B-EPB/HEPB PMO, ADB	Prepare the EIAs and EMPs for subprojects and cumulative effect assessment for the bundled project. Review and approve the EIAs including EMPs. Review and approve the SEIAs including EMPs.
Design	DIs  PMO, IAs	Update EMPs in cooperation with environmental institutes, and incorporate mitigation measures in engineering detailed designs and contracts. Review and approve environmental measures.
Tendering	PMO, contractors, , IAs	Incorporate EMP clauses in the bids.
Construction	PMO, IAs, B-EPB, LEBPs Contractors ESCs contracted by IAs, IAs LEMSs or/and BEMC ,C-EPBs and B-EPBs, BWRB	Advise on implementation of mitigation measures. Implement mitigation measures. Carry out internal inspection and monitoring. Carry out external monitoring and inspection of the implementation of mitigation measures.
Test operation	IA and contracted monitoring institutes B-EPB	Prepare environmental acceptance monitoring and audit report of project completion and operation. Approve environmental acceptance of project operation.
Operation	Environmental consulting companies contracted by IAs, IAs LEMSs or/and LEMC, C-EPBs, B-EPB, BWRB	Conduct internal environmental monitoring and inspection.  Conduct periodic and random environmental monitoring and inspection of environmental compliances.

B-EPB = Baoding Municipal Environmental Protection Bureau, BMEC = Baoding Municipal Environmental Monitoring Center, PMO = Project Management Office, BWRB = Baoding Water Resource Bureau, ESC = environmental supervision company, IA = implementing agency, LEBP = local environmental protection bureau, LEMS = local environmental monitoring station.

Sources: PPTA consultants and individual environmental impact assessment reports (IAs, 2006) and the Cumulative Effect Assessment Report, Xinguohuan Environment, Inc. 2006.

16. To ensure the implementation of mitigation measures for all ADB subprojects, a strong PMO is necessary. The PMO will be appointed by Baoding Project Leading Group (BPLG) to have overall responsibility for environmental management and supervising implementation of mitigation measures. BEMU with 3–5 employees will be set up in PMO. It will ensure the EMPs are carried out and will engage DIs and professional consultants to help with environmental management during the preparation, design, construction, and operation phases. PMO will arrange for environmental monitoring reviews and respond to any adverse impacts beyond those foreseen in the EIAs, attend to C-EPBs/B-EPB's and ADB's requests for mitigating measures, and be responsible for arranging training programs for IAs.

17. In accordance with the EMPs, the IAs will have their own EMUs that will generally require two employees each. During the project, the EMUs will be responsible for (i) implementing the EMPs and developing further implementation details; (ii) supervising contractors' implementation of mitigation measures during construction; (iii) implementing training programs for contractors; (iv) incorporating environmental management, monitoring, and mitigation measures into construction and operation management plans; (v) developing and implementing internal routine environmental monitoring; and (vi) reporting performance of the EMPs to PMO and relevant agencies. The EMUs will be supported and supervised by the

respective C-EPBs/B-EPB and LEMSs/BEMC. Contractors will be responsible for actual implementation of mitigation measures during construction and the IAs during operation.

18. B-EPB and C-EPBs will ensure compliance with PRC and local environmental regulations through spot checks or regular environmental monitoring and inspection during construction and operation. LEMSs will conduct the actual environmental monitoring on behalf of C-EPBs, and if C-EPBs lack the capacity for environmental monitoring, BEMC may be requested to help in the spot checks and regular environmental monitoring. B-EPB and C-EPBs will review the effectiveness of regulations annually and modify them, if necessary, in accordance with applicable legal procedures. Appropriate penalties for noncompliance may be levied on the IAs and contractors. Local governments will ensure that IAs (operators) will have financial and managerial autonomy to operate the project facilities.

#### **F. Institutional Strengthening and Training**

19. An assessment undertaken during the PPTA indicates that PMO has certain technical and institutional capacities for project implementation. However, the PMO, especially IAs, lack the capacity for environmental management and monitoring. For proper implementation of the EMPs, it is necessary to build up and strengthen the capacity of the implementing and supervising agencies. The BMPO/IAs will therefore need EMP training (Table A3.7).

20. This 3-tiered arrangement—BPLG, PMO, and IAs—is expected to provide a reasonable framework for project management and control. It is essential that PMO and IAs have the capacity to implement the Project effectively. Their responsibilities and relationship with government departments and agencies concerned must be clearly defined.

21. The environmental specialists in PMO, IAs, focal persons from BEMC and LEMSs, contractors as well as key operators will receive training in environmental management monitoring and supervision, mitigation planning, emergency response, environmental policy making, and other environmental management techniques. Funding for the training will be included in the project budget and in the operation and management budgets during the operation phase.

