

# Environmental Assessment Report

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Summary Environmental Impact Assessment  
Project Number: 42382  
November 2008

## People's Republic of China: Liaoning Small Cities and Towns Development Demonstration Sector Project

Prepared by the Liaoning provincial government for the Asian Development Bank (ADB).

The summary environmental impact assessment is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

## CURRENCY EQUIVALENTS

(as of 18 November 2008)

Currency Unit	—	yuan (CNY)
CNY1.00	=	\$0.1465
\$1.00	=	CNY6.8270

## ABBREVIATIONS

ADB	—	Asian Development Bank
CO	—	carbon monoxide
COD <sub>Cr</sub>	—	chemical oxygen demand using the dichromate reflux method
DMF	—	design and monitoring framework
EA	—	executing agency
EAMF	—	environmental assessment and management framework
EIA	—	environmental impact assessment
EIRR	—	economic internal rate of return
EMC	—	environmental management consultant
EMP	—	environmental management plan
EPB	—	environmental protection bureau
FSR	—	feasibility study report
GHG	—	green house gas
IA	—	implementing agency
LPG	—	Liaoning provincial government
MSW	—	municipal solid waste
NH <sub>3</sub> -N	—	ammonia nitrogen
NO <sub>2</sub>	—	nitrogen oxide
O&M	—	operation and maintenance
pH	—	a unit of acidity
PM <sub>10</sub>	—	particulate matter with diameter ≤10 μ
PMO	—	project management office
PPTA	—	project preparatory technical assistance
PRC	—	People's Republic of China
PVC	—	polyvinyl chloride
WTP	—	water treatment plant
WWTP	—	wastewater treatment plant

## WEIGHTS AND MEASURES

μ	—	micron
°C	—	degree Centigrade
dB(A)	—	A-weighted decibel
ha	—	hectare
km <sup>2</sup>	—	square kilometer
kg	—	kilogram
Leq	—	equivalent continuous sound pressure level [dB]
m <sup>2</sup>	—	square meter
m <sup>3</sup>	—	cubic meter
m <sup>3</sup> /d	—	cubic meter per day

m/s	—	meter per second
m <sup>3</sup> /s	—	cubic meter per second
mg/l	—	milligram per liter
mg/m <sup>3</sup>	—	milligram per cubic meter
mm	—	millimeter
mu	—	unit of land area equal to 1/15 ha or 667 m <sup>2</sup>
t/d	—	ton per day
tCO <sub>2</sub> e	—	ton of carbon dioxide equivalent

**NOTE**

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

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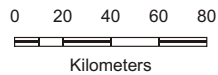
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**LIAONING SMALL CITIES AND  
TOWNS DEVELOPMENT DEMONSTRATION  
SECTOR PROJECT  
IN THE  
PEOPLE'S REPUBLIC OF CHINA**



- Core Subproject City/Town
  - Provincial Capital
  - City/Town
  - National Road
  - Provincial Road
  - Railway
  - River
  - Provincial Boundary
  - International Boundary
- Boundaries are not necessarily authoritative.

## I. INTRODUCTION

1. The Liaoning Small Cities and Towns Development Demonstration Sector Project (the Project) in the People's Republic of China (PRC) is a sector loan prepared under project preparatory technical assistance (PPTA) 4959-PRC from the Asian Development Bank (ADB), covering three sector projects in the provinces of Hebei, Liaoning, and Shanxi. Sector loans are a form of ADB assistance for project-related investments that are linked to sectors or subsectors. Their purpose is to assist in the development of a specific sector or subsector by financing investment in the sector or subsector. A sector loan is expected to improve sector policies and strengthen institutional capabilities, and such lending is particularly appropriate when several subprojects in a sector or subsector are to be financed.

2. The Project aims to (i) support the development of selected small cities and towns to encourage similar actions in Liaoning Province and elsewhere in the PRC; (ii) demonstrate how small cities and towns can achieve economically, socially, and environmentally sustainable urban development; (iii) support the provision of quality infrastructure including roads, water supply, wastewater, district heating, and solid waste management; (iv) support the incorporation of environmental and social considerations into urban planning and development; (v) provide better infrastructure and municipal services so that small cities and towns can fulfill their potential to increase economic efficiency and to enable sustainable development; and (vi) promote integration of various infrastructure services to maximize the benefits from individual sector improvements. Donggang City, Kazuo Mongolian Autonomous County, and Linghai City were selected as the core subprojects. Following these core subprojects, several noncore subprojects will be selected and implemented. An environmental assessment of the Project was conducted based on the environmental impact assessments (EIAs) for the core subprojects and development of the environmental assessment and management framework (EAMF) for subsequent noncore subprojects.

3. This summary EIA reviews the results of three EIA reports prepared by the Liaoning Environmental Science Research Academy and the EAMF. It explains (i) the sector project approach; (ii) sector conditions; (iii) project interventions, benefits, and impacts; (iv) a detailed analysis of subproject selection; and (v) selection, review, and appraisal procedures for noncore subprojects implemented through the EAMF. Each EIA incorporated most of the environmental management plan (EMP) clauses, and the remaining EMP items were developed jointly by the PPTA team and the Liaoning Environmental Science Research Academy. Each EIA and feasibility study report (FSR) was revised based on input and suggestions provided by the PPTA team. The Liaoning provincial government (LPG) review of the EIAs has been completed.

4. Since 1980, the PRC's urban population has more than tripled, reaching 577 million persons in 2006. The urban share of its total population is 44% today and is expected to exceed 50% by 2015. The average disposable income of urban households is about 3.3 times that of rural households. With increasing mechanization and labor efficiency in the agricultural sector, waves of rural migrants continue to seek employment in urban areas. The PRC is facing the challenge of creating employment opportunities for 150 million rural people and housing for 300 million from 2000 to 2020—as its existing 660 cities cannot absorb this population shift. Towns, a largely untapped urban resource, must now be brought to bear through development of physical and institutional infrastructure for economic and urban growth.

5. The Government views urbanization as a means to increase national economic productivity and to promote “harmonious development”, in which the benefits of economic

growth will be shared more equitably. The 11th Five-Year Plan<sup>1</sup> continues the PRC's urban policy tradition of promoting the development of small cities and towns, which have the potential to provide a higher standard of living to rural in-migrants without exacerbating infrastructure fatigue and other problems afflicting large cities. Towns are viewed as having untapped potential to increase national economic productivity while narrowing the urban income gap, thereby contributing to social stability.

6. Much more fewer townships and town enterprises are located in small cities and towns. This impedes the achievement of economy of scale and the development of the tertiary sector in villages, constraining the absorption of the rural surplus work force to townships and town enterprises. To attract the surplus workforce, development of small cities and towns is vital to attract a larger share of industrial and commercial investment.

7. While many cities and towns have made significant investments in various types of urban infrastructure, few have developed an integrated approach to urban development that combines infrastructure improvements with demand-driven, pro-poor development and appropriate, town-specific urban designs. The supply side dominates the approach to development in most cities and towns, i.e., building infrastructure to attract investment and achieve growth. Less developed is a complementary demand-side approach, i.e., what businesses and households need to create jobs and enjoy a higher standard of living.

8. At the same time, most cities and towns model their development on that of big cities—massively wide arterial roads to accommodate increasing automobile traffic, commercial towers and shopping malls located at key intersections, and identical apartment blocks sited mechanically in rows. This type of development is not attractive; beyond a certain volume of vehicles, it is not even efficient. The generic quality of the urban environment in many cities and towns offers residents little that they cannot get in a big city. In this respect, small cities and towns are losing the opportunity to create local environments with a specific character that provide an alternative lifestyle—and in some cases, a higher quality of life—to their residents.

9. As of 2005, 5.37 million people resided in 616 small cities and towns in Liaoning Province, accounting for only 12.8% of the provincial population. The average population of one of its town is only 9,000 (see footnote 1). Such sparsely populated cities and towns ineffectively link cities and villages as well as the nonfarming and the farming sectors, and cannot absorb most of the surplus rural workforce. Prominent towns that can have substantial impact on development of surrounding areas are few.

10. Liaoning is located in the PRC's northeast and functions as a hub between the northeast economic region and the Pan-Bo Hai economic region. It is historically an industrial heartland and is the base for industrial materials and machinery. However, it has faced economic challenges related to the conversion of former state-owned enterprises. Liaoning has an area of 145,900 square kilometers (km<sup>2</sup>), which is 1.5% of the size of the PRC, consisting of 59.8% mountains, mainly in the eastern and western regions of the province; 33.4% plains, mainly in the central region; and 6.8% lakes and rivers. Its jurisdiction also covers 78,300 km<sup>2</sup> in Bo Hai and 71,900 km<sup>2</sup> in the Yellow Sea, as well as 506 islands with a total area of 187.7 km<sup>2</sup>. It has a coastline of 2,178 kilometers (km), representing 12% of the country's coastline. Liaoning is separated from Democratic People's Republic of Korea to the east by Yalujiang River. Its total population in 2006 was 42.71 million, comprising mainly Han Chinese, but also 6.70 million ethnic minorities, about 16% of the population. The population living in urban areas represented

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<sup>1</sup> Liaoning Province National Economic and Social Development 11th Five-Year Plan. 2006.

59% of the total in 2006, which is expected to rise to 63% by 2010. In 2006, about 6.2% of the total population in Liaoning lived on incomes below the official poverty line, compared with 2.3% nationally.

11. Liaoning is rich in natural and cultural resources. Natural resources include fisheries and minerals. Fisheries' production in 2007 was 4,546,000 tons (t), with 84% from salt water and 16% from fresh water. Archaeological finds at Jinniu Mountain in Yingkou City have dated human activities in the province back 280,000 years. It was the birthplace of the Qing Dynasty, with an Imperial Palace in Shenyang.

12. Liaoning's small cities and towns have made substantial progress in recent years in facilitating economic growth. Some resourced-based small cities and towns have taken advantage of the mining and metals sector growth, and some located within metropolitan areas and development corridors play important roles as manufacturing centers, transport hubs, or agroprocessing sites (based on the marketability of specialty products). Others have been successful in capturing multiplier effects in the service sector. On the supply side in particular, small city and town governments are effective in providing key inputs to investors, such as serviced land, regulatory support, and adequate supplies of labor. However, they rarely use market information to guide policy development or to promote their assets to private investors. The government-wide priority on gross domestic product growth in recent years has prioritized industrial development over service sector growth, which has limited the impact of investment on job creation.

13. The rapid development and the race to urbanize and industrialize have left many with very significant pollution problems and correspondingly poor living conditions. Atmospheric, aquatic, and ground pollution blight Liaoning, creating a living environment and a serious threat to human health and life expectancy. Congestion and conflict between heavy traffic from trade, industrial activities, and other road users; inadequate potable water supplies and network coverage; and lack of sewage collection and wastewater treatment make living conditions worse. Centralized heating has limited coverage; elsewhere, a multiplicity of coal-burning stoves provides heat. Solid waste management is often rudimentary with poor environmental protection. Increases in the urban population have outstripped the capacity to provide services, and poor asset maintenance has compounded the problem. Public service providers are unable to manage sustainable operations, and restructuring is of paramount importance to ensure future viability and independence. There is also a need to reduce unemployment by realigning skills to match the growing demand for workforce in secondary industries.

14. Infrastructure provision in these small cities and towns is low and mostly outdated, and cannot satisfy development needs. For the past decade, rural villages' gross production has increased 11 times, yet investments in towns have increased only 3.9 times. Buildings in the towns lack character and are generally of low standard. Public green area per capita is low at 3.5 square meters (m<sup>2</sup>). The road density is low. The province's water resources are scarce; its amount of water resources per capita is only one third of the national average. Potable water coverage is only 39%. Many water supply facilities are aged, pipe network coverage is low, and the water production capability of water sources is inadequate. As many drainage pipes and channels have been used for 40 years—and some for 100 years—breakage and blockage have become serious. There are very few wastewater treatment plants (WWTPs) and solid waste treatment facilities. Most garbage collection vehicles are worn, and there are few garbage collection stations.<sup>2</sup>

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<sup>2</sup> Liaoning Province Development and Reform Commission August 2006.

15. Concern is increasing over the effects of population growth on the inadequacy of public services in the cities and towns. Continuing urbanization has resulted in increasing demand for private cars, a lifestyle change that creates a more diversified range of travel demands and different urban land use patterns. Furthermore, the small cities and towns face environmental threats from pollution of surface and subsurface waters from untreated wastewater and garbage, water pollution in rivers and streams, flooding, and poor pipe borne sewerage.

16. The Ministry of Environmental Protection conducted audits of 595 cities' environmental performance in 2006. Over 50% of the audited cities in Liaoning had no centralized wastewater treatment, no sanitary treatment or disposal of solid waste, and no centralized medical waste treatment. Air quality in 39 cities was found to be worse than Class III standards; 7 were in Liaoning including Linghai, a core subproject city. According to data published by the LPG,<sup>3</sup> sulfur dioxide emissions in 2005 totaled 1,197,000 t in the province, with 961,000 t from industries and 236,000 t from domestic and municipal chimneys. Particulate matter with diameter  $\geq 10 \mu$  ( $PM_{10}$ ) emissions in 2005 totaled 746,000 t, with 518,000 t from industries and 228,000 t from domestic sources. The major pollutant in most cities was  $PM_{10}$ , especially from coal dust during the heating season. The province is also suffering from acid rain, with rainwater having an annual average factor of acidity (pH) of 5.31 in 2005. Dandong suffered the most in the province, with acid rain occurring at a frequency of 64.9% and the lowest pH recorded at 3.53. A core subproject city, Donggang, is under the administration of Dandong. To improve air quality, 1,074 household coal-burning stoves and 674 chimneys were removed in 2007.

17. In the province's cities, noise levels measured in 2007 in terms of equivalent continuous noise level ( $Leq$ ) averaged 54.3 A-weighted decibels (dB[A]). The 2007 annual average of road traffic noise levels measured in Liaoning cities in terms of  $Leq$  was 67.8 dB(A). These showed slight improvements over 2006.

18. Liaoning generated 2.19 billion t of wastewater in 2005 (about 6 million t per day [t/d]), consisting of 1.05 billion t of industrial wastewater and 1.14 billion t of domestic wastewater. The resulting pollutant loads were 268,000.0 t of chemical oxygen demand using the dichromate reflux method ( $COD_{Cr}$ ); 34,000.0 t of ammonia nitrogen ( $NH_3-N$ ); 99.9 t of phenol; 1,371.9 t of total petroleum hydrocarbon; 49.7 t of cyanide; and 9.4 t of heavy metals from industrial wastewater; and 376,000 t of  $COD_{Cr}$  and 57,000 t of  $NH_3-N$  from domestic wastewater. In 2007, Liaoning had 18 wastewater treatment plants (WWTPs) providing treatment to 45% of the wastewater generated in the province. It has been projected that by 2010, approximately 3.31 billion t of wastewater will be generated annually (about 9 million cubic meters [ $m^3$ ] per day). Sixty-seven wastewater projects have been planned in the province, mostly in townships and county-level cities and towns. These projects will add 3 million  $m^3$  per day ( $m^3/d$ ) to the treatment capacity, raising provincial wastewater treatment percentage to 60%.

19. The discharge of untreated or undertreated industrial and domestic wastewater has resulted in the deterioration of water quality in the province's water bodies. The LPG in 2005 monitored 36 sections of 6 major rivers, and 33.3% of the sections showed worse than Class V  $COD_{Cr}$  standards and 66.7% showed worse than Class V  $NH_3-N$  standards.  $NH_3-N$  was the major pollutant in Liaoning's rivers, showing the impact of the untreated domestic wastewater discharge. The Liao River, the largest river in Liaoning, was the worst among the six major rivers with 62.2 milligrams per liter (mg/l) of  $COD_{Cr}$  and 3.61 mg/l of  $NH_3-N$ , both measurements exceeding Class V surface water quality standards. Among the six major rivers, the Daling River had the highest  $COD_{Cr}$  concentration of 109 mg/l, and the Hui River had the highest  $NH_3-N$

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<sup>3</sup> Liaoning Provincial Government 2006.

concentration of 6.70 mg/l. Both exceeded Class V surface water quality standards. The Yalujiang River complied with Class II standards on all sections monitored and had the province's best water quality.

20. Monitoring of near-shore marine water quality by the LPG in 2005 showed 86% compliance with the standards assigned to the respective near-shore marine water functional zones, an increase of 7.5% from 2004. Major pollutants were inorganic nitrogen, phosphate, and 5-day biochemical oxygen demand. Of the coastal cities, Donggang City meets Class II marine water quality standards and was classified as having good marine water quality. Linghai City meets Class IV marine water quality standards and was classified as having medium-level pollution.<sup>4</sup>

21. In 2005, monitoring of 44 locations at drinking water sources for centralized water supply showed a compliance rate of 82.8%, with groundwater and surface water resources having compliance rates of 98.0% and 74.8% respectively. Different locations exceeded different parameters such as total nitrogen, total phosphorus, total petroleum hydrocarbon, *E. coli*, COD<sub>Cr</sub>, and fluoride. Monitoring of water quality in 14 reservoirs showed that eight met Class III standards, one met Class IV standards, three met Class V standards, and two were worse than Class V standards. Major pollutants were total nitrogen and total phosphorus.

22. The national average for solid waste treatment is 51.79%. For Liaoning, it was 40% for urban areas only in 2005. In 2006, Liaoning had 10 solid waste treatment facilities consisting of sanitary landfills, incinerators, and composting plants, providing treatment and disposal to 1,161 t of municipal solid waste per day. This small quantity was way below the design capacities of these facilities, indicative of garbage collection problems.