**Table A3.7: Institutional Strengthening and Training**

<b>Strengthening Activity</b>	<b>Agencies</b>	<b>Strengthening Plans</b>	<b>Timing</b>
Capacity building	PMO, IAs	Institutional organization, development of responsibilities for each position	During project preparation and implementation
Monitoring	Contractors, IAs, and PMO	Procurement of related monitoring instruments and equipment	During project preparation and implementation

Training	Attendees	Contents	Times	Period (days)	No. of Persons	Cost (CNY/ person/ day)	Total Costs (CNY 1,000)
Environmental laws, regulations, and policies	PMO, IAs/ operators, contractors	(i) Environmental laws and regulations (ii) Environmental policies and plans (iii) Basic environmental management, (iv) Environmental emergency response	2	2	40/each time	300	48
EMP implementation	PMO, IAs/ operators, contractors	(i) Responsibility and duties for project construction, management and environmental protection (ii) Task of environmental protection in project construction (iii) Key environmental protection , etc., in project construction (iv) Various environmental reporting (v) EMP improvement and corrective actions	2	5	40	300	120
Crisis handling	IAs/ operators, contractors	(i) Setting up a crisis-handling unit, (ii) Crisis-handling methods	1	2	40	300	24
Environmental technologies and equipment	PMO, IAs/ operators and contractors	Engineering technologies, selection and procurement of pollution control equipment	1	2	40	300	24
Environmental facility operation and maintenance	IAs/ operators, contractors	(i) Operation and maintenance of environmental installations (ii) Safety operation regulations (iii) Equipment management and emergency response procedures	4	2	20	300	48
Environmental monitoring and inspection	IAs/ operators, C-EPBs, LEMSs, BEMC, contractors	Monitoring and inspection methods, data collection and processing, interpretation of data, reporting system	4	4	25	300	120
<b>Total</b>							<b>384</b>

B-EPB = Baoding Municipal Environmental Protection Bureau, BMEC = Baoding Municipal Environmental Monitoring Center, PMO = Project Management Office, IA = implementing agency, LEBP = local environmental protection bureau, LEMS = local environmental monitoring station.

Sources: PPTA consultants and individual environmental impact assessment reports (IAs, 2006) and the Cumulative Effect Assessment Report, Beijing, 2006.

## G. Reporting and Supervision

22. **Internal Monitoring Reports.** During the construction period, results of internal monitoring by ESCs contracted by PMO will be reflected in the weekly and monthly construction reports. The reports will summarize (i) environmental issues during construction; (ii) mitigation measures taken, if any; and (iii) consequences of the impacts on the environment and/or surrounding communities.

23. The contractors will be trained to take immediate action to remedy unexpected adverse impacts or ineffective or inefficient mitigation measures, as required by the EMPs. The IAs will also respond to these reports to ensure that contractors have taken appropriate and timely action. Additional measures may be taken, if needed, to ensure that all issues raised by the reports are appropriately addressed.

24. Results of the detailed internal environmental monitoring program and mitigation actions for the construction phase will be submitted weekly to IAs, monthly to the PMO and C-EPBs, and twice a year by the PMO/IAs to B-EPB. B-EPB may request that further environmental mitigation actions be taken, if deemed necessary, and may determine further mitigation measures for different stages.

25. **External Monitoring Reports.** LEMSs authorized by C-EPBs will be responsible for external monitoring and inspection of compliance with PRC environmental regulations during construction and operation. The compliance monitoring reports will include (i) project background, (ii) construction and operation activities, (iii) environmental conditions, (iv) measurement or sampling locations, (v) analytical results, (vi) interpretation and implication of the monitoring results, (vii) determination of the compliance status with regard to applicable regulations and standards, and (viii) recommendations for improvement. The reports will be submitted to C-EPBs/B-EPB by LEMSs with a copy to the BMPO/IAs. B-EPB may request that further environmental mitigation actions be taken if necessary.

26. **Environmental Acceptance Monitoring and Audit Report of the Completion of Each Subproject.** Environmental acceptance report of the completion of each subproject will be prepared in accordance with the PRC regulation on *Environmental Inspection-and-Acceptance of Project Completion (SEPA, 2001)* within 3 months after completion. The report will focus on environmental compliance and performance when it is put into operation. The report will be sent to B-EPB for review and approval. If noncompliance is found, the Project will be asked to improve to satisfy the requirements before the operation can commence.