23. In the LPG's work report presented on 23 January 2007, Liaoning's provincial governor stated that the Provincial Government would develop county seats and several key towns, creating favorable conditions for a strategic shift in the rural labor force. Development of cities and towns would be integrated with development of the counties' economy and rural enterprises. Industrial projects and tertiary industries would be concentrated in county seats and key towns to promote economic prosperity of the cities and towns.

24. The LPG is promoting development of small cities and towns in a more coordinated and cost-effective manner by bringing about more sustainable investments in physical and environmental protection infrastructure to improve the quality of life. The city and town governments are coordinating and implementing elements of urban transport master plans and making investments in roads, water supply, heating, and environmental improvement including garbage and solid waste treatment, drainage, and connection of households to a wastewater network. They will be involved in owning and managing the completed facilities.

25. The Project is a direct response to Liaoning's 11th Five-Year Plan to promote sustainable economic development, particularly in its small cities and towns, via construction and upgrading of road infrastructure, water supply, and environmental improvement. All components in the Project are integral components in the plan. The small city and town government master plans are reasonably sound and are integrated with the overall planning process. The Project aims to promote balanced and environmentally sustainable urbanization; narrow the urban-rural gap; and improve production, employment, and living conditions in

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<sup>4</sup> The county level cities and towns are administered by the county authorities, the provincial level cities and towns are administered by the provincial authorities.

Liaoning's small cities and towns. The Project will support the development of selected small cities and towns that will be an example to other small cities and towns in Liaoning and elsewhere in the PRC. The Project will assist provincial and local governments in developing a mechanism for selecting and prioritizing subproject cities and towns with potential for employment generation, economic growth, and environmental improvement. Institutional strengthening and identification of market-based mechanisms for the delivery of services will be cornerstones of the Project. Developing markets and creating jobs by supporting urbanization and protecting the environment in small cities and towns are in line with ADB's strategic objective of poverty reduction and promoting growth with equity in the PRC.

26. The Project has many benefits. Roads will improve the transport network and connectivity, thereby reducing travel time. This will reduce vehicle emissions, which will have a positive effect on greenhouse gas (GHG) emissions and climate change. Water supply and wastewater treatment will improve public health and reduce the discharge of pollutants into rivers and groundwater. River improvement will provide flood protection, thereby reducing economic losses and public health hazards due to flooding. This summary EIA concludes that the Project will have substantial environmental, health, and socioeconomic benefits.

27. Adverse impacts on the physical and natural environment during the Project's construction and operational phases will be largely insignificant with the implementation of the recommended mitigation measures identified in the EMP. The incremental costs required for implementation are included in the project costs.

## **II. DESCRIPTION OF THE PROJECT**

28. The Project covers core and noncore subprojects. The core subprojects represent the full province-wide scope of needs, conditions, and possibilities that will be facing the noncore subprojects to be selected during the implementation stage. The core subprojects are Donggang City, Kazuo Mongolian Autonomous County, and Linghai City. The selection of the three core subprojects was based on socioeconomic indicators, level of preparedness to undertake investments in municipal infrastructure, and potential to grow economically and to provide jobs to in-migrants from rural areas. The availability of viable investment projects directly supporting approved development master plans and programs as well as the potential to serve as models in the preparation of subsequent components were other considerations. The core subprojects focus on development of citywide primary and secondary infrastructure with emphasis on environmental infrastructure.

29. The three core subprojects typify the key issues in Liaoning: medium-size small cities with high economic potential but poor road networks and environmental infrastructure; and poor and remote towns vying for economic development but unsure of resources, particularly water. Project intervention specifically addresses these key issues, with environmental objectives to (i) improve air quality by substituting centralized heating for small boilers and household coal burning, (ii) improve public health by supplying reliable potable water, (iii) collect and treat wastewater before discharge into the natural environment, (iv) improve river quality and flood protection capacity, and (v) improve road networks and connectivity.

30. The three core subprojects have different economic and social characteristics that can have demonstration effects on other small cities and towns. Donggang City is a border port; international trading hub; and a distribution center for agricultural products, fisheries, and container port secondary industries. Linghai is a coastal city strategically located in the Pan-Bo Hai economic region and is a major agricultural, fisheries, and food crop base with rapid growth

in light industries, clothing, agroprocessing, and mechanical and electrical equipment manufacturing. Kazuo Mongolian Autonomous County is a poor inland county with a high ethnic minority population and is constrained in economic growth by a shortage of water resources.

31. A key zone in Liaoning's development strategy, known as "5 points and 1 line" (referring to a 80–100-km wide coastal strip and five places along the strip), is considered to have the greatest potential to spur the province's growth. Donggang City, with an important harbor near the national border, is within the easternmost "point" and has the potential to drive the development of a large area. The proposed road, bridge, and associated services component in Donggang City will promote its development as an important distribution center for agricultural, fisheries, and industrial products to outside of the province. Its proposed wastewater, river improvement, and landscaping components will improve the present poor environmental conditions and alleviate flood damage. Linghai City is along the major transport corridor between the three northeastern provinces and the inner region of the PRC (especially the region south of the Great Wall on the eastern and central part), so also has the potential to drive the development of a large area. Its proposed roads and related municipal services component will upgrade the present inadequate and outdated infrastructure for residents as well as serve the markets for agricultural and industrial products and daily necessities. Kazuo Mongolian Autonomous County, being a poor county, is considered representative of the western part, which is the poorest part of Liaoning. Its proposed water supply component will serve previously unserved villages in a low-income region as well as a growing industrial development district with potential, close to abundant mineral resources and to major transport lines but presently constrained by water shortage.

32. Key issues in the subproject cities and county are: (i) inadequate availability of infrastructure, (ii) severe pollution, (iii) a significant share of the population living under the poverty line, and (iv) lack of integrated management of urban development. The Project, consisting of several sector interventions primarily targeted to support job creation, economic growth, environmental protection, improvement of infrastructure and municipal services, and industrial development, aims to address these issues to support sustainable urban development. Different cities and towns will promote different economic sectors, depending on their base and their potential.

33. The subprojects involve (i) construction of new roads, focusing on town bypasses, upgrading the existing inadequate or unsurfaced roads, and improving traffic planning and management; (ii) increases in the capacity to supply potable water and coverage of distribution networks, and provision of storm water and wastewater collection systems; and (iii) river improvement works with area upgrading to reduce the risk of seasonal flooding and to increase the capacity to impound water for various uses.

34. The Project also provides opportunities for capacity building in environmental management, which lays the foundation for future economic growth and sustainable development.

#### **A. Donggang City**

35. Donggang is a coastal city in southeastern Liaoning under the administration of Dandong City, bordering Bo Hai to its south and the Yalujiang River to its east. It is the northernmost city on the PRC's coastline, with a land area of 2,445 km<sup>2</sup> and a sea area of 3,500 km<sup>2</sup>. It has a population of 642,000, with 15 ethnic minority groups making up approximately 10% of the population scattered throughout the city. Donggang City serves as a border port and

has the important function of being a secondary city to Dandong City for developing international trade, marine resources, and container port secondary industries. It is famous for its agriculture and aquaculture, especially the farming of wet rice, corn, strawberries, fish, and shellfish. Its port has seven berths with an annual throughput of 7 million t.

36. The subproject includes investments in roads, a bridge, and related municipal services; drainage and wastewater; and river improvement with area upgrading.

37. The present urban traffic network in Donggang City is incomplete, especially the connectivity, functional readiness, and adequacy of trunk roads and secondary roads. The lack of a sound traffic management system has resulted in competing use of roads among pedestrians, bicycles, and motor vehicles, as well as severe traffic congestion at intersections. The Dadonggou River flows from northeast to southwest across Donggang City, and presently most traffic crossing it relies on two bridges, with a combined flow of approximately 1,800 vehicles per day. With the old town on the west bank and new economic development areas being planned and built on the east bank, there will be more traffic traversing these bridges. A new bridge, the Renmin Bridge, is needed to facilitate transport across the river, to ease traffic congestion on the existing two bridges, and to promote economic development in Donggang City. The proposed roads and bridge will improve traffic circulation around the city and promote Donggang City's development as an important regional distribution center.

38. There is no unified planning of the present drainage network of Donggang City, which is outdated and designed to low standards. Storm water and untreated wastewater flow into the Dadonggou River via open culverts. Donggang City presently discharges 28,600 t of wastewater (70% domestic and 30% industrial) per day into the river. Being a tidal river, the Dadonggou is unable to disperse pollutants during incoming tide, resulting in serious water quality deterioration and siltation problems, posing threats to public health and compromising its flood protection function. Water quality also impacts the coastal zone, affecting the mariculture industry and ecology of the Yellow Sea. A well-designed drainage system with separate storm water and wastewater collection is badly needed. Wastewater treatment is also needed. A 10,000 m<sup>3</sup>/d capacity WWTP will be built in two phases using build–operate–transfer as the project delivery mechanism.

39. Although the Dadonggou River provides flood protection to the city, its flood protection function has been diminished by the siltation. Moreover, its banks are not structurally stable enough to withstand 1 in 50 year storms. River improvement and embankment works are badly needed to restore its flood protection function. There are wetland habitats, including a large lake along the river's banks, which will be landscaped, restored, and enhanced to improve their ecological carrying capacity and biodiversity of wildlife and to provide enjoyment and aesthetics to the citizens of Donggang City.

40. The Donggang subproject is appropriate for replication in other Liaoning small cities and towns that are experiencing rapid economic growth but require infrastructure investment and institutional capacity-building in order to achieve economically, socially, and environmentally sustainable development. Subproject components are described below.

41. **Roads, Bridge, and Related Municipal Services Component.** This component consists of constructing 3.2 km of a new trunk road, upgrading 4.7 km of two existing trunk roads, constructing a 172-meter (m) cable-stayed bridge, and installing 466 sets of road lights and 6 transformers.

42. **Drainage and Wastewater Component.** This component consists of constructing 7.3 km of storm water pipes and 4 storm water pumping stations, 8.1 km of wastewater pipes and 2 wastewater pumping stations, and a 740-m long box culvert.

43. **River Improvement and Area Upgrading Component.** This component consists of improvement works to the Dadonggou River, including 2.4 km of embankment dikes and 1.1 million m<sup>2</sup> of landscaped and habitat restoration areas (which include a lake and marsh/wetland habitats).

## **B. Linghai City**

44. Linghai City is a coastal city located by Liaodong Bay in Bo Hai in southwestern Liaoning. It is under the administration of Jinzhou City. Linghai City has a land area of 2,733 km<sup>2</sup> with an urban area of 17.53 km<sup>2</sup>. With 82,400 hectare (ha) of cultivated land, it is one of the major food production bases in the country with annual crop production exceeding 500 million kilograms (kg). Major crops include corn, sorghum, wet rice, and vegetables. The city has 298 town and village enterprises in light industries, chemical refining, clothing, paper, printing, and mechanical and electrical products manufacturing. It was listed by the State Council in 1993 as one of the important cities in the Pan–Bo Hai economic region. Linghai City has a population of 560,000, with 520,000 involved in agriculture.

45. The subproject includes investments in roads and related municipal services, water, and drainage. Presently, the road network lacks adequate access to the western part of the city. By 2010, the road network will be unable to adequately serve the city. Trunk roads and secondary roads in the old urban area also need upgrading to improve road conditions and connectivity, especially to ease congested traffic flow to the north, thus promoting economic development in the northeastern part of the city. The lack of a sound traffic management system has resulted in competing use of roads among pedestrians, bicycles, and motor vehicles, as well as traffic congestion at intersections. This subproject will improve and expand the city's road network, improve road safety, and enhance the functionality of the road network and the quality of road services to surrounding areas.

46. Linghai City's urban area extracts groundwater for potable use from three wells with a combined design capacity of 30,000 m<sup>3</sup>/d, but in practice, only 18,000 m<sup>3</sup>/d is being extracted due to aging mechanical and electrical equipment. With recent population growth, this supply can no longer meet the population's needs. During peak hours, water pressure is inadequate to supply households on buildings' highest floors. The aging of undersized water distribution pipes also leads to unreliable supply and significant water loss due to leakage. The use of many secondary pumping stations to boost pressure has resulted in secondary pollution to the water and diminished the strength of disinfectant in the water. This Project will improve the quality, quantity, and reliability of potable water supply by installing properly designed water distribution pipes during road works provided by this Project.

47. Linghai City's present drainage system is a combined storm water and wastewater system discharging into the Daling River. During heavy rain, the water level in the Daling River rises, preventing the collected storm water and wastewater from draining into the river. When this happens, the storm water and wastewater have to be diverted to nearby irrigation channels. There is no wastewater treatment for most of the untreated wastewater discharging into the Daling River, causing pollution in the river as well as in the groundwater to the west of the river that is a major water source for the city. This Project provides well-designed storm water and wastewater collection systems, with wastewater to be taken to a planned plant for treatment,

eliminating the threat to the major water source for the city. The subproject has the following component.

**48. Roads and Related Municipal Services Component.** This component consists of constructing 25.00 km of roads (consisting of 3.00 km of a new trunk road, 10.80 km of 3 upgraded trunk roads, 10.50 km of 8 upgraded secondary roads, and 0.65 km of a reconstructed branch road), 71,000 m<sup>2</sup> of greening, and 1,100 road lights with no transformer. With existing roads in Linghai City's urban area totaling 29.00 km, this Project will revamp the transport network. This component also consists of constructing water supply pipelines and storm water pipelines in conjunction with the roads.

### **C. Kazuo Mongolian Autonomous County**

49. Kazuo Mongolian Autonomous County is located in western Liaoning in the upstream mountainous region of the Daling River, with an area of 2,237.86 km<sup>2</sup> and a population of 423,000, consisting of 19.5% Mongolians. It is under the administration of Chaoyang City. Kazuo Mongolian Autonomous County's water resources total 229.6 million m<sup>3</sup>, with 66% from surface water and 34% from groundwater (only 68 million m<sup>3</sup> of groundwater is extractable from a replenishing total of 177 million m<sup>3</sup>).

50. Kazuo Mongolian Autonomous County is a poor county dominated by agriculture but constrained in growth by traditional agricultural practices, with farmers' per capita annual income at CNY3,410 in 2006. Recently, it expedited growth in its Gongyingzi New District with investments from several industrial enterprises that employ many workers. Gongyingzi New District was legally established in Gongyingzi Town over an area of 6.65 km<sup>2</sup> with a population of about 24,000. The enterprise development has been positioned to include metallurgical casting, automobile spare parts, and intensive processing of nonferrous metals, supplemented by processing of agricultural produce, trade, and logistics. Thirty-five enterprises have invested in the new district, which is expected to grow much further, contributing to employment generation and economic development. However, its growth is constrained by a water shortage.

51. Water supply for Gongyingzi New District primarily comes from the water source in the basin of the Mangniu River, which runs dry during some parts of the year. The average flow is 0.49 m<sup>3</sup> per second (m<sup>3</sup>/s), but more extraction is not possible since this will deplete the water source. There is a water treatment plant (WTP) on Zhongxing Street in Dazhibu Village with a designed capacity of 4,080 m<sup>3</sup>/d, and the actual water usage is 1,000 m<sup>3</sup>/d. The users include 1,850 residential households and 35 enterprises. The coverage of potable water is about 30%, and water treatment is inadequate, with high fluoride content in some areas. This causes mottled teeth and diarrhea, the incidences of which are respectively about 40% and more than 20%.

52. The water supply pipes have been laid for over 20 years. Leakage of these outdated pipes is serious. Pipe bursts are frequent. Moreover, no water supply pipes have been laid for those parts of Gongyingzi New District outside the present built-up area. Therefore, according to the planning for Gongyingzi New District, new construction and rehabilitation of the water distribution pipe networks are essential.

53. Most industrial and other enterprises and residents obtain water from many self-provided wells. This is unfavorable to the development of Gongyingzi New District and the unified management and scheduling of water supply. In addition, the water supply system in Gongyingzi New District cannot satisfy its own water demand.

54. The percentage of water reuse for the industrial enterprises in Gongyingzi New District is approximately 47%. It is estimated that in 2020, 5,640 m<sup>3</sup>/d of reclaimed water will be available for nonpotable reuse, including road watering and landscaping and part of industrial water use. In line with the master plan and Gongyingzi Town's water supply plan, a pipe network of reclaimed water will be built to satisfy the development needs of Gongyingzi New District. A water demand of 32,670 m<sup>3</sup>/d in 2020 has been projected (consisting of 12,000 m<sup>3</sup>/d for integrated domestic use; 15,000 m<sup>3</sup>/d for industrial use; 3,000 m<sup>3</sup>/d for street washing and landscape watering; 3,000 m<sup>3</sup>/d for leakage loss; and the rest for contingency). After deduction of 5,640 m<sup>3</sup>/d of reclaimed water and the present water supply capability of 4,000 m<sup>3</sup>/d, the additional water supply needed will be about 23,000 m<sup>3</sup>/d.

55. A suitable water source is a river basin in the Shuiquanguan District of Nanliangzi Village, which is approximately 17 km from the Gongyingzi New District. The river basin has been dammed up to collect water from the Daling River. The facility was built in 2001 for supplying irrigation water at a design flow rate of 1.5 m<sup>3</sup>/s and for providing hydropower. Kazuo Mongolian Autonomous County planted a protective zone near the river to grow vegetables and melons, which conserve water, and adopted scientific management of the irrigation system, resulting in saving 40% of the water originally used for irrigation. In recent years, the area using this water for irrigation has also decreased by approximately 1,000 ha. The Gongyingzi New District needs a water supply of 0.3 m<sup>3</sup>/s to meet its demand in 2020, which will be obtained from the water no longer needed for irrigation from this water source. Subproject consists of a water supply component based on using this water source.

56. **Water Supply Component.** This component consists of constructing a 26,000 m<sup>3</sup>/d capacity water intake below the dam at Shuiquanguan District, 18 km of raw water intake pipeline, a 26,000 m<sup>3</sup>/d capacity intermediate water pumping station, a 25,000 m<sup>3</sup>/d capacity water treatment plant located approximately 18 km southeast of Gongyingzi New District, and 58.5 km of water distribution pipelines.

#### **D. Institutional Development and Capacity Building**

57. One important objective of the ADB loan is to bring added value to the LPG, local governments, and implementing agencies (IAs) through capacity building. Although the Liaoning project management office (PMO) has many years of experience with internationally funded projects, the subproject PMOs, IAs, and operation and maintenance (O&M) organizations have limited experience in these projects, ADB procedures, and international best practices. The Project will provide adequate training for developing and strengthening their capacity for operational and financial sustainability of the facilities and services in the long term.

58. Institutional development and capacity building will include (i) strengthening the organizational capacity of the executing agency (EA), IAs, and O&M organizations to improve municipal infrastructures through project delivery and environmental management measures; (ii) implementing the Project in compliance with national and ADB standards pertaining to technical requirements, environmental management, social safeguards, procurement, and financial management; (iii) building the IAs' and O&M organizations' capacity and resources to implement, operate, and maintain all project facilities to achieve benefits and long-term sustainability, and (iv) strengthening the environmental management capacities of the subproject cities and towns in the areas of water supply, wastewater treatment, and solid waste management. The requirements for institutional strengthening and training related to environmental management needs are described in the EMP. Similar measures for the noncore subprojects will be implemented through the EAMF.

## **E. Associated Projects Funded by Others**

59. In Donggang City, the associated WWTP project will install 8.1 km of wastewater collection pipelines and two wastewater pumping stations. A plant with 100,000 m<sup>3</sup>/d capacity will be built on a 10.6 ha site on the west bank of the Dadonggou River downstream from the city, east of Xincheng Road and south of the South Ring Road. Project delivery will be by build–operate–transfer, and the tendering for the first phase of the 50,000 m<sup>3</sup>/d treatment capacity occurred in April 2008. Cyclic activated sludge system has been selected as the treatment process, with effluent reuse at 30,000 m<sup>3</sup>/d and treated effluent meeting Class IA standards.

60. In Linghai City, the associated WWTP project will install 3.45 km of a box culvert for wastewater collection. One will be located to the southeast of the new town area. The ultimate treatment capacity will be 220,000 m<sup>3</sup>/d, with the first phase providing 120,000 m<sup>3</sup>/d treatment capacity to be completed by the time the box culvert provided under the Project is completed. Wastewater will undergo secondary treatment, and the treated effluent will be discharged to an irrigation channel running parallel to the Daling River, with the treated effluent to be reused for irrigation.

61. Due diligence on associated projects for noncore subprojects will be implemented through the EAMF.

## **F. Policy Dialogue**

62. Policy dialogue is an important aspect of ADB's operations in the PRC's urban development, and may cover urban planning, water supply, wastewater treatment, sanitation and solid waste management, and urban transport. The Project supports policy dialogue on urban transport, effective traffic management and road safety, expansion of water supply and wastewater services, solid waste management, environmental management, and ecocity development.

63. More specifically, policy dialogue for this Project will include: (i) climate change adaptation and mitigation in future urban master plans of Liaoning's small cities and towns, (ii) training on environmental awareness and environmental management system for all three core subprojects, (iii) training on traffic management and road safety in Donggang and Linghai, (iv) wastewater management in Donggang and Linghai, (v) protection of water sources in Kazuo, and (vi) industrial pollution control and prevention in Kazuo.

## **III. DESCRIPTION OF THE ENVIRONMENT<sup>5</sup>**

### **A. Atmosphere and Climate**

64. Liaoning has a temperate continental monsoon climate, with distinct seasons of long winters and short springs and autumns. Annual average temperature ranges from 7 to 11 degrees Celsius (°C), with maximum temperature reaching 30 °C and minimum temperature about -30 °C. The frost-free period averages 130 to 200 days, more in the southeast and less in the northwest, but most places have more than 150 days. With annual rainfall averaging 600–1,000 millimeters (mm), Liaoning has the most rainfall among the provinces in the northeast. Rainfall distribution is uneven, wet in the eastern mountainous region with more than 1,100 mm

<sup>5</sup> The analysis of noncore subprojects will be similar to the Chapter III discussion of core subprojects. It will be carried through by implementing the EAMF.

per year, dry in the western mountainous region with less than 400 mm per year, and intermediate in the central plains with approximately 600 mm per year.

65. Donggang City is in the northern temperate continental climate zone. Influenced by the Yellow Sea, it has maritime monsoon climate characteristics with cold springs, cool summers, warm autumns, and warm winters; small temperature differences between day and night; a long frost-free period; and perennial humidity. The annual average temperature is 8.5 °C. The annual average frost-free period is over 182 days, and the maximum depth of frozen soil is 0.81 m. The annual average rainfall is 967 mm, mainly in July and August with an average relative humidity of 76%. Predominant wind directions are from the northwest and southeast with an average annual speed of 4.23 m per second (m/s). Air quality monitoring results showed that PM<sub>10</sub> concentrations exceeded the Class II environmental air quality standards (GB3095-1996) by 0.11 times, while carbon monoxide (CO) and nitrogen dioxide (NO<sub>2</sub>) concentrations were within the Class II levels. The air quality was generally good.

66. Linghai City is in the northern temperate continental climate zone. The seasons in Linghai City are distinct with windy and dry springs, hot and rainy summers, cool autumns, and dry and cold winters. The average annual temperature is 8.6 °C. The average annual precipitation is 612.7 mm. The dominant wind is from the south and southwest in the summer and from the north and northwest in the winter, with an annual average wind speed of 3.0 m/s. The frost-free period is 160–180 days. According to the 5-day air quality monitoring data at six sites from 14 to 19 April 2008, air quality was good. Daily average concentration of PM<sub>10</sub>, CO, and NO<sub>2</sub> were within Class II standards.

67. Kazuo Mongolian Autonomous County is in the East Asian monsoon zone with a seasonal continental climate. Annual average temperature is 8.2 °C. Average temperature is 22.8 °C in the summer and -8.4 °C in the winter. The extreme maximum temperature is 42.0 °C, and the extreme minimum temperature is -29.9 °C. The average annual precipitation is 510 mm with a relative humidity of 53%. The dominant wind is from the southwest in the summer and from the north in the winter, with an annual average wind speed of 2.4 m/s. The frost-free period is 152 days, and the average depth of seasonal frozen soil is 1.5 m from November to March. According to the 5-day air quality monitoring data at two sites in Kazuo from 4 to 8 March 2008, air quality was good. Daily average concentration of PM<sub>10</sub>, total suspended particulates, sulfur dioxide, and NO<sub>2</sub> were within Class II standards.

## **B. Topography and Geology**

68. Donggang City is located in the southeast of Liaoning, 45 km from Dandong. It is next to the Yellow Sea on the south; Fengcheng and Xiuyan Man Autonomous Counties on the north and northwest; Zhuanghe City on the west; Zhen'an District of Dandong on the northeast; and Longchuan County in Ping'anbeidao, Democratic People's Republic of Korea on the east. It is a seaport located in a transitional zone between the north bank of Yellow Sea and the southern portion of the Qianshan Mountains. Landforms in the southern portion include tidal flats and coastal plains. The middle part is low hills, and the northern part is low mountainous areas. Typical topographic features include low hills and valleys, mesa plains, and tidal flat plains. Geologically, Donggang City is located at the connecting point of the Liaodong uplift and Yellow Sea hollow. Since the Pleistocene of the Quaternary Period, it has accumulated 30–50 m of depositions including earth fill layer, silty clay layer, silty muddy layer, fine silt layer, silty layer, medium sand, gravel, marble, and clay slate.

69. Linghai is a coastal city in the southwest of Liaoning, next to Liaodong Bay on the south, Panjing City on the east, Huludao City, Chaoyang City on the west, and Jieyi County and Beipiao City on the north. Its topographical features include mountains on the north and the sea to the south. Its northwestern part is mountainous, part of the Songling Mountains, accounting for 28.2% of the total area. Its northeastern and southwestern areas are hilly, accounting for 18.3% of the total area. The middle and southern areas are depressed areas and plains, accounting for 53.5% of the total area. Main soil types include brown earth and meadow soils. The geological structure of the area is the Quaternary Period depositions including detritus, conglomerate, and sandstone.

70. Kazuo Mongolian Autonomous County is located in the stepladder boundary zone of the Mongolian plateau. The topographical feature is mountainous and hilly with an average altitude of about 350 m. Its topography is high in the north and west, and low in the south and east. Soils in the area consist of mainly mild clay and light loam. The geological structure of the area is Quaternary Period depositions in the upper layers, overlaying a mudstone layer of cretaceous.

### **C. Noise**

71. In Donggang City, there are 16 noise-sensitive areas near the core subproject areas, including three schools, one temple, and 12 residential areas. Six monitoring locations around the current sensitive areas were chosen to collect baseline noise conditions. Noise levels in terms of Leq ranged from 47 dB(A) to 66 dB(A) during the day and from 42 dB(A) to 56 dB(A) during the night. The noise environment in Donggang City basically met Class II urban environmental noise standards (GB3096-93), except the nighttime noise levels near Qingnian North Road and Yingbin West Street slightly exceeded the standards due to traffic noise.

72. In Linghai City, there are 27 noise-sensitive areas near the core subproject, including 10 schools, hospitals, a kindergarten, and 17 residential areas. Current noise levels at these sensitive areas met Class II standards.

73. In Kazuo Mongolian Autonomous County, there are no noise-sensitive areas near the water source area, water transmission alignment, and the WTP. The existing noise level met Class I standards. However, water distribution pipelines will be constructed in the Gongyingzi New District and will be close to shops and households that are sensitive targets.

### **D. Surface Water**

74. Liaoning has more than 390 rivers, totaling 160,000 km. Most flow from the east, west, and north toward the southern central plains then into Bo Hai. Major rivers include the Liao River, Hui River, Daling River, Taizi River, Raoyang River, and Yalujiang River. There are many marshes, wetlands, tidal flats, and oxbow lakes in the southern plains where the rivers meet the sea. Forest coverage is 28.7%, with 4,185,000 ha.

75. The main rivers flowing through the urban area of Donggang City are the Dadonggou River and its tributary, the Erdaogou River. The Dadonggou River originates from the northern part of Donggang City and flows to the southeast through Demonstrate Farmland, Dongjianshan Town, and Shizijie Town. It then enters the Donggang City planned urban area at Pingan Bridge of National Highway 201, passing through the Xigou River Gate, confluent with Erdaogou at Chanshan Town and flows southward to the Yellow Sea. The section flowing through the Donggang urban area is 9.36 km long. The river water quality is Class V (GB3838-2002), which means that it is seriously polluted, due to municipal and industrial wastewater discharges.

The Erdaogou River originates from Chanshan Town and flows through the Donggang urban area for 5.8 km.

76. In Linghai City, the Daling River and Xiaoling River flow through the urban area. The Dalinghe River's average annual flow volume is 1.916 billion m<sup>3</sup> with a maximum flow of 13,300 m<sup>3</sup>/s and minimum flow of 4.11 m<sup>3</sup>/s. The Xiaoling River's maximum flow is 9,330 m<sup>3</sup>/s, and the minimum flow is 0.415 m<sup>3</sup>/s. On a functional scale of Class I (best quality) to Class V (worst quality), the water quality of the Linghai section of Daling River should be Class III based on the designated environmental function by Liaoning Environmental Protection Bureau (EPB). However, currently the levels of four pollutants including oil, COD<sub>Cr</sub>, hydroxybenzene, and permanganate exceed the limits of Class III standards. The rest of the parameters meet the standards.

77. Kazuo Mongolian Autonomous County's rivers belong to the Daling River system. The Daling River and its tributary, the Mangniu River, are the two major rivers flowing through the subproject area. The Daling River is the largest river in the western part of Liaoning. It originates from two major upstream branches, one from Jianchang County in Liaoning and the other from Pingquan County in Hebei Province. Downstream of Kazuo Mongolian Autonomous County, the Daling River passes through Chaoyang City, Beipiao City, Yi County, and Linghai City and then flows to Bo Hai. Its total length is 435 km, with a total catchment area of 23,837 km<sup>2</sup>. The average flow volume is 40.7 m<sup>3</sup>/s with a maximum flow speed of 5.5 m<sup>3</sup>/s. The volatile hydroxybenzene and fluoride exceed Class IV standards. The Mangniu River originates from Jianping County, flowing 12 km in Kazuo Mongolian Autonomous County and joining the Daling River at Shuiquan Township. Its water quality should be Class III based on the designated environmental function zoning. However, currently the pollution levels of oil, COD<sub>Cr</sub>, and total phosphorus exceed Class III standards. The main pollutant sources are wastewater from the mines in Jianping County at upstream and domestic wastewater from Gongyingzi Township at downstream.

## **E. Groundwater**

78. Donggang City's groundwater resource reserve amounts to 67 million m<sup>3</sup>. Affected by the tidal intrusion of the Yellow Sea, the groundwater is salty with water mineralization of greater than 1 gram per liter, which does not meet the drinking water standards.

79. Linghai City lacks groundwater resources, so its water is mainly supplied by rainfall. Currently, groundwater extraction is greater than replenishment. Water samples taken from the wells generally met Class III groundwater quality standards (GB14848-93).

80. Kazuo Mongolian Autonomous County has a groundwater reserve of 177 million m<sup>3</sup> of which 68 million m<sup>3</sup> is extractable. Over the years, overextraction has caused the groundwater level to drop, and some wells have become dry. Monitoring results show that the groundwater quality in the project area met the Class III standards.

## **F. Solid Waste**

81. Donggang City has a sanitary landfill with a treatment capacity of 300 t/d. However, it is located near a residential area and school, and people complain about its odor. The local government has selected another site to build a new one and is now conducting the feasibility study.

82. Linghai City has no municipal solid waste (MSW) treatment and disposal facility that meets regulations. Several open garbage pits are around town, which produce insects and pests, odor, landfill gas, and leachate, putting the environment and the health of nearby residents at risk.

83. In Kazuo Mongolian Autonomous County, there is no MSW treatment and disposal facility. However, on 26 May 2008, the local government held a bidding meeting on a Kazuo landfill project. After project completion, solid waste will be transported to the county landfill. MSW will be transported to the landfill directly. Industrial solid waste will be sorted, and valued materials such as metals, plastic materials, and papers will be recycled. Dangerous and medical solid waste will be sent to a qualified solid waste treatment plant.

## **G. Ecological Resources**

84. Donggang City has a total forest area of 52,989 ha accounting for 21.7% of its total area. The forest coverage rate is 30.1%, and the major tree species is oak. There are 114 kinds of water birds in Donggang City, accounting for 78% of the species recorded in Liaoning and 50% in the PRC. The project is located in the built urban area with no wild trees and animals.

85. Linghai City flora is part of the north PRC temperate zone flora system with combined conifer and broadleaf vegetation. In the northern part of Linghai City, the forest is mainly for water and soil conservation, and major tree species include pine, acacia, apricot, and seabuckthorn. In the northeastern and southwestern parts, the forest is economic forest and water and soil conservation forest. In the middle portion, the forest grows largely for protection of the plain farmland. In the southern part, the forest is the sea shelterbelt and stream bank protection forest along the Daling and Xiaoling Rivers. The project is located in the built urban area with no wild trees and animals.

86. The wild animals in Kazuo Mongolian Autonomous County include wolves, foxes, yellow weasels, rabbits, ocelots, yellow goats, and roe deer. There are about 40 species of birds including hawks, sparrows, owls, quail, and wide geese. There are about 30 fish species including silver carp, spotted silver carp, herring, grass carp, and crucians. Forest vegetation mainly consists of pine, cypress, poplar, willow, mulberry, Japanese pagoda, and Chinese linden trees. Economic forest species include apple, Chinese pear-leaved crabapple, Chinese flowering crabapple, pear, apricot, peach, plum, hawthorn, and Chinese date trees.

87. No rare or endangered species or protected areas have been recorded at the project sites in the three core subproject towns.

## **H. Economic Development**

88. Donggang City has rich mineral resources. There are 22 mine deposits and 171 mines, including for gold, copper, granite, marble, and limestone. Donggang City is a national rice production base, with 1.2 million mu<sup>6</sup> of farmland, of which 0.7 million mu are rice paddies. Donggang City is also famous for its fish, shrimp, crab, and shellfish production. Industries in Donggang City consist mainly of metal refining, machinery, electromechanical, chemical, construction material manufacturing, and agroproduct processing. In 2006, the total gross domestic production was CNY16.9 billion. Its industry total output value was CNY36.2 billion, agricultural production output was CNY2.8 billion, and total volume of retail sales was CNY3.5

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<sup>6</sup> Unit of land area equal to 1/15 ha or 667 m<sup>2</sup>.

billion. The annual per capita income of urban residents was CNY8,092, and the annual per capita income of farmers was CNY4,838.

89. Linghai City has rich reserves of mineral resources including iron, oil, coal, granite, sand, clay, limestone, pencil stone, and silica. Industries consist mainly of papermaking, metal refining, commerce, catering, and trade. In 2006, the gross domestic production was CNY9 billion, an increased of 17.6% over the previous year. The production value of primary, secondary, and tertiary industries was CNY2.25 billion, CNY3.6 billion, and CNY3.25 billion respectively. The annual per capita income of farmers was CNY4,342 with an annual increase rate of 16.9%.

90. Since a few years ago, Kazuo Mongolian Autonomous County has expedited economic growth and development of its Gongyingzi New District. Enterprise development has been positioned to include primarily metallurgical casting, automobile spare parts, and intensive processing of nonferrous metals, supplemented by processing of agricultural produce, and trade and logistics. Thirty-five enterprises have invested in the new district, with an industrial production of CNY1.8 billion in 2007, contributing to 43.2% of the gross industrial production and 35.3% of the total tax revenue of the whole county, as well as employing 9,877 people. The annual per capita income of farmers is CNY3,410.