27. **Reports to ADB.** PMO with assistance from project consultants will monitor and assess overall project activities, including environmental targets, against the project design and monitoring framework. PMO will submit to ADB the EMP progress reports and information on project implementation and the performance of the environmental contractors, IAs, environmental supervision companies. The reports will include (i) semiannual environmental reports on EMP implementation, and (ii) environmental compliance monitoring and audit report of the completion of each subproject. Progress reports will emphasize (i) progress made in water quality improvement, (ii) monitoring results at appropriate points in the rivers and Baiyangdian Lake, (iii) implementation of mitigation measures, (iv) environmental compliance, (v) training, and (vi) capacity-building progress. ADB may request that further environmental mitigation actions be taken, if deemed necessary, and may determine further mitigation measures for different stages. The reporting plan is presented in Table A3.8.

**Table A3.8: Reporting Plan**

<b>Report</b>		<b>From</b>	<b>To</b>	<b>Frequency of Reporting</b>
<b>1. Construction Phase</b>				
Internal monitoring and inspection	Weekly internal monitoring reports by contractors	Contractors	IAs	Weekly
	Monthly internal monitoring reports by project/environmental supervision company(ies) contracted by PMO	Project/environmental supervision company(ies)	PMOs, IAs	Monthly
External monitoring and inspection	Spot-check monitoring and inspection reports	LEMSs	C-EPBs	Randomly
	Monthly external environmental monitoring and inspection reports	LEMSs	C-EPBs	
	Semiannual external environmental monitoring and inspection reports based on the monthly reports	C-EPBs with assistance from LEMSs	B-EPB	Twice a year
Reports to ADB	Semiannual progress reports based on all the internal and external reports	PMO	ADB	Twice a year
<b>2. Test Operation</b>				
Project acceptance	Environmental acceptance reports of project completion	A certified monitoring institute contracted by IAs or PMO	B-EPB and ADB	Within 3 months after project completion, or no later than 1 year with B-EPB permission
<b>3. Operation</b>				
Internal monitoring	Routine environmental monitoring reports	IAs/Operators	C-EPBs, PMO	Monthly
External monitoring and inspection	Environmental compliance reports	LEMSs	C-EPBs, PMO	Quarterly
Reports to ADB	Semiannual reports based on all internal and external monitoring inspection reports during operations	PMO	ADB	Twice a year

B-EPB = Baoding Municipal Environmental Protection Bureau, BMEC = Baoding Municipal Environmental Monitoring Center, PMO = Project Management Office, BWRB = Baoding Water Resource Bureau, ESC = environmental supervision company, IA = implementing agency, LEBP = local environmental protection bureau, LEMS = local environmental monitoring station.

Sources: PPTA consultants and individual environmental impact assessment reports (IAs, 2006) and the Cumulative Effect Assessment Report, Xinguohuan Environment, Inc. 2006.

## **H. Work Plan**

28. Before construction, the PMO and IAs will develop detailed responsibilities and requirements for contractors and will provide detailed cost estimates of mitigation measures and environmental monitoring in the construction contracts. They will also specify the responsibilities of their environmental management offices and prepare their work schedules.

29. IAs as operators will develop detailed work plans for environmental management and monitoring during operation based on the EMP. The work plans will be submitted to B-EPB and C-EPBs to facilitate their supervision of implementation.