## **I. Social and Cultural Resources**

91. Donggang City has 16 townships, five farm and three street committees, and two economic development zones, totaling 646,899 people in 2006. It has four junior high schools, two vocational senior middle schools, 31 middle schools, 155 primary schools, and eight other schools. The urban area of 15 km<sup>2</sup> has a population of 130,000. Most public transport vehicles are minibuses. Donggang City's total road length is 46.3 km, and the total length of main drainage pipelines and channels is 50 km. There is one WTP with a designed capacity of 100,000 m<sup>3</sup>/d and a current capacity of 50,000 m<sup>3</sup>/d. Donggang City has a combined storm water wastewater collection system, and most of the collected water flows by gravity within the urban area to the Dadonggou River. However, because of poor drainage, the roads become muddy when it rains. Its drainage network includes 122.4 km of drainage pipes with 58.0 km of trunk pipelines. The density of the drainage network is 4.03 km/km<sup>2</sup>. The whole county has 26 protected cultural heritages of which three are of provincial protection level, four are of municipal protection level, and 17 are of county protection level.

92. Linghai City has a total land area of 2,733 km<sup>2</sup>, including 17.53 km<sup>2</sup> in the main urban district. The population in the central urban area is 146,000. Linghai City has a road network of 892 km, including 80 km of national highways, 90 km of provincial highways, 155 km of county-level highways, and 566 km of township-level roads. There are three groundwater sources for the built-up area of Linghai City: Dalaihao, Linghe, and Liudian water sources, built in 1980, 1995, and 1976, respectively. The drainage system is a combined storm water and wastewater system. There are two major discharge channel outlets, the north outlet and the south outlet, which collect all the storm water and wastewater for discharge into the Daling River. During heavy rains, the river water level rises and the outlets cannot discharge naturally. The discharge then has to be diverted to nearby irrigation channels.

93. Kazuo Mongolian Autonomous County administers an area of 2,238 km<sup>2</sup> with a population of 423,000, of which 83,000 are Mongolian minorities, accounting for 19.5% of the total. Kazuo Mongolian Autonomous County has 10 towns, 11 townships, one farm and one street committee, and 190 villages. It has 25 hospitals with 871 beds and 196 schools including four junior high schools, one vocational senior middle school, 25 middle schools, 157 primary

schools, three kindergartens, and five other schools. Development of its Gongyingzi New District, an area of 6.65 km<sup>2</sup> with a population of about 24,000, has improved residents' living standards. There is a WTP on Zhongxing Street in Dazhibu Village, with a designed capacity of 4,080 m<sup>3</sup>/d (170 m<sup>3</sup> per hour), which satisfies water demand for Gongyingzi New District.

94. There are no recorded archaeological or cultural heritage sites or land and resources for traditional purposes used by indigenous peoples at the project sites in all three core subproject towns.

## **IV. ALTERNATIVES<sup>7</sup>**

### **A. With-Project and Without-Project Alternatives**

95. Donggang City and Linghai City are growing, and their road networks are lagging, hindering economic development. This Project will expand their road networks and improve road conditions and connectivity. With proper traffic management, this will ease traffic congestion, improve road and pedestrian safety, and promote better traffic flow. With new road networks and better connectivity, travel time will be shortened, thus saving fuel and reducing exhaust emissions. This will improve air quality and reduce GHG emissions, positively impacting climate change. Without this Project, these benefits will not materialize.

96. Drainage and wastewater components in Donggang City and Linghai City will improve the water quality of their water bodies. Both are coastal cities with aquaculture and capture fisheries as major industries. Without this Project, continual water quality deterioration due to the lack of drainage and wastewater collection and treatment systems will threaten the sustainability of fishery resources.

97. River improvement and area upgrading works in Donggang City will improve flood protection to the city. Wetland habitats by the river will be restored and enhanced as part of the area upgrading and landscaping, thus promoting conservation and biodiversity. Without this Project, residents will continue to live under threats of economic and property loss due to flooding. In addition, wildlife and biodiversity will not have the benefit of an enhanced wetland habitat.

98. The Project's water supply components in Linghai and Kazuo are crucial to their economic development by providing reliable water supply to residents and industries. Linghai City's aged water supply system can no longer meet its population's need. Kazuo Mongolian Autonomous County's lack of adequate and reliable water supply is a major constraint to attracting industries. Kazuo Mongolian Autonomous County, in particular, will benefit economically from these components by being able to attract industries to the Gongyingzi New District.

### **B. Specific Alternatives Discussion**

#### **1. Roads and Bridge**

99. Both Donggang City and Linghai City considered three types of pavement material: bituminous, cement concrete, and noise-reducing. For facilitation of the possible frequent

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<sup>7</sup> The analysis of noncore subprojects will be similar to the Chapter IV discussion of core subprojects. It will be carried through by implementing the EAMF.

changes to the road layout due to embedment of pipelines, e.g., at road junctions, where modifications will often be necessary, bituminous pavement offers a quicker and easier way to implement any local traffic management measures. Both cities recommended bituminous for adoption in the design.

100. There are two design proposals for the Renmin Bridge in Donggang City: a cable-stayed bridge and a suspension bridge. The construction cost of a cable-stayed bridge is less than that of a suspension bridge. The latter also involves higher construction complexity, so a cable-stayed bridge was recommended.

101. Two alignments for the Renmin Bridge were also considered. One runs perpendicularly across the river and the other slants across. The perpendicular alignment is shorter, thus having a shorter construction period and less impact to the river's water quality and was therefore selected.

## **2. Water Supply**

102. Linghai City compared the advantages and disadvantages of steel pipes, spheroid graphite cast iron pipes, and polyethylene pipes. Spheroid graphite cast iron pipes were selected for diameter DN300 and above, polyethylene pipes were selected for those less than DN300, and steel pipes were selected for sections having to cross obstacles.

103. Kazuo Mongolian Autonomous County considered different diameters and materials of water transmission pipes and water distribution pipes. These include steel pipes, ductile iron pipes, fiberglass reinforced pipes, polyethylene pipes, and prestressed reinforced concrete pipes. Ductile iron pipes were selected for pipes with diameters equal to or larger than 300 mm, and polyethylene pipes were selected for pipes with diameters less than 300 mm due to high rankings in corrosion and pressure resistance, ductility, ease of installation, and service life. The diameters of the water transmission pipes were determined from a static economic comparison, and DN700 pipes were selected.

104. Kazuo Mongolian Autonomous County also compared two alternatives for the water treatment process. Alternative 1 consisted of a pipe mixer, mechanical flocculation, horizontal flow settling tank, V-type filtration tank, and liquid chlorine disinfection. Alternative 2 consisted of a pipe mixer, grid flocculation, inclined tube settling tank, rapid filtration tank, and liquid chlorine disinfection. From the comparison, Alternative 2 was selected because of higher treatment efficiency and a smaller plan area, resulting in savings of infrastructure costs, better shock resistance, better suitability for a wider range of water quality, and more convenient and simpler start-up.

## **3. Drainage and Wastewater**

105. Donggang City considered alternative materials of reinforced concrete pipes and double-walled corrugated polyvinyl chloride (PVC) pipes for the wastewater pipes. PVC pipes were recommended. Alternatives and least-cost for the underground drainage works were also considered. A reinforced concrete box culvert was compared with reinforced concrete pipes. From the comparison, a reinforced concrete box culvert was recommended.

106. Linghai City compared reinforced concrete pipes, plastic pipes, and double-walled corrugated PVC pipes. Reinforced concrete pipes were selected for diameters less than 1.5 m. For those larger than 1.5 m, a reinforced concrete box culvert was selected.

#### 4. River Improvement

107. Donggang City considered two types of slope protection for its river improvement works. Type 1 consisted of laying dry stone masonry inside a reinforced concrete frame of 5 m by 5 m by 300 mm thick. Type 2 consisted of dry laid stone masonry with block stones that are 300 mm thick with dimensions of 240 mm by 300 mm by 480 mm. In terms of investment, the difference was very small. However, the first type involved more complicated construction, and the construction quality was not easy to control due to local conditions. Moreover, the construction period is longer. Therefore, the second type was selected.

### V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES<sup>8</sup>

108. This chapter discusses the core subprojects' anticipated impacts and mitigation measures. The predicted impacts and mitigation measures will be similar to those of the noncore subprojects, and this chapter provides guidance on the model for formulating mitigation measures for noncore subprojects.

#### A. Positive Impacts and Environmental Benefits

109. The Project has many positive impacts and environmental benefits. It provides a sound basis in infrastructure and social service systems for sustainable economic development. To other small cities and towns in Liaoning, the Project can demonstrate how to achieve sustainable economic growth in the process of urbanization. The Project will contribute to poverty reduction through improving the local economy, protecting the environment by reducing pollution and risks to health, and supporting the PRC's national and regional infrastructure development strategies. It will also provide employment opportunities during construction and operation of project facilities, with anticipated flow on effects to economic development.

110. The Project can promote the development of small cities and towns and accelerate the transfer of surplus rural labor, and is an important means to improve agricultural labor productivity and overall economic benefits. It can drive the rapid development of rural tertiary industries, especially service industries, and create more job opportunities for farmers. It can also drive rural capital construction and the development of the real estate industry; expand investment demand; attract nongovernment investment; promote the commercialization of farmers' consumption; and expand the demand for housing, farm produce, and durable consumer goods and services. It will balance economic development between urban and rural areas and will improve farmers' living standards.

111. The Project is in line with the PRC's national poverty reduction strategy for development of the northeastern region, which seeks to decrease the regional gap and supports the Government's development vision of a "harmonious society" as articulated in the 11th Five-Year Plan aimed at maintaining high rates of growth, but channeling it toward poverty reduction and reducing disparities. The Project supports the PRC's *Country Partnership Strategy (2008–2010)* priority areas of (i) promoting regional cooperation and integration, (ii) managing the environment, and (iii) improving inclusive social development.

112. The Donggang subproject, covering road construction and improvement, the wastewater system under the roads, and flood control with river greening, will directly and immediately

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<sup>8</sup> The analysis of noncore subprojects will be similar to the Chapter V discussion of core subprojects. It will be carried through by implementing the EAMF.

benefit more than 16,000 persons—all rural and 4.38% poor. Currently, there is no wastewater collection system, and this results in some pollution in the water and land environment. Better road network and conditions provided by this Project will improve connectivity and traffic flow. Wetland restoration and enhancement as part of the river improvement and area upgrading will promote conservation and biodiversity, benefiting wildlife and providing aesthetics to the residents.

113. The Linghai subproject, covering road construction and improvement and the water supply and wastewater pipe system under the roads, will directly and immediately benefit more than 68,000 persons—7.7% rural and 5.0% poor. The subproject will increase the coverage rate of sanitary water supply and wastewater collection from the current 50% to 100%.

114. The Kazuo subproject, covering water supply, will guarantee sanitary water supply to 3,436 rural households with 12,502 persons living in six villages of Gongyingzi Town; 3,451 urban households with 8,471 persons; and several businesses with a floating employee population of 4,500, with 9% categorized as poor. Having a reliable water supply will also help to attract new investments and industries to the new district, thus promoting new employment and better socioeconomic conditions.

## **B. Impacts Associated with the Project Location, Planning, and Design**

115. Based on the resettlement impacts identified (physical and economic displacement), the construction of the three core subprojects will affect 297 households or 1,103 persons due to permanent land acquisition; relocate 91 households or 336 persons due to the demolition of residential structures; and affect 8 enterprises and 61 shops with 225 employees. In total, 27.1 ha of land will be acquired permanently, including 17.8 ha of cultivated land. Along with land acquisition, 7,645 m<sup>2</sup> of residential houses and 3,529 m<sup>2</sup> of nonresidential houses will be demolished, causing the relocation of 91 households and 336 persons and affecting 8 enterprises and 61 shops. In addition, associated productive assets, ground attachments, and basic infrastructure and facilities will also be affected.

116. The Donggang subproject will permanently acquire 25.7 ha of land area. About 63% is farmland, affecting 194 households or 715 persons from seven villages in three towns. Along with land acquisition, a total of 11,174 m<sup>2</sup> of structures will be demolished, including 7,645 m<sup>2</sup> of residential structures, affecting 91 households and 336 persons, and 3,529 m<sup>2</sup> of nonresidential structures, affecting 8 enterprises and 61 shops with 225 employees. While the enterprises will only be partially affected and do not need relocation, the shops will.

117. The Linghai subproject will be constructed either on the existing right of way or on land area acquired in 2007. The total land area temporarily required for construction is 50.6 ha, including 37.6 ha of farmland. A total of 291 households and 901 persons from three villages will be affected. Along with land acquisition, a total of 1,607 m<sup>2</sup> of houses will be demolished with relocation of 12 households and 42 persons.

118. The Kazuo subproject will involve permanent land acquisition of 1.4 ha of farmland from three villages, which will affect 12 households and 52 persons. During pipeline construction, a total of 7.6 ha of land area will be temporarily occupied, including 1.2 ha of farmland. The remaining land areas are mainly urban road spaces. For both permanent and temporary land acquisition, no house demolition and relocation is required, and no temporary land occupation is required.

119. The technical design of the roads, including carriageway, pedestrian, and bicycle lanes; road lighting; bus stations; and landscaping, must be adequate to ensure road safety, encourage nonmotorized traffic and related environmental benefits; and visually harmonize with the surrounding environment.

120. The technical design of the WTP must be able to provide quality and reliable water supply to users and meet the safety requirements of plant operation.

121. The design and construction plan of the water supply and wastewater pipelines must be adequate to ensure that the supply or connections to existing users will not be adversely affected. They should also be properly designed to prevent pipe bursts.

122. The dike embankment on the Dadonggou River in Donggang City must be designed to withstand 1 in 50 year storm events.

123. Sensible construction planning is important to minimize environmental and traffic impacts and busy and noisy activities at night, during school examination periods, and in morning and afternoon peak traffic hours. Temporary traffic management will be needed during the construction stage to ensure proper traffic flow.

## **C. Impacts and Mitigation Measures during the Construction Phase**

### **1. Land and Habitat Loss**

124. The Project will result in the permanent loss of approximately 27.1 ha of land, including 17.8 ha of cultivated land. The temporarily occupied land will mainly be used to stage construction works and equipment, such as a sandstone plant, asphalt mixture plant, soil borrow area, production and living areas for construction workers, and temporary roads during construction.

125. There is no record of heritage or archaeological sites nor any threatened or endangered species on the project sites.

### **2. Roads, Bridge, and Related Municipal Services**

126. The Project involves road and bridge construction in Donggang City and Linghai City. Project interventions will also involve the provision of road lighting, traffic signs, landscaping, and drainage pipes.

127. Key environmental impacts during road construction are on air quality due mainly to dust on construction sites and emissions from asphalt or cement plants. Construction noise is another key environmental impact during road construction and upgrading.

128. In Donggang City, major air- and noise-sensitive areas are located 10–44 m from the curb on Qingnianbei Road (schools, residential buildings, a temple, and a home for the elderly), Xincheng Road (residential buildings), Goubei Road (residential buildings), and Yingbinxida Street (residential buildings). The residential buildings on Qingnianbei Road and Xincheng Road do not have windows facing the streets and therefore are unlikely to be impacted.

129. In Linghai City, air- and noise-sensitive areas include seven schools (one kindergarten, three primary schools, and three secondary schools), three hospitals, and eight residential

areas that are located 5–50 m from the curb of Qingnianda Street, Shangye Road, Baokang Street, Jiankang Road, Xincun Street, and Jimou Street. All are major trunk roads except Jiankang Road and Baokang Street. Those that are 5 m from the curb and therefore the most affected include seven residential buildings at Fuhuayuan on Jimou Street, and the following on Qingnianda Street: three residential buildings at Yuandingyu New Estate and four residential buildings at Furongyuan Estate, Shifuhuayuan Estate, and Linghai City's No. 3 Primary School.

130. Road construction is a linear activity, i.e., when a section of the road is finished, construction activities move away. Therefore, air quality and noise impacts to a specific location from these construction activities will be short-term and temporary, lasting from several weeks to a few months.

131. Dust, noise, construction runoff, and wastewater, including the muddy wastewater from piling works during bridge construction, may cause water pollution and have adverse impacts on river hydraulics. Mitigation measures, as well as other good site practices described as follows, will be adopted to avoid any potential adverse impacts. An emergency plan will be developed on a response to accidental spillage of chemicals on the construction site.

132. Road works usually generate large quantities of excavated soil and require large quantities of fill. A plan to temporarily store, reuse, and dispose of the excavated spoil will need to be developed in the detailed design stage and implemented during the construction stage by the contractor. The primary objective is to reuse much of the excavated spoil on site as backfill material. The source of extra fill will also need to be identified. In Donggang City, approximately 265,080 m<sup>2</sup> of spoil will be excavated, and 98,980 m<sup>2</sup> will be reused as backfill, while the remaining 166,100 m<sup>3</sup> will be taken to an existing excavated soil storage facility for use in the land formation of the Lingang Industrial Park.

133. Good practices (paras. 134–140) will be adopted during construction to mitigate dust, noise, solid waste, wastewater, sanitation, and construction traffic impacts. Water and soil conservation measures will be developed and implemented.

134. Dust will be lessened by paving frequently used haul roads, frequently watering unpaved areas and haul roads, minimizing onsite storage time of construction and demolition wastes, covering stockpiles, using tarpaulin to cover trucks carrying dusty materials, controlling vehicle speeds on construction sites, and timely restoring disturbed land to minimize adverse impacts on humans and crops. To reduce impacts from the asphalt plant, the plant will be equipped with a dust removal mechanism and an enclosed mixing chamber, and be located at least 500 m downwind from sensitive receivers.

135. Noise will be mitigated by using quiet equipment; observing good O&M of machinery; using temporary hoardings or noise barriers to shield noise sources; and stopping construction between 2400 and 0800 hours near residential areas, hotels, and hospitals. If there are schools or places of worship near construction activities, the contractors will maintain continual communication with them to avoid noisy activities during examination and worship periods.

136. To minimize adverse impacts from the refuse generated by the workers, it will be stored in closed containers and regularly transported off site for disposal at landfills. Construction and demolition wastes will be cleared and removed regularly.

137. The excavated spoil needs to be safely disposed of or temporarily stored for backfilling. Facilities to be used for storage and/or disposal of excavated spoil and acquisition of backfill

materials will be identified in the detailed design stage. The selection criteria will include environmental considerations including favorable geological conditions, land use, habitats and vegetation on-site, impacts on affected people, and distance to the project areas.

138. Uncontrolled wastewater and muddy runoff from construction sites could potentially pollute nearby water bodies and clog up drains. Portable toilets and small package WWTPs will be provided for the workers and canteens. If there are nearby public sewers, interim storage tanks and pipelines will be installed to convey wastewater to those sewers. Sedimentation tanks will be installed onsite to treat wastewater and muddy runoff with high concentrations of suspended solids. If necessary, flocculants will be used to facilitate sedimentation.

139. Sanitation is a key public health issue during construction. The majority of the workforce will be from outside the immediate neighborhood and may be living in temporary quarters. To avoid health hazards, efficient sanitation will be maintained and monitored, and adequate health services will be provided.

140. The increase in construction traffic might cause traffic congestion and inconvenience to other vehicles, pedestrians, and shop owners. Temporary traffic management will be needed. Mitigation measures will include diverting construction traffic from morning and afternoon peak traffic hours, regulating traffic at the road crossings, building interim roads, selecting transport routes to reduce disturbance to regular traffic, and reinstating the roads as soon as possible.

### **3. Drainage and Wastewater**

141. The Project involves construction of storm water and wastewater pipelines, storm water and wastewater pumping stations, and box culverts in Donggang City and Linghai City. In Donggang, one storm water pumping station is 20 m from a residential area and another is 59 m from a school.

142. A major part of the Project is to connect the collection system to households. As such, it is unavoidable that pipeline installation works will, at times, be conducted near or at these locations that are sensitive to air and noise pollution. However, pipeline construction is a linear activity. Therefore, air quality and noise impacts to a specific location will be short-term and temporary, lasting from several weeks to a few months. Dust and noise mitigation measures as well as other good site practices described previously will be adopted to minimize environmental impacts.

### **4. Water Supply**

143. The Project involves constructing water supply pipelines, a water pumping station, and water storage tank in Linghai City; and water transmission and distribution pipelines, an intermediate water pumping station, and a WTP in Kazuo Mongolian Autonomous County. A major part of the works is to connect the supply system to households. As such, it is unavoidable that pipeline installation works will, at times, be conducted near or at these locations that are sensitive to air and noise pollution. However, pipeline construction is a linear activity, and dust and noise impacts to a specific location will be short-term and temporary, lasting from several weeks to a few months. Dust and noise mitigation measures as well as other good site practices described previously will be adopted to minimize environmental impact.

## 5. River Improvement and Area Upgrading

144. Improvement of the Dadonggou River in Donggang City and area upgrading works include dredging of the riverbed and embankment construction. Major environmental impacts are noise from dredging and other mechanical equipment, odor from the dredged spoil, and downstream water quality impact (mainly suspended solids) during dredging. Dust and noise mitigation measures as well as other good site practices described previously will be adopted to minimize environmental impact. Closed grabs should be used for dredging to minimize overflow and loss of fines to the water column. Dredged spoil will be taken to designated disposal sites and its on-site temporary storage time kept to a minimum.

### D. Resettlement

145. This Project will affect 297 households or 1,103 persons due to permanent land acquisition; relocate 91 households or 336 persons due to the demolition of residential structures; and affect 8 enterprises and 61 shops with 225 employees. Along with land acquisition, 7,645 m<sup>2</sup> of residential houses and 3,529 m<sup>2</sup> of nonresidential houses will be demolished, causing relocation of 91 households and 336 persons and affecting 8 enterprises and 61 shops.

146. Resettlement plans have been prepared for the three subproject towns and cities. The plans describe the resettlement of affected households and people as well as compensation. They fully meet the PRC and ADB policies and requirements on resettlement.

### E. Impacts and Mitigation Measures during the Operational Phase

#### 1. Roads, Bridge, and Related Municipal Services

147. Operational impacts from road traffic include vehicle emissions and traffic noise. Based on roadside monitoring in Donggang City, existing NO<sub>2</sub> and CO levels comply with Class II air quality standards and existing noise complies with Class II urban noise standards. Based on the traffic forecast for the three major trunk roads in Donggang City, traffic volume on Qingnianbei Road, Goubai Road, and Yingbinxida Street in 2018 will actually be less than the no-project scenario due to the increase in the number of roads and the better network. Vehicle emissions and traffic noise from vehicles travelling on these three roads will experience a decreasing trend prior to 2018. Based on the traffic forecast compared to the no-project scenario, in 2026, NO<sub>2</sub> emissions will be increased by 0.02–0.12 milligrams per cubic meter (mg/m<sup>3</sup>) (1.2–9.6%), CO by 0.23–1.11 mg/m<sup>3</sup> (1.5–9.7%), and total hydrocarbon by 0.06–0.35 mg/m<sup>3</sup> (1.3%–9.8%), with the highest percentages occurring on Qingnianbei Road and the lowest percentages occurring on Yingbinxida Street. These increases will still meet the standards.

148. Linghai City shows similar situations. Of the 12 roads provided under this Project (excluding Linghe Road, which is a new road), seven roads show either the same or reduced emissions in CO and eight roads show either the same or reduced emissions in nitrogen oxide and total hydrocarbon in 2018 compared to the no-project scenario. In 2026, Linghai East Ring Road and Tiebei Road will show reductions in CO, nitrogen oxide, and total hydrocarbon emissions compared to the no-project scenario. Other roads show increases ranging from 1.5% to 15%, with absolute value increases ranging from 0.01 mg/m<sup>3</sup> to 0.32 mg/m<sup>3</sup>. These increases will still meet the standards.

149. Despite the intermediate decreasing trend in vehicle emissions due to improved road network and conditions, the ultimate scenario shows an increase in emissions due to increased traffic flow. Increased fuel efficiency and emission control on the engines of future motor vehicles and the potential use of alternative fuels could decrease emissions from future motor vehicles—but this is beyond the scope of this Project. Improved road network, better connectivity, and better road conditions provided by this Project do offer shorter travel time per vehicle trip, thus reducing fuel consumption and GHG emissions, positively impacting climate change.

150. Existing traffic noise at schools, the temple, and the home for the elderly on Qingnianbei Road in Donggang City already exceeded daytime Class II standards. Existing nighttime traffic noise at all the sensitive areas facing Qingnianbei Road, Goubei Road, and Yingbinxida Street except two residential areas exceeded the nighttime Class II (for schools and hospitals) and Class IV (for residential areas) noise standards. The situation will be similar in 2018, but with all sensitive areas exceeding the nighttime noise standards. In 2026, daytime traffic noise at all the noise-sensitive areas on Qingnianbei Road and Yingbinxida Street will exceed the Class II (for schools and hospitals) and Class IV (for residential areas) noise standards; and nighttime traffic noise at all noise-sensitive areas on these two roads plus Goubei Road will exceed Classes II and IV standards.

151. Existing traffic noise at the sensitive areas all met Class II (for schools and hospitals) and Class IV (for residential areas) standards in Linghai City based on noise monitoring conducted under this Project. In 2018 and 2026, predictions show that traffic noise at the Linghai City's No. 3 Kindergarten on Jiankang Road, Linghai City's No. 1 Primary School on Qingnianda Street, and the Linghai City's Chinese Medicine Hospital on Xincun Street will exceed both daytime and nighttime Class II standards. Traffic noise at the sensitive residential areas will meet the Class IV daytime noise standard in both 2016 and 2028 but will exceed the Class IV nighttime noise standard in both 2016 and 2028.

152. To mitigate traffic noise impact, the provision of double-glazed windows or air-conditioning to the noise sensitive targets has been proposed in the EIAs for Donggang City and Linghai City.

## **2. Drainage and Wastewater**

153. Wastewater and storm water pipes may leak and burst, leading to localized flooding. This will have environmental, health, and economic impacts. Adequate design of the pipes, choice of proper piping materials, proper supervision during construction, and proper O&M are essential to preventing these potential impacts.

154. Operation of the pumping stations will have noise impact on nearby residents. In Donggang City, two pumping stations have a residential area and a school 20–59 m away. Predictions showed that the operational noise from these two pumping stations would range from 50.1 to 51.9 dB[A] during the day and 43.0 dB[A] at night. No impact on the nearby sensitive areas is expected. Despite this finding, the pumping stations will be designed with adequate acoustic mitigation measures such as soundproof doors, double-glazed windows, and adequate wall thickness to contain the pump noise. Its look will also be designed to fit in with the nearby environment and buildings, with proper landscaping around to provide aesthetics to nearby residents.

### 3. Water Supply

155. Water pipes may leak and burst, leading to localized flooding. This will have environmental and economic impacts. Adequate design of the pipes, choice of proper piping materials, proper supervision during construction, and proper O&M are essential to preventing these potential impacts.

156. The intermediate pumping station and the WTP have no nearby sensitive targets that could be impacted by the operational noise from these facilities.

157. Operation of the WTP will generate air emissions from its boiler, as well as wastewater and solid waste from the work force. It was estimated that the boiler will emit 0.05 t/d of sulfur dioxide and will produce 0.98 t/d of bottom ash. Approximately 4.950 t/d of wastewater, 0.045 t/d of solid waste, and 0.370 t/d of sludge will be produced. Wastewater will be pretreated through a septic tank prior to discharging into the public sewer. Sludge, after filtering and dewatering, and solid waste will be transported to sanitary facilities for disposal. These quantities comply with discharge standards, are relatively small, and should not have adverse impacts on the environment.

158. The WTP will use chlorine gas for disinfection. Chlorine is a toxic gas that is heavier than air. As suggested in the FSR, the size of the chlorine tank will be 500 kg and no more than 20 days' supply should be stored onsite. As recommended in the EIA, the chlorine storage room will be equipped with safety and alarm systems.

159. The water supply component in Kazuo Mongolian Autonomous County will take water from the dammed up river basin at Shuiquanguan District in Nanliangzi Village. The water comes from the mid- to upstream sections of the Daling River..

160. A report was prepared in 2007 and updated in 2008 for this PPTA to verify the feasibility of using this water source for supplying water to Gongyingzi New District (Liaoning Hydrological and Water Resource Survey Bureau. 2007 and 2008). The Project will extract 2.7% of the Daling River's flow (0.3 m<sup>3</sup>/s from a historical average flow of 11 m<sup>3</sup>/s). This, plus the fact that there are at least three large tributaries (the Second Mangniu River, Shengli River, and Laohushan River) approximately 11 km downstream flowing into the Daling River, will not deplete the water supply to downstream users. Monitoring results show that water quality at the intake location meets Class III surface water quality standards (GB3838-2002) except total petroleum hydrocarbon and total nitrogen, and also met drinking water quality standards (CB5749-2006) except permanganate, ammonia nitrogen, total petroleum hydrocarbon, and *E. coli*. With proper treatment and continual environmental control and protection of the water source, the report confirmed that water from the Shuiquanguan District can be extracted for integrated potable and industrial uses.

161. To protect the water source, the EIA requires the implementation of the following measures during project implementation:

- (i) establish a Class I protection zone within 5.5 km upstream of the dam;
- (ii) establish a Class II protection zone from 5.5 km to 21.5 km upstream of the dam;
- (iii) set up a water source protection plan for these zones to forbid polluting activities, including farming and ranching and discharge of domestic and industrial wastewater, and to promote tree planting and soil conservation;

- (iv) implement total quantity control on pollutants discharging into upstream water bodies and set up and implement plans to treat urban wastewater with treated effluent meeting the water bodies' functional requirements to protect Class III water quality; and
- (v) strengthen the monitoring and control of intake water quality by using online monitoring equipment.

#### **4. River Improvement and Area Upgrading**

162. Upon improving the Dadonggou River in Donggang City, the river flow will be enhanced. This will also improve the flood water-carrying capacity of the river, thus protecting nearby residents from property and economic losses due to flooding and promoting river trade. The enhanced wetland will promote conservation and wildlife biodiversity. The key is to prevent the discharge of untreated wastewater and the dumping of garbage into the river that will cause water quality deterioration.

#### **F. Climate Change Implications**

163. As a developing country of responsibility, the PRC attaches great importance to the issue of climate change. The National Coordination Committee on Climate Change was established, and a series of policies and measures to address climate change has been taken in the overall context of national sustainable development strategy, making positive contributions to the mitigation of and adaptation to climate change.

164. Most global warming observed over the past 50 years was likely induced by the increase in concentrations of GHG, such as carbon dioxide, methane, and nitrous oxide, due to human activities. In the context of global warming, the PRC's climate has experienced noticeable changes over the past 100 years. Major observed evidence of climate change in the PRC includes the following (National Development and Reform Commission of the PRC 2007).

- (i) Annual average air temperature has increased by 0.5–0.8 °C during the past 100 years, which was slightly above the average global temperature rise. Most of this temperature rise was observed over the last 50 years.
- (ii) In the past 100 years, there was no obvious trend of change in the PRC's annual precipitation, but there exists considerable variation among five regions, with the decrease in northern PRC and the increase in southern and southwestern PRC being most severe.
- (iii) Extreme climate and weather events throughout the PRC have become more frequent and intense during the last 50 years. Droughts in northern and northeastern PRC, as well as floods in the middle and lower reaches of the Yangtze River and southeastern PRC, have become more severe.
- (iv) The rise in sea level along the PRC's coasts during the past 50 years was 2.5 mm per year, slightly higher than the global average.
- (v) The mountain glaciers in the PRC have retreated, and the trend is accelerating.

165. The trend of climate warming in the PRC will further intensify in the future. Projections by Chinese scientists indicate the following.

- (i) The nationwide annual mean air temperature will increase by 1.3–2.1°C in 2020 and 2.3–3.3°C in 2050 as compared to that in 2000. The warming magnitude will

- increase from south to north in PRC, particularly in northwestern and northeastern portions where a significant temperature rise is projected.
- (ii) Precipitation in the PRC will increase during the next 50 years, with a projected nationwide increase of 2–3% by 2020 and 5–7% by 2050. The most significant increase may be experienced in southeastern coastal regions.
  - (iii) The possibility of more frequent extreme weather/climate events will increase in the PRC, which will have immense impacts on socioeconomic development.
  - (iv) The PRC's arid areas will become larger, and the risk of desertification may increase.
  - (v) The sea level along the PRC's coasts will continue to rise.
  - (vi) The glaciers in the Qinghai-Tibetan Plateau and the Tianshan Mountains will retreat at an accelerated rate, and some smaller glaciers will disappear.

166. According to tentative estimates, the PRC's total GHG emissions in 2004 was about 6,100 t of carbon dioxide equivalent (tCO<sub>2</sub>e) (5,600 million t of net emissions), consisting of 5,050 million t of carbon dioxide; 720 million tCO<sub>2</sub>e of methane; and 330 million tCO<sub>2</sub>e of nitrous oxide. From 1994 to 2004, the annual average growth rate of GHG emissions was around 4%, and the share of carbon dioxide in these total emissions increased from 76% to 83%.

167. Historically, the PRC's GHG emissions were very low, and its per capita emissions below the world average. Statistics from the International Energy Agency indicates that the country's per capita carbon dioxide emissions from fossil fuel combustion were 3.65 t in 2004, equivalent to 87% of the world average and 33% of the level in Organization for Economic Co-Operation and Development countries. Along with steady social and economic development, the emission intensity, defined as carbon dioxide emission per unit of gross domestic product, declined. According to the International Energy Agency, the PRC's emission intensity fell to 2.76 kg of carbon dioxide per dollar (constant 2000 dollars) in 2004, as compared to 5.47 kg of carbon dioxide per dollar in 1990, a 49.5% decrease. For the same period, emission intensity of the world average dropped only 12.6% and that of the Organization for Economic Co-Operation and Development countries dropped 16.1%.

168. There has been increasing awareness of the adverse effects of the PRC's unprecedented industrialization—which contributes to the country's ranking as the world's second biggest emitter of GHGs responsible for climate change—on temperature increase, extreme weather events, biodiversity, livelihoods, and economic development. The Ministry of Environmental Protection announced in January 2008 revised criteria for “ecologically sound” provinces, cities, and counties that balance environmental protection objectives with economic growth goals. This illustrates an ongoing government trend in policy to emphasize environmental sustainability in urban and economic development, including use of sustainable development indicators to assess local governments and officials. The Chinese Public's Environment and Inhabitant Livelihood Index 2007, released by the PRC Environmental Culture Promotion Association in January 2008, shows that Chinese people are dissatisfied with the level of air pollution, with 26% saying they are very concerned about air quality.

169. As a developing country of responsibility, the PRC was among the first to formulate *PRC's Agenda 21 - White Paper on PRC's Population, Environment and Development in the 21st Century*, soon after the United Nations Conference on Environment and Development in 1992. It adopted the following policies and measures while also taking into account specific national circumstances:

- (i) restructuring the economy, promoting technology advancement, and improving energy efficiency;
- (ii) optimizing the energy mix by developing low-carbon and renewable energies;
- (iii) launching a nationwide tree-planting and afforestation campaign and enhancing ecology restoration and protection;
- (iv) effectively controlling the growth rate of population through family planning;
- (v) strengthening laws, regulations, policies, and measures relevant to addressing climate change;
- (vi) further improving institutions and mechanisms;
- (vii) attaching great importance to climate change research and capacity building; and
- (viii) strengthening education, training, and public awareness on climate change.

170. **Project Climate Change Adaptation Issues.** Based on such trends and projections, climate change will affect the subproject towns over 20 to 50 years. The rise in sea level will impact coastal cities like Donggang and Linghai; land areas will be diminished and drainage capacities will be reduced. Therefore, the planning of new development areas and drainage systems should take climate change impacts into consideration. Although precipitation has been projected to increase nationwide, the historical trend in northern PRC, as well as more frequent droughts, shows severe decrease. As such, flooding events could decrease but water shortages in places such as Linghai and Kazuo, would become more severe, so long-term sustainable planning for water resources is important.

171. This Project supports the PRC's climate change initiatives in reducing GHG emissions. The provision of roads with better travel conditions and connectivity will reduce the travel time per vehicle trip and therefore fuel consumption. This will contribute to reducing GHG emissions, positively effecting climate change.

172. This Project will address both climate change adaptation and mitigation issues. Through policy dialogue, future urban planning will incorporate climate change adaptations. The Project will support the following specific climate change mitigation measures: (i) introduction of climate change issues in urban master plans, favoring the development of energy-efficient technologies; (ii) new technologies, i.e., online real-time energy information systems to determine the best means of reducing and managing utility costs; (iii) water management, introducing longer planning horizons and long-term water availability forecasting, developing comprehensive water balances, and finding solutions and securing agreements on necessary follow-ups; (iv) wastewater management by promoting sludge digestion, biogas extraction, and beneficiary use; (v) solid waste management by securing high rates of solid waste collection and promoting biogas extraction and beneficiary use in landfills management; (vi) urban roads management through better connectivity reducing fuel consumption and promoting cleaner fuel and better car fleets (proper inspections and better enforcement regime); and (vii) heating by promoting energy efficiency and clean energy (also for water and wastewater utilities and landfills).

## VI. ECONOMIC ASSESSMENT

173. The total project cost (including core and noncore subprojects) is estimated at \$229.7 million equivalent. ADB will finance \$100 million or 43%, and the local governments will finance \$129.7 million or 57%.

174. The Project will generate several economic benefits. The road components in Donggang City and Linghai City will support the Government's poverty reduction policies through provision of sustainable road infrastructure and increased economic activities and employment, and will (i)

protect the environment by controlling and reducing pollution; (ii) improve health and living conditions; and (iii) promote growth and investments. They will fulfill functional requirements of individual areas. Apart from improving accessibility within the areas, they provide an opportunity for the extension of road infrastructure to existing and proposed premises. The new and upgraded roads are expected to improve traffic conditions and public transport. Road safety and traffic management are also areas of concern. Capacity building in urban planning and traffic engineering will improve traffic management capability.

175. River improvement and area upgrading of the Dadonggou River in Donggang City will improve the flood-carrying capacity of the river, thus protecting the city from floods. The reinforcement and improvement of the dike will safeguard daily protection and domestic activities of the urban residents, while landscaping along the river will help provide a pleasant living environment for urban residents.

176. Provision of drainage and wastewater collection systems in Donggang City and Linghai City will protect the environment by controlling and reducing pollution, thus improving health and living conditions that will promote growth and investments.

177. Provision of water supply for domestic use and production activities of Gongyingzi New District in Kazuo will (i) promote economic development through the expansion of industries, growth in employment, and increased incomes; (ii) improve living and health conditions; and (iii) protect water resources from further pollution resulting from more wells being drilled. The Project will also improve water quality and provide safe water for domestic use in the urban area.

178. The estimated economic internal rates of return (EIRR) of the selected core subprojects are shown in Table 1. The individual EIRRs are higher than the economic opportunity cost of capital, assumed at 12%.

**Table 1: Estimated Internal Rate of Return of Selected Core Subproject Components**

No	Component by City and Area	EIRR (%)
1	Donggang	17.9
2	Linghai	19.9

EIRR = economic internal rate of return.

Source: Project preparatory technical assistance draft final report. 2008.

179. The costs and benefits of the environmental impacts and mitigation measures are reflected in the economic analysis. The EMP costs listed in Appendix 2 are part of the total project costs. Similarly, EMP costs for noncore subprojects are considered part of the total project costs.

## VII. ENVIRONMENTAL MANAGEMENT PLAN<sup>9</sup>

### A. Environmental Management

180. The EMP describes the procedures and plans for the mitigation measures and monitoring requirements during the present and subsequent stages of the Project. It consists of

<sup>9</sup> Environmental management for noncore subprojects will be similar to the Chapter VII discussion of core subprojects. It will be carried through by implementing the EAMF.

a plan for implementing mitigation measures and a plan for environmental monitoring. The EMP (Appendix 2) is prepared for the core subprojects, and EMPs for noncore subprojects will be prepared through the implementation of EAMF.

181. Implementing the environmental mitigation measures will cost about \$0.756 million equivalent, and environmental monitoring during the construction and operation stages will cost about \$0.060 million equivalent. Public consultation will cost about \$0.013 million equivalent. Meanwhile, \$0.200 million has been proposed for training in capacity building to improve the environmental management capabilities of the PMO, EAs, IAs, and the contractors. The total cost of EMP implementation for the core subprojects is about \$1.027 million equivalent, which is about 0.4% of the project cost. This includes costs embedded in design and construction costs for the contractor. This does not include long-term operational phase environmental monitoring after the first year of operation, which will be conducted by the IAs and O&M organization's own environmental personnel.

182. The plan for implementing mitigation measures is organized by potential environmental impacts during the construction and operation phases. For each impact, appropriate mitigation measures are described. For each mitigation measure, a responsible implementing party is listed. The agency or agencies for supervising each mitigation measure are also listed.

## **B. Environmental Monitoring**

183. The plan for environmental monitoring is organized by core subprojects. Monitoring requirements are clearly spelled out, including the parameters to be monitored, the number and locations of monitoring stations, monitoring frequency, and monitoring duration. For each parameter, a responsible party for carrying out monitoring is listed so that accountability is clear. The supervising agency or agencies for each parameter are also listed.

## **C. Institutional Enhancement**

184. At present, the IAs lack capacity in environmental management and monitoring. To properly implement the EMP, it is necessary to build up and strengthen the capacity of the supervising agencies, PMOs, and IAs. The EMP describes the respective institutional strengthening and training requirements. An environmental management office will be established for each PMO and IA, and two environmental specialists will be placed in each office. The institutional organization and the responsibilities for each environmental position for the Liaoning PMO, local PMOs, and IAs will be finalized before the construction phase starts. Ten training courses will cover EMP implementation and adjustment, dispute resolution, environmental processes, environmental monitoring, environmental policies and plans, wastewater management, solid waste management, and traffic and safety management. The procurement of related environmental monitoring equipment by the city PMOs, IAs, and the contractors will be completed before the construction phase starts.

## VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE<sup>10</sup>

### A. Public Participation during Project Preparation

185. Two rounds of public consultation were conducted during the EIA and summary EIA process. Separate public meetings were conducted in Donggang City, Kazuo Mongolian Autonomous County, and Linghai City. The respondents and attendees included government employees, local residents, and representatives. The first round provided an opportunity for stakeholders to understand the Project and various components, their benefits, and potential environmental impacts. Stakeholders also had the opportunity to voice their views, concerns, and suggestions. The second round allowed the project teams to present the initial findings and environmental mitigation measures and to respond to the views, concerns, and suggestions raised in the first round.

186. In Donggang City, two rounds of public consultation were conducted in mid April and late May 2008 in public forums. Forty people attended the first round. The Project was overwhelmingly supported, with main concerns related to impacts from the construction phase. Requests included shortening the construction period, properly phasing construction activities to reduce daytime impact to schools and nighttime impact to residents, and reducing dust and noise when working near schools and residential areas. Fifty people attended the second round and expressed similar concerns. The majority indicated that if the mitigation measures were carried out, they would be satisfied.

187. In Linghai City, two rounds of public consultation were conducted in mid April and late May 2008 in public forums. Thirty-eight people attended the first round and expressed concerns over impacts from the construction phase. Fifty people attended the second round and expressed similar concerns. The majority indicated that if the mitigation measures recommended in the EIA report and presented in the meeting were carried out during the construction phase, they would be satisfied.

188. In Kazuo Mongolian Autonomous County, two rounds of public consultation were conducted in mid May and mid July 2008 in public forums. The stakeholders recognized the Project's environmental, social, and economic benefits and overwhelmingly supported it. Most attendees wanted to see the Project completed early, and some questioned whether it would bring them employment opportunities. Most were not concerned over the minor environmental impacts that could result from the construction and operation phases of the Project.

### B. Future Plans for Public Participation

189. Since some participants raised their concerns over construction programs and impacts, it is important to maintain a dialogue with the stakeholders throughout the construction stage. Continued public participation will ensure that such dialogue is maintained and that stakeholders' concerns are understood and addressed in a timely manner. The EMP has accordingly provided plans for future public participation.

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<sup>10</sup> The public consultations for noncore subprojects will be similar to the Chapter VIII discussion of core subprojects. They will be carried through by implementing the EAMF.

## **IX. ENVIRONMENTAL ASSESSMENT AND MANAGEMENT FRAMEWORK**

190. This chapter summarizes the procedural items of noncore subproject selection, review, and appraisal, including the preparation and appraisal of the EIAs and EMPs. The complete EAMF, including the technical procedures in conducting the EIA studies and preparing the EIA reports and EMPs, is provided in Appendix 3.

191. The sector project analysis identified three core subprojects in Donggang City, Kazuo Mongolian Autonomous County, and Linghai City for ADB funding. These core subprojects were selected based on comprehensive selection criteria, including environmental criteria described in paras. 193–194. The selected subprojects represent the full scope of (i) project interventions, (ii) conditions of small cities, and (iii) anticipated benefits and impacts. Summary EIA reports and EMPs have been prepared under this PPTA for these core subprojects. Remaining noncore subprojects will also fully meet the necessary environmental due diligence and EIA requirements of ADB. The provincial PMO, subproject PMOs, EAs, IAs, the local design institutes, and ADB will use this EAMF as a guide for noncore subproject selection and appraisal, including the preparation and review of the EIA reports and the EMPs. The EAMF should ensure that the necessary due diligence and procedures for environmental assessment and review of noncore subprojects are strictly met.

### **A. Environmental Criteria for Subproject Selection**

192. There will be two levels of subproject selection. The first is the review and selection of subproject cities and towns by the provincial PMOs. The second is the selection of subproject components in the subproject cities and towns by local PMOs.

193. The criteria for reviewing and selecting subproject cities and towns are:

- (i) socioeconomic indicators;
- (ii) level of preparedness to undertake investments in municipal and environmental infrastructure;
- (iii) development of citywide primary and secondary infrastructure, with emphasis on environmental infrastructure;
- (iv) potential for positive environmental improvements;
- (v) sound small city and town government master plans that are integrated with the overall planning process; and
- (vi) similarity to core subproject cities in terms of conditions and needs.

194. For selecting subproject components, a component must be similar to other core subproject components and have potential environmental improvement benefits. The following rationale will be used:

- (i) The principle of negative impact avoidance will take top priority. Siting of facilities will avoid sensitive areas and habitats such as water gathering grounds, nature conservation areas, protected ecological habitats, and protected heritage sites.
- (ii) The water supply component will improve the environmental and public health conditions of the residents by providing reliable and good quality drinking water, thus having environmental and social benefits to the community.
- (iii) The wastewater subproject will improve the quality of receiving surface and groundwater bodies through the provision of wastewater collection and treatment. It will also improve the community's sanitation and public health.

- (iv) The solid waste subproject will improve sanitary conditions, having environmental and public health benefits including promotion of waste reduction and recycling.
- (v) The river improvement subproject will provide benefits in flood control, thereby reducing the risks of property loss and public health hazards due to flooding.
- (vi) The district heating subproject will reduce reliance on small boiler rooms and household stoves, which are inefficient and polluting. The provision of district heating also will economize coal use, reducing coal burning and thus GHG emissions, with positive effects on climate change.
- (vii) The transport subproject that improves road conditions and road network will result in better connectivity and travel conditions. This will lead to shorter travel time per vehicle trip, with benefits of less fuel consumption and vehicle emissions. This will reduce GHG emissions, having positive effects on climate change.

## **B. Country's Environmental Assessment and Review Procedure**

195. The Project requires that all domestic EIAs be approved by the provincial EPB. It is local practice to prepare one domestic EIA for each component, so a subproject might have more than one EIA for domestic approval. PMOs and environmental management consultants will request that the local design institutes prepare one EIA (including EMP) per subproject or to minimize their number and to combine the EMPs if time allows.

196. This Project has been classified by ADB as a Category A project. As such, ADB requires EIA reports and EMPs as described in Appendix 3 for all noncore subprojects. Similar to ADB, the PRC has procedures in categorizing the EIA requirements for different types of projects based on their potential environmental impacts. For projects having substantial impacts on the environment (which is similar to ADB's Category A projects), the PRC requires the preparation, submission, and approval of a project EIA report. For projects with less substantial environmental impacts on the environment (which is similar to ADB's Category B projects), the PRC requires the preparation, submission, and approval of a project EIA table. Some noncore subprojects or subproject components may only need an EIA table under the domestic system; the EIA table might not meet the requirements. The local design institutes will provide the EIAs and EMPs in the format described in Appendix 3.

## **C. Review and Appraisal Procedures**

197. There will be two levels of review and appraisal. The first is the review and appraisal of subproject and subproject components. The second is the review and appraisal of the EIA reports and EMPs.

198. **Review and Selection of Subprojects and Subproject Components.** Environmental management consultants will (i) collect and review all necessary data; (ii) discuss with the PMO and other stakeholders all relative issues; (iii) with the PMO, conduct subprojects and subproject components review and selection against the criteria described in paras 193–194; and (iv) submit to ADB recommendations for selecting the subprojects and subproject components. ADB will review and endorse the subprojects and subproject component selection and/or advise otherwise.

199. **Review and Appraisal of EIA Reports and EMPs.** The provincial PMO will review and appraise all the domestic EIA reports and EMPs against the requirements and formats described in Appendix 3 to ensure that the information needs presented in the EAMF are fully provided in the reports and that the impacts are mitigated to acceptable levels with the

implementation of described mitigation measures. The procedures for the review and appraisal of EIA reports and EMPs are described as follows.

- (i) The provincial PMO will review and appraise all EIA reports and EMPs.
- (ii) The provincial PMO will reject reports not meeting the informational, procedural, and organizational requirements and send them back for improvements and resubmission. Resubmitted reports will again be reviewed and appraised.
- (iii) If the EIA reports and EMPs informational, procedural, and organizational requirements are met, the provincial PMO will sign off on the reports and submit them to the environmental management consultants.
- (iv) The PMO will also submit its recommendations for further processing the subprojects or subproject components, which requires the special attention described in para. 200. The review and appraisal procedures for subprojects and subproject components requiring special attention will be conducted as specified in para. 201.
- (v) The consultants will sign off on these recommendations, if appropriate.
- (vi) The environmental specialist of ADB's Operations Department will endorse all EIAs and EMPs for subprojects not requiring the special attention described in para. 200, based on the submitted recommendations.
- (vii) After the endorsement of EIAs and EMPs by ADB, the subprojects not requiring special attention as described in para. 200 will be approved by the provincial PMO. The provincial PMO is responsible for incorporating into the subproject design any revisions made in the EIAs and EMPs during EIA appraisal.

200. The following is a list of the most sensitive components requiring special attention:

- (i) the solid waste component involving incineration;
- (ii) the solid waste component involving landfill and/or composting facilities without leachate and/or methane gas collection and treatment;
- (iii) the district heating component without dust removal and flue gas desulfurization equipment for the central heat supply station using coal as fuel;
- (iv) the water supply component using groundwater as the water source;
- (v) the water supply component using more than 5% of the surface water flow as the water source;
- (vi) the wastewater treatment component with the WWTP having a total design capacity of more than 100,000 m<sup>3</sup>/d and discharging into a Class III or better water body;
- (vii) the transport component located in a densely populated area;
- (viii) the component that would impinge on water gathering ground, nature conservation area, protected ecological habitat and/or a protected heritage site; and
- (ix) component with other factors involving ADB Category A.

201. Review and appraisal procedures for the EIA reports and EMPs that need the special attention specified in para. 200 are as follows:

- (i) The environmental management consultants will conduct separate reviews and appraisals of EIA reports and EMPs following the PMO review and recommendations.
- (ii) The consultants will reject EIA reports and EMPs not meeting the informational, procedural, and organizational requirements; not providing sufficient estimates of

- project impacts; and/or unable to monitor and mitigate adequately the project impacts and send them back for improvements and resubmission. Resubmitted reports will again be reviewed and appraised.
- (iii) If the EIA reports and EMPs informational, procedural, and organizational requirements and impact assessments monitoring and mitigation as of ADB requirements are met, the consultants will sign off on the reports and submit to ADB with the recommendation for web posting or rejection by articulated reasons.
  - (iv) The environmental specialist of ADB's Operations Department will approve or reject all EIAs and EMPs based on the previous recommendations.
  - (v) After approval of EIAs and EMPs by ADB, the subprojects will be approved by the provincial PMO. The provincial PMO will be responsible for incorporating into the subproject design any revisions made in the EIAs and EMPs during EIA appraisal.
  - (vi) ADB's Operations Department will ensure posting of the noncore subproject EIAs and EMPs on the ADB web site within 1 month for 120 days.
  - (vii) Construction of the project will start on the expiration of the posting period.

## **X. CONCLUSIONS**

### **A. Project Risks**

202. The main project risks include the low institutional capacity in environmental management and failure of the PMOs, IAs, and O&M organizations to monitor environmental impacts and to implement the EMP during construction and operation phases of the Project, and for the project-associated facilities to be built on time. These risks will be mitigated by (i) providing extensive training in environmental management under the Project, (ii) appointing qualified project implementation consultants, (iii) following appropriate project implementation monitoring and mitigation arrangements, and (iv) ADB conducting project reviews.

203. The following assurances and covenants on the environmental aspects of the Project are required.

- (i) The LPG will ensure that each project city and IA will construct, operate, maintain, and monitor the project facilities in strict conformity with (a) all applicable national, Liaoning, and local laws and regulations and standards on environmental protection, health, labor, and occupational safety; and (b) all environmental mitigation and monitoring measures detailed in the design and construction contract and in the operational guidelines.
- (ii) The LPG will cause each core subproject city and IA to ensure that an adequate number of full-time personnel and sufficient resources are provided to monitor the implementation of the environmental monitoring program, under the guidance of the LPG, Donggang, Linghai, and/or Kazuo EPBs or other environmental monitoring centers.
- (iii) The LPG will cause each core subproject city and IA to ensure that the Liaoning EPB and PMO will review any changes to the project design that may have a potential for causing negative environmental impacts, so that environmental monitoring and mitigation measures are adjusted accordingly in consultation with ADB.
- (iv) The LPG will ensure that each core subproject city will take necessary actions to minimize the impact of interruptions to water supply, wastewater collection, and other utility services during project construction.

- (v) The LPG will ensure that the PMO will prepare and submit to ADB semiannual environmental reports in a format acceptable to ADB, until loan closure.
- (vi) The LPG will ensure that associated WWTPs will be constructed and operated in a timely manner to receive wastewater derived from Donggang and Linghai subprojects.
- (vii) The Government will ensure that the LPG and PMO follow the EAMF.

## **B. Benefits**

204. The overarching objectives of these subprojects will be to increase employment and sustainable economic growth, improve the urban environment, and/or improve urban infrastructure and municipal services.

205. The core subprojects have many benefits. Roads will improve the transport network and connectivity, thereby reducing travel time per trip. This will reduce vehicle emissions per trip that will have a positive effect on air quality. Water supply and wastewater treatment will improve public health and reduce the discharge of pollutants to rivers and groundwater. Water supply provision in Kazuo Mongolian Autonomous County will reduce reliance on groundwater, and groundwater extraction by private wells will decrease. River improvement will provide flood protection, thereby reducing economic loss and public health hazards due to flooding. Improving river water quality will promote river trade and protect coastal areas that are important fishing and mariculture grounds. Enhancement of wetland habitats during river improvement will promote conservation and wildlife biodiversity.

206. This Project will have positive effects on climate change, which supports the PRC's climate change initiatives. The provision of roads with better travel conditions and connectivity will reduce travel time per vehicle trip. This will reduce fuel consumption and therefore GHG emissions.

207. This summary EIA concludes that the Project will have substantial positive environmental and socioeconomic benefits. The Project will also have a demonstration effect on the other small cities and towns that are also under rapid urbanization in Liaoning.

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

208. An unavoidable impact of the core subprojects will be the need to resettle 1,103 persons due to permanent land acquisition and the demolition of residential structures. The resettlement plans have been prepared, and they describe the resettlement of affected households and people, and compensation. The plans fully meet PRC and ADB policies and requirements on resettlement.

209. During construction, dust from construction sites, noise from power mechanical equipment, wastewater, solid wastes, and construction traffic are the main adverse impacts. Most of the subproject components will be constructed in new urban expansion or new town areas with no occupants to be impacted. However, good housekeeping and effective mitigation measures will still be pursued to reduce these impacts to acceptable levels.

210. During operation, the main adverse impacts include: (i) air emissions and traffic noise from the roads; (ii) operational noise from the storm water, wastewater, and water supply pumping stations; and (iii) air emissions, operational noise, wastewater, and solid waste from the WTP. Due to better road network provided by this Project, air emissions and noise from

traffic were found to actually decrease in the intermediate term compared to the no-project scenario, although ultimately there will be increases in vehicle emissions and traffic noise due to increased traffic flow. Noise mitigation measures, through provision of double-glazed windows or air-conditioning to the affected households, have been suggested in the EIA reports. Operational noise from the pumping stations has been assessed to be acceptable. Small quantities of wastewater and solid waste generated from the operation of the WTP will be properly discharged to public sewer and disposed of at the sanitary landfill.

211. The type and magnitude of potential impacts from noncore subprojects are expected to be similar to the one from the core subprojects. They will be analyzed and mitigation measures will be formulated along with implementation of the EAMF.

212. Overall, the Project is expected to have no adverse impacts if the mitigation and monitoring plans are implemented, and the environmental management and institutional capacities of the PMOs and IAs are built up and strengthened by establishing environmental management offices and running an EMP training program.

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

213. The Project will result in the permanent loss of about 27.1 ha of land and associated habitats. No rare, threatened, or protected species have been recorded in the project areas.

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

214. An EMP has been developed for the design, construction, and operation phases of the core subprojects. The plan includes institutional arrangements and strengthening for implementing the mitigation measures and undertaking environmental monitoring. The EMP will be continuously developed as the Project progresses. EMPs for noncore subprojects will be prepared, reviewed, appraised, and implemented through the implementation of EAMF.

## REFERENCES FOR LIAONING PROVINCE

### A. References

1. AECOM International Development. 2008. Interim Report. Prepared for the Asian Development Bank on TA No. 4959-PRC, Liaoning Small Cities and Towns Development Demonstration Sector Project.
2. AECOM International Development. 2008. Draft Final Report. Prepared for the Asian Development Bank on TA No. 4959-PRC, Liaoning Small Cities and Towns Development Demonstration Sector Project.
3. Liaoning Environmental Science Research Academy. 2008. Environmental Impact Assessment Report for Donggang City Urban Infrastructure Engineering Project.
4. Liaoning Environmental Science Research Academy. 2008. Environmental Impact Assessment Report for Linghai City Urban Infrastructure Improvement Project.
5. Liaoning Environmental Science Research Academy. 2008. Supplementary Information on Environmental Impact Assessment for Kazuo County Gongyingzi New District Water Supply Project.
6. Liaoning Hydrological and Water Resource Survey Bureau. 2007/2008. Water Supply Verification Report for the Gongyingzi New District Nanliangzi Water Source in Kazuo County.
7. Liaoning Province Development and Reform Commission. 2006. Application for ADB Funding for Small Cities and Towns Project.
8. Liaoning Provincial Government, 2006. Liaoning Yearbook 2006.
9. National Development and Reform Commission of the PRC. 2007. PRC's National Climate Change Programme. Beijing.
10. PRC Environmental Culture Promotion Association. 2008. Chinese Public's Environment and Inhabitant Livelihood Index 2007. Beijing.
11. The Administrative Centre for China's Agenda 21. 1994. China's Agenda 21 - White Paper on China's Population, Environment and Development in the 21st Century. Beijing.

### B. Environmental Regulations and Standards

1. Air pollutant integrated emission standards GB16297-1996
2. Boiler air pollutant emission standards GB13271-2001
3. Effluent standards for discharging wastewater into public sewers CJ3082-1999
4. Effluent standards for wastewater treatment plants in cities and towns GB18918-2002

5. Environmental air quality standards GB3095-1996
6. Groundwater quality standards GB/T14848-93
7. Noise limits at the boundary of construction site GB12523-90
8. Odorous pollutants emission standards GB14554-93
9. Pollution control standards for the storage and treatment of general industrial solid waste GB18599-2001
10. Soil environmental quality standards GB15618-1995
11. Standards for noise at the boundary of industrial and enterprise facilities GB12348-90
12. Surface water environmental quality standards GB3838-2002
13. Urban environmental noise standards GB3096-93
14. Wastewater integrated discharge standards GB8978-1996

## **ENVIRONMENTAL MANAGEMENT PLAN LIAONING PROVINCE**

### **I. INTRODUCTION**

1. This environmental management plan (EMP) covers the design, construction, commissioning, and operation phases of the Liaoning Small Cities and Towns Development Demonstration Sector Project (the Project) so that environmental impacts are monitored and environmental mitigation measures are implemented. The EMP deals with overall environmental management at the project- and subproject-level, with focus on core subprojects. The subproject-specific plan will be developed and implemented through the environmental assessment and management framework. Maps of the three core subprojects are as follows: Figure A2.1 for Donggang City, Figure A2.2 for Linghai City, and Figures A2.3 and A2.4 for Kazuo Mongolian Autonomous County.

2. Environmental monitoring programs will be carried out, and the results will be used to evaluate (i) the extent and severity of actual environmental impacts against the predicted impacts, (ii) the performance of the environmental protection measures or compliance with related rules and regulations, (iii) trends of impacts, and (iv) overall effectiveness of the project EMP.

3. Environmental protection measures will (i) mitigate environmental impacts, (ii) achieve compliance with national or local environmental regulations, (iii) provide compensation for lost environmental resources, and (iv) enhance environmental resources.

### **II. SUMMARY OF POTENTIAL IMPACTS**

4. Potential impacts of the Project during the construction and operation phases, as identified by the environmental impact assessment (EIA), as well as corresponding mitigation measures designed to minimize the impacts, are summarized in Table A2.1.

### **III. MITIGATION MEASURES**

5. The mitigation measures will be (i) designed by the local design institutes (where appropriate); (ii) incorporated into tendering documents (where applicable), construction contracts, and operational management plans; and (iii) implemented by contractors and implementing agencies/units under supervision of the Liaoning and local project management offices (PMOs). The effectiveness of these measures will be evaluated based on the results of the environmental monitoring to determine whether to continue or make improvements. Improvement measures need to be confirmed through stipulated environmental management procedures.

6. Resettlement plans were prepared with the goal of properly resettling the affected persons and avoiding deterioration of the affected persons' quality of life. Details of required actions are given in the project resettlement plans.

Table A2.1: Summary of Potential Impacts and Mitigation Measures

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
<b>A. Design Stage</b>								
	Odor from dredged spoil during river improvement works in Donggang	<ul style="list-style-type: none"> <li>Properly identify locations for the temporary storage of dredged spoils that are away from residents, hospitals, and schools</li> </ul>						
Air	Dust from construction activities in Donggang, Linghai, and Kazuo	<ul style="list-style-type: none"> <li>Include in tender documents specifications on good construction site practices related to dust control described in the summary EIA, such as daily watering of unpaved areas and stockpiles, covering of stockpiles, and vehicle speed control</li> </ul>	Local design institute	DMMD, LMMD, KCIC	Included in the detailed design contract			
	Operational noise from the water supply, storm water, and wastewater pumping stations in Donggang, Linghai, and Kazuo	<ul style="list-style-type: none"> <li>Select low-noise equipment and design soundproof or noise absorptive facilities for main noise sources</li> </ul>						
Noise	Noise from powered mechanical equipment during construction in Donggang, Linghai, and Kazuo	<ul style="list-style-type: none"> <li>Include in tender documents specifications on good construction site practices described in the summary EIA related to noise control, such as the use of low-noise equipment, temporary noise barriers or hoardings, and regular maintenance of equipment</li> </ul>	Local design institute	DMMD, LMMD, KCIC	Included in the detailed design contract			
	Construction site runoff and wastewater from construction workers	<ul style="list-style-type: none"> <li>Include in tender documents specifications on good construction site practices related to construction site drainage and wastewater management described in the summary EIA, such as perimeter drainage ditch, sedimentation tanks, and potable chemical toilets</li> </ul>						
Water			Local design institute	DMMD, LMMD, KCIC	Included in the detailed design contract			

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)				
					Donggang	Linghai	Kazuo	Total	
	Design of the water treatment plant in Kazuo	<ul style="list-style-type: none"> <li>Proper design of the water treatment plant to ensure reliable water supply and water quality</li> <li>Proper design of the chlorine storage and dosing facility to ensure safety and adequate alarm system</li> </ul>							
	Design of water supply, storm water, and wastewater pipelines	<ul style="list-style-type: none"> <li>Proper pipeline design and material selection to prevent pipe burst</li> </ul>							
Solid Waste	Disposal of excavated soil, construction and demolition wastes, and dredged spoil during construction in Donggang, Linghai, and Kazuo	<ul style="list-style-type: none"> <li>Identify storage and/or disposal facilities and specify the use of these facilities in the tender documents</li> </ul>	Local design Institutes	DMMD, LMMD, KCIC	Included in the detailed design contract				
<b>B. Construction Stage</b>									
Air	Dust	<ul style="list-style-type: none"> <li>Adopt advanced construction techniques and select appropriate machinery and transport vehicles in compliance with national emission standard</li> <li>Organize material storage, separate stone and sand materials, store concrete in separate areas, minimize transport required, clean up construction and demolition waste</li> <li>Spray water on exposed surface and unpaved haul roads</li> <li>Avoid truck overloaded, cover material during transport; timely clear the dust and spray water on haul road;</li> <li>Set up hoarding around construction site, particularly for sensitive receivers nearby roads, including school,</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB		10	10.2	3	23.2

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
		worshipping place, hospital, residential areas; <ul style="list-style-type: none"> <li>Stop construction during strong wind and cover the stockpile;</li> <li>Limit vehicle speed on unpaved haul roads to &lt; 8 km/h.</li> </ul>						
		<ul style="list-style-type: none"> <li>Program construction activities to avoid construction during nights (2400 hr to 0800 hr)</li> <li>Substitute pneumatic tools with hydraulic tools</li> <li>Use low noise machinery</li> <li>Install temporary noise barriers around noisy machinery</li> <li>Avoid concrete mixing, use premixed concrete</li> <li>Traffic control on site and limit the honning</li> <li>During transport, loading, and unloading of construction materials, prohibit honking when vehicles pass through sensitive receivers.</li> <li>Liaise with nearby schools to avoid noisy activities during examination periods</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	5	3	2	10
Noise	Noise from mechanical equipment and vehicles							
		<ul style="list-style-type: none"> <li>Strengthen management, discharge domestic wastewater to the nearby sewer network, or have it treated by on-site package plant</li> <li>Build storage tanks, drainage ditches, and temporary sedimentation tanks to treat wastewater from excavation, equipment cooling, or washing before discharging to sewer network</li> <li>Regular maintenance of construction equipment to avoid accidents during construction</li> <li>Locate storage site and sand mixing site should be at least 100 m away</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	1.7	3		4.7
Water	Wastewater from construction workers, canteens and machinery maintenance, and site runoff							

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
		<p>from water body, and regularly spray water during construction to reduce the pollution</p> <ul style="list-style-type: none"> <li>• Enclose asphalt mixing site in the downwind direction at least 500 m away from the water body to avoid the water body from being contaminated</li> <li>• Strengthen water use management, and avoid introduction of chemicals during the vegetation rehabilitation work to reduce water pollution</li> </ul>						
Solid Waste	<p>Refuse generated on construction sites, construction and demolition waste, excavated soil</p>	<ul style="list-style-type: none"> <li>• Collect and clean up the refuse and dispose in landfill</li> <li>• Sort the construction waste and recycle or reuse if possible</li> <li>• Maximize the reuse of excavated soil for backfilling</li> <li>• Dispose of the waste to designated sites only</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	2	6	2	10
Ecology, Habitat, and Soil Conservation	<p>Affected vegetation</p> <p>Soil erosion and water/soil conservation</p>	<ul style="list-style-type: none"> <li>• Relocate the trees affected by the construction, avoid tree cutting, and restore the vegetation on completion of construction</li> <li>• Set up hoarding around the construction site, build temporary drainage ditch and hoarding for temporary living quarters, install hoarding and drainage for temporary roads, regularly water haul road, cover the soil, and aggregate materials on the truck during transport</li> <li>• Build drainage ditch and slope protection during site formation</li> <li>• Develop rainy season construction plan to prevent surface runoff and soil erosion</li> <li>• Protect farmland and channels near construction sites</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	26.2	10.8		37

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
Workplace Health and Safety	Health and safety of workers	<ul style="list-style-type: none"> <li>Maintain efficient sanitation in the construction area, and provide health checks to workers</li> <li>Strengthen safety training and management to ensure the safe construction</li> <li>Equip construction workers with personnel protection utilities, such as earplugs and helmets when necessary</li> <li>Regularly maintain construction equipment to avoid accidents during construction</li> </ul>	Contractor	DMMD, LMMD, KCIC	8.2	3.6	11.8	
Social	Traffic congestion	<ul style="list-style-type: none"> <li>Divert or schedule the construction traffic to avoid peak hours</li> <li>Build temporary roads</li> <li>Phase construction in busy traffic road and reduce the construction period</li> <li>Select transport routes to reduce disturbance to regular traffic</li> </ul>	Contractor	DMMD, LMMD, KCIC	2	1.2	3.2	
Cultural Heritage	Culture heritage affected by the construction activities	<ul style="list-style-type: none"> <li>Should culture heritage discovered during the construction, stop construction, protect the site, and report to the authority</li> </ul>	Contractor	DMMD, LMMD, KCIC				
Management	Management of EMP implementation	<ul style="list-style-type: none"> <li>Hire personnel on construction site supervision to ensure EMP implementation</li> </ul>	Contractor	DMMD, LMMD, KCIC	80	80	160	
<b>C. Operational Stage</b>								
Air	Potential chlorine leakage in water treatment plant	<ul style="list-style-type: none"> <li>Use only 500 kg chlorine cylinders, and store at maximum a 20-day supply</li> </ul>	KCIC	KPMO				Included in operating costs
Noise	Building units affected by traffic noise	<ul style="list-style-type: none"> <li>Install double-glazed windows or air-conditioning at the affected building units in Donggang</li> </ul>	DMMD, LMMD	DPMO, LPMO	192.4	61.7	254.1	

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
	Noise from the water supply, storm water and wastewater pumping stations in Donggang, Linghai, and Kazuo	<ul style="list-style-type: none"> <li>Regularly maintain machinery, and keep the equipment in good condition</li> </ul>	DMMD, LMMD, KCIC	DPMO, LPMO, KPMO	Included in operating costs			
Water	Water source protection	<ul style="list-style-type: none"> <li>Set up and implement water source protection plan</li> </ul>	KPMO	LPPMO	Included in operating costs			
Solid Waste	Sludge from water treatment plant in Donggang	<ul style="list-style-type: none"> <li>Dispose at sanitary landfill after dewatering</li> </ul>	KCIC	KPMO	Included in operating costs			
<b>Total</b>								<b>514</b>

DEPB = Donggang Environmental Protection Bureau, DMMD = Donggang City Municipal Management Department, DPMO = Donggang Project Management Office, EIA = environmental impact assessment, KCIC = Kazuo County Construction and Investment Company Ltd, KEPB = Kazuo Environmental Protection Bureau, kg = kilogram, KPMO = Kazuo Project Management Office, LEPB = Linghai Environmental Protection Bureau, LMMD = Linghai City Municipal Management Department, LPMO = Linghai Project Management Office, LPPMO = Liaoning Provincial Project Management Office, m = meter. Sources: EIA reports.

## IV. ENVIRONMENTAL MONITORING

### A. Monitoring Program

7. The monitoring program will focus on the environment within the core subproject area. A detailed environmental monitoring program is presented in Table A2.2. This program considers the scope of monitoring, monitoring parameters and frequency, data processing, and quality control requirements. A brief cost estimation of this monitoring program is included in the same table. A detailed cost breakdown will be conducted during the preparation of the detailed environmental monitoring program at the outset of project implementation. For compliance monitoring, the monitoring will follow the methodology provided in the national standard methods for monitoring pollutants. Other associated standards are national environmental quality standards and pollutant discharge and/or emission standards. The local monitoring stations will be responsible for implementing this program of compliance monitoring.

8. The Liaoning PMO, local PMOs, the implementing agencies (IAs) or operation and maintenance (O&M) companies, the environmental management consultants (EMCs), and the construction supervision companies will, at the outset of project implementation, prepare more detailed internal environmental monitoring programs to be implemented during the construction and operation phases if necessary, through the EMP mechanism of feedback and adjustments. These will be carried out more frequently than the compliance monitoring programs. These monitoring programs and budgets will be included in project tendering documents and budgets, as well as construction and operation contracts. At the outset of project implementation, the Liaoning PMO, local PMOs, IAs, and EMCs will develop (i) comprehensive project design and monitoring framework (DMF) procedures for to generate data on inputs and outputs of project components; and (ii) detailed environmental and related social economic indicators to measure project impacts.

9. The DMF indicators for the Project include (i) public satisfaction with the living environment, (ii) increased employment, (iii) wastewater collection and treatment rate, (iv) increased public transport routes, (v) increased portable water coverage, (vi) increased heat and gas supply coverage, (vii) increased local gross domestic product, and (viii) increased tourism numbers. Under this framework, baseline and progress data will be reported at the requisite time intervals by the IAs. The IAs will be responsible for analyzing and consolidating the data through their management information system. The framework will be designed to permit adequate flexibility to adopt remedial action regarding project design, schedules, activities, and development impacts. The Liaoning PMO, local PMOs, and IAs will refine the framework, confirm achievable goals, confirm monitoring and recording arrangements, and establish systems and procedures no later than 6 months after loan effectiveness.

### B. Monitoring Management

10. During the construction and operation phases, each IA or O&M company will make appropriate arrangements for internal monitoring according to the progress of project implementation. The local monitoring station with qualified staff and adequate monitoring equipment and technical capability will be appointed by the IA or O&M company to carry out the monitoring in the project areas with the frequency, time, parameters, and location specified in the monitoring program (Table A2.2) Monitoring reports will be made available to the local environmental protection bureaus (EPBs) and the Liaoning EPB as required. When complaints are received from the public, Liaoning EPB or local EPBs' monitoring personnel will conduct additional immediate inspections.

Table A2.2: Environmental Monitoring Program

Subject	Parameter	Location	Time	Frequency	Implementing Agency	Supervision Agency	Estimated Cost (CNY10,000)
<b>Donggang: Construction Phase</b>							
Air	Total suspended particulates, PM <sub>10</sub>	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road, and Xincheng Road	Once in the morning and once in the afternoon	Two days per month	Contractor	DMMD, DEPB	3.2
Noise	Leq	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road, and Xincheng Road	2 consecutive days with 24-hour continuous monitoring on each day	Once per month	Contractor	DMMD, DEPB	2
<b>Donggang: Operation Phase</b>							
Air	PM <sub>10</sub> , carbon monoxide, nitrogen oxide, total hydrocarbon	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road, and Xincheng Road	2 consecutive days with 24-hour continuous monitoring on each day	Two times per year, once in the spring and once in the autumn	DMMD	DPMO, DEPB	1.2 (for first year)
Noise	Leq	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road, and Xincheng Road	2 consecutive days with 24-hour continuous monitoring on each day	Two times per year	DMMD	DPMO, DEPB	1.2 (for first year)
<b>Linghai: Construction Phase</b>							
Air	Total suspended particulates, PM <sub>10</sub>	4 locations: Linghai No. 2 Secondary School, Linghai Chinese Medicine Hospital, Dianli residential block, and Mingqiuyuan residential block	Once in the morning and once in the afternoon	Two days per month	Contractor	LMMD, LEPB	5

Subject	Parameter	Location	Time	Frequency	Implementing Agency	Supervision Agency	Estimated Cost (CNY10,000)
Noise	Leq	6 locations: Linghai No. 1 Primary School, Linghai Chinese Medicine Hospital, Linghai No. 3 Kindergarten, Shijiyuan residential block, Fuhuayuan, and Mingqiuyuan residential block	2 consecutive days with 24-hour continuous monitoring on each day	Once per month	Contractor	LMMD, LEPB	2
<b>Linghai: Operation Phase</b>							
Air	Carbon monoxide, nitrogen oxide, total hydrocarbon, PM <sub>10</sub>	3 locations: Linghai No. 2 Secondary School, Linghai Chinese Medicine Hospital, Dianli residential block	2 consecutive days with 24-hour continuous monitoring on each day	Two times per year, once in the spring and once in the autumn	LMMD	LPMO, LEPB	5 (for first year)
Noise	Leq	5 locations: Linghai No. 1 Primary School, Linghai Chinese Medicine Hospital, Linghai No. 3 Kindergarten, Shijiyuan residential block, and Fuhuayuan	2 consecutive days with 24-hour continuous monitoring on each day	Two times per year	LMMD	LPMO, LEPB	2 (for first year)
<b>Kazuo: Construction Phase</b>							
Air	Total suspended particulates	At the water treatment plant construction site and along the pipeline route	Once in the morning, once in the afternoon and once at night	2 days per month	Contractor	KCIC, KEPB	6
Noise	Leq	At the water treatment plant construction site boundary and nearby residential areas (Wangjiadian, Fangshanzi, Tabeiyingzi, Shuiquansiju, Erdaomen, Xidi, and Nanliangzi)	2 consecutive days with 24-hour continuous monitoring on each day	Two times per month	Contractor	KCIC, KEPB	3
Surface water	Acidity, total petroleum hydrocarbon, suspended solids, water quantity	(i) Two locations on the Daling River at 200 m upstream and 500 m downstream of Nanliangzi (ii) two locations on the	Once in the morning and once in the afternoon	3 days per week	Contractor	KCIC, KEPB	1.5

Subject	Parameter	Location	Time	Frequency	Implementing Agency	Supervision Agency	Estimated Cost (CNY10,000)
		Mangju River when pipeline work crosses the Mangniu River, at 200 m upstream and 500 m downstream of the pipeline crossing respectively					
<b>Kazuo: Operation Phase</b>							
Noise	Leq	Two locations: (i) at the water treatment plant boundaries and (ii) at the village of Wangjiadian	2 consecutive days with 24-hour continuous monitoring on each day	Twice per year: once during the heating season and once during the non-heating season	KCIC	KPMO, KEPB	1 (for first year)
Surface water	Acidity, suspended solids, chemical oxygen demand, ammonia nitrogen, water quantity	Three locations: at intake of the water treatment plant; 300 m upstream of reservoir; 1,000 m downstream of reservoir	2 times per day at water intake 3 consecutive days with once daily on rivers	Daily at water intake Three times per year on rivers, once in wet season, once in dry season, and once in-between wet and dry seasons	KCIC	KPMO, KEPB	5 (for first year)
Ground water	Acidity, chemical oxygen demand, ammonia nitrogen, total hardness, iron, total coliform	Three groundwater well locations: 50 m upstream, and 50 m and 100 m downstream of the water treatment plant-	1 day	Twice per year, once in wet season and once in dry season	KCIC	KPMO, KEPB	2.5 (for first year)
<b>Total</b>							<b>40.6</b>

DEPB = Donggang Environmental Protection Bureau, DMMD = Donggang City Municipal Management Department, DPMO = Donggang Project Management Office, EIA = environmental impact assessment, KCIC = Kazuo County Construction and Investment Company Ltd, KEPB = Kazuo Environmental Protection Bureau, KPMO = Kazuo Project Management Office, Leq = equivalent continuous sound pressure level, LEPB = Linghai Environmental Protection Bureau, LMMD = Linghai City Municipal Management Department, LPMO = Linghai Project Management Office, m= meter, PM<sub>10</sub> = particular matter with diameter ≤10μ.

Notes: (i) Detailed internal monitoring program during the construction and operation phases will be prepared at the beginning of project implementation by the PMO, implementing agencies, and environmental management consultants.  
(ii) In addition to regular compliance monitoring, other unannounced monitoring will be carried out to determine compliance.  
(iii) Indicative cost will be finalized at late stage.

Sources: Subproject EIAs, project preparatory technical assistance.

## V. PUBLIC CONSULTATION

### A. Public Consultation during Project Preparation

11. Two rounds of public consultation were conducted in each subproject town. For details, please refer to paras. 185–188 of the summary EIA.

### B. Future Public Consultation Plan

12. Plans for public involvement during the design, construction, and operation phases were developed during project preparation. These 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 Project is completed. These plans will include several types of public involvement, including site visits, workshops, investigation of specific issues, interviews, and public hearings, as indicated in Table A2.3.

13. The public consultation plans are part of the project implementation and management plan. IAs are responsible for organizing public participation during project implementation. The contractors will be asked to communicate and consult with the communities near the construction site. An eye-catching public notice board will be erected at each construction site to notify the public of the main construction activities and the construction duration. The board will also provide contact names and telephone numbers to enable the public to express their concerns about construction activities. Costs for public participation activities during project implementation are included in the project funding. Costs are estimated at (i) CNY20,000 for each consultation workshop, (ii) CNY10,000 for each public investigation on a particular issue, (iii) CNY8,000 for each public workshop, and (iv) CNY6,000 for each press conference.

**Table A2.3: Public Consultation Plan**

Organizer	Approach	Times	Subject	Attendees
<b>A. Project Preparation</b>				
Liaoning PMO, local PMOs, EIA preparation institutes, PPTA consultants	Public meeting	Twice	Environmental quality status; project information; major impacts and benefits; mitigation measures; attitudes, comments, and recommendations of the public	Residents, enterprises, NGOs and other stakeholders within construction and service area; specialists from various sectors
Local PMOs, local social survey institutes, PPTA consultants	Social survey	Once		
Local PMOs, resettlement plan preparation institutes, PPTA consultants	Survey on resettlement	As required by relevant resettlement plan	Comments on resettlement, improvement of living conditions, livelihood, and poverty reduction; comments and suggestions	Persons affected by resettlement and relocation
Local PMOs, EMDP preparation institutes, PPTA consultants	Pubic participation	As required by relevant EMDP	Comments on minority development plan, comments and suggestions	Ethic minorities in the project areas

Organizer	Approach	Times	Subject	Attendees
<b>B. Construction Phase</b>				
Liaoning PMO, local PMOs, and IAs	Public consultation and site visits	At least once	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents adjacent to components, representatives of social sectors
Liaoning PMO, local PMOs, and IAs	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on mitigation measures, public opinions	Experts of various sectors, media
Liaoning PMO, local PMOs, and IAs	Survey on resettlement	As required by relevant resettlement plan	Comments on resettlement, improvement of living conditions, livelihood, and poverty reduction	Persons affected by resettlement and relocation
Liaoning PMO, local PMOs, and IAs	Survey on minority	As required by relevant EMDP	Comments on minority development	Minorities in the project areas
<b>C. Operation Phase</b>				
Liaoning PMO, local PMOs, IAs, O&M companies	Public consultation and site visits	Once in the first 2 years	Effects of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to component sites, representatives of residents and representatives of social sectors
Liaoning PMO, local PMOs, IAs, O&M companies	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on operational impacts, public opinions	Experts of various sectors, media

EIA = environmental impact assessment, EMDP = ethnic minority development plan, IA = implementing agency, NGO = nongovernment organization, O&M = operation and maintenance, PMO = project management office, PPTA = project preparatory technical assistance.

Sources: EIAs, PPTA.

## VI. RESPONSIBILITIES AND AUTHORITIES

### A. Environmental Responsibilities and Institutional Requirements

14. The EMP provides details on the effective implementation of mitigation measures.

15. During project preparation and implementation, various organizations with different environmental management responsibilities—Liaoning EPB; Liaoning PMO; PMOs and EPBs in Donggang City, Kazuo Mongolian Autonomous County, and Linghai City; IAs; EIA preparation institutes; EMCs; construction supervision companies; design institutes; and contractors—have been involved and will continue to be involved in the EMP. The Liaoning PMO, local PMOs, contractors, and IAs will each nominate full-time trained and qualified environmental specialists to undertake environmental management activities for effective implementation of the EMP. Table A2.4 shows the environmental responsibilities in different phases of the Project.

**Table A2.4: Environmental Responsibilities**

Phase	Responsible Agencies	Environmental Responsibilities
Preparation	EIA preparation Institutes	Preparation of EIAs
	Liaoning EPB	Review and approval of EIAs
	Liaoning PMO, Liaoning EPB, ADB	Review and approval of the summary EIA, including the EMP
Design	Design institutes	Incorporation of mitigation measures in engineering designs and contracts
	Liaoning PMO, local PMOs, IAs	Review and approval of environmental measures
Tendering	Contractors, local PMOs, IAs	Incorporation of EMP clauses in the bids
Construction	EMCs, local PMO, IAs	Advise on implementation of mitigation measures
	Contractors, construction supervision company	Implementation of mitigation measures and internal monitoring
	Local EPBs, IAs	Implementation of compliance monitoring
	Local EPBs, IAs, EMCs	Supervise implementation of mitigation measures and monitoring
Operation	EMCs, local EPBs	Advise on compliance monitoring and internal monitoring requirements
	IAs, O&M Companies	Implementation of mitigation measures and internal monitoring
	Local EPBs, IAs, O&M companies	Implementation of compliance monitoring
	IAs, O&M companies, local EPBs, EMCs	Supervise implementation of mitigation measures and monitoring

ADB = Asian Development Bank, EIA = environmental impact assessment, EMC = environmental management consultant, EMP = environmental management plan, EPB = Environmental Protection Bureau, IA = implementing agency, local EPBs = Environmental Protection Bureaus in Donggang, Linghai, and Kazuo, O&M = operation and maintenance, PMO = project management office.

Note: EMCs appointed for project implementation will advise the city PMOs and IAs on carrying out their environmental responsibilities.

Sources: Liaoning PMO, local PMOs, project preparatory technical assistance.

16. The IAs will be responsible for environmental management and implementation of mitigation measures. They will ensure that the EMP is carried out and will engage design institutes and professional consultants to help with environmental management at the preparation, design, construction, and operation phases. The IAs will be responsible for arranging environmental monitoring reviews and responding to any adverse impacts beyond those foreseen in the EIAs. The IAs will also respond to the EPBs and Asian Development Bank (ADB) requests for mitigating measures.

17. Construction contractors will be responsible for implementation of mitigation measures during construction, while IAs will be responsible for implementation of such measures during operation.

18. In accordance with the EMP, the IAs will establish an environmental management office that will generally require two employees. During the Project, this office will be responsible for (i) implementing the EMP and developing additional implementation details; (ii) supervising implementation of mitigation measures during construction; (iii) implementing training programs; (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 on the performance of the EMP to the responsible agencies. This office will be supported and supervised by local EPBs and the EMCs.

19. Local governments will provide the IAs with financial and managerial autonomy to operate the project facilities. The IAs have relatively limited environmental management capacities, which will, however, be strengthened by environmental management training provided by the Project, as summarized in Table A2.5. They will incorporate environmental management activities into construction and operation management plans. Local governments will annually review local regulations for management of the roads and traffic, sewerage, drainage, water supply, solid waste, and central heating; that responsibilities of the agencies involved are clearly defined; that appropriate penalties for noncompliance are established; and that the effectiveness of regulations is reviewed annually and, if necessary, modified in accordance with applicable legal procedures.

20. The EMCs will advise the city PMOs, IAs, and contractors on all aspects of environmental management and monitoring for the project components. The consultants will (i) review project environmental practices and procedures; (ii) provide guidance in setting environmental standards and assisting with implementation procedures; (iii) review the start-up of the water treatment plant; (iv) advice on the management of city roads; (v) advise on mitigation during the construction and operation phases, in accordance with the EMP; and (vii) investigate and make recommendations on other environmental issues.

## **B. Institutional Strengthening and