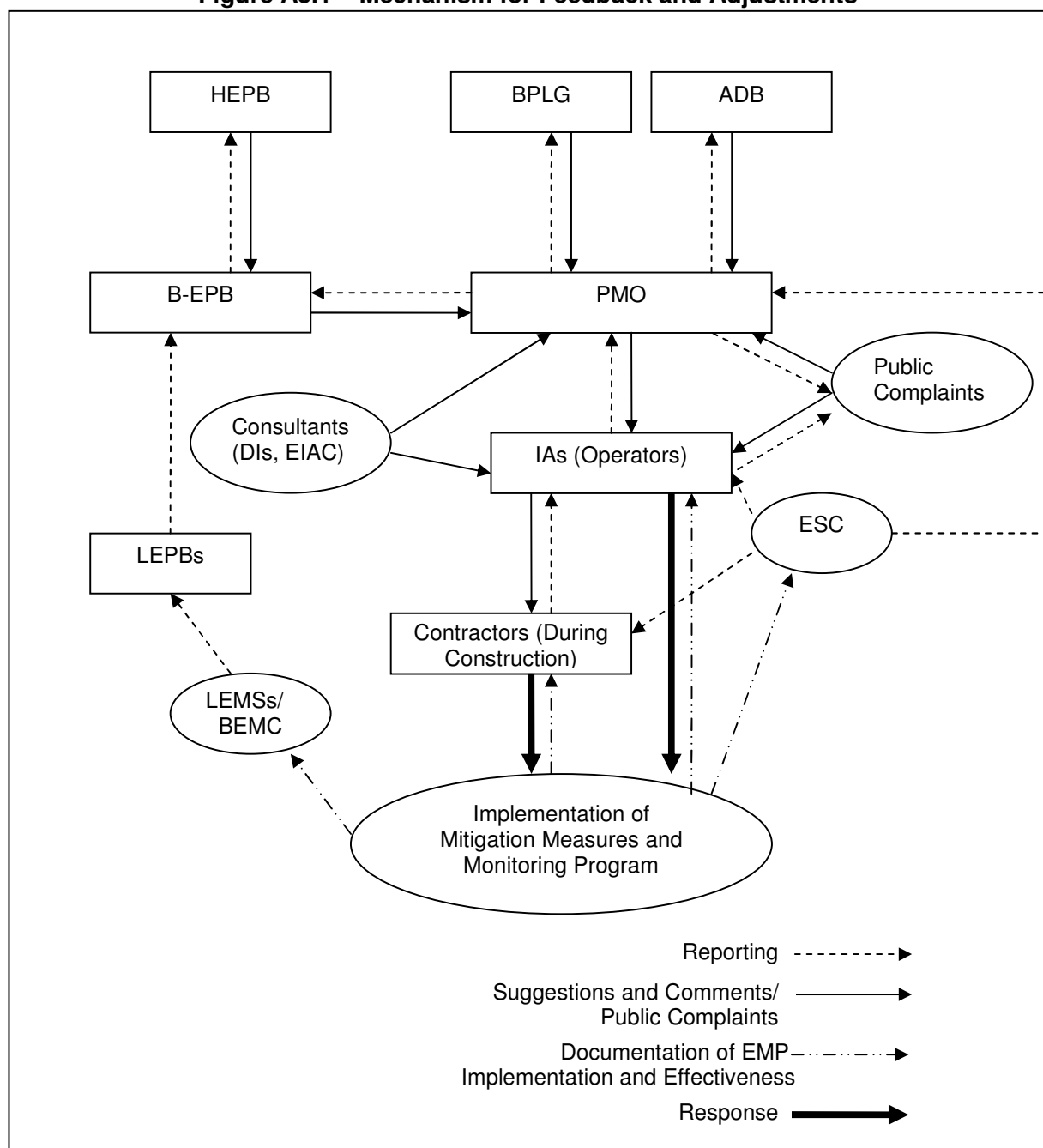
## **I. Procurement Plan and Cost Estimates**

30. The IAs with help from the PMO will develop detailed plans for procuring equipment, materials, and civil works and for implementing mitigation measures and monitoring plans. The plans will be incorporated into the project contracts. Environmental considerations will be incorporated into the procurement to ensure environment-responsive procurement.

31. Cost estimates for mitigation measures and monitoring plans are summarized in Tables A3.1–A3.4. The IAs will bear all compliance monitoring costs and will ensure the necessary budgets are available for the PMO and LEMSs. Internal monitoring costs will be borne by the IAs/contractors during construction, and by the IAs/management companies during operation. The IAs will also ensure that the required budgets are available. Before implementing a monitoring plan, responsible agencies will present a detailed breakdown of the estimated budget. During project implementation, the budgets will be adjusted to actual requirements. Contractors will bear the costs for all mitigation measures during construction, which will be included in the tender and contract documents. The IAs will bear the costs related to mitigation measures during operation. Costs related to environmental supervision during construction and operation will be borne by the IAs. Costs for ESCs and the training will be borne by the Project as a whole. The budget for the training programs will be included in the construction and operation contracts. During the operation phase, the training budget will be included in the operation and maintenance budget.

## **J. Mechanism for Feedback and Adjustment**

32. On the basis of the inspection and monitoring reports, B-EPB will decide whether (i) further mitigation measures or corrective actions are required, or (ii) improvement is required to strengthen environmental management practices. If inspection shows substantial deviations from the EMP or any changes made to the Project or any subprojects that may cause substantial adverse environmental impacts or increase the number of affected people, then the PMO should consult with B-EPB and ADB immediately and form an EIA team to conduct additional environmental assessment and, if necessary, further public consultation. The revised EIA reports including the EMP should be submitted to B-EPB for review, then to ADB. The revised EMP will be given to the contractor(s) and IAs for implementation.

**Figure A3.1 Mechanism for Feedback and Adjustments**

ADB = Asian Development Bank, B-EPB = Baoding Municipal Environmental Protection Bureau, BPLG-Baoding Project Leading Group, PMO = Project Management Office, ESC = environmental supervision company, DI = design institute, EIAC = environmental impact assessment company, HEPB = Hebei Provincial Environmental Protection Bureau, IA = implementing agency, C-EPB = local environmental protection bureau, Source: PPTA consultants in consultation with PMO.

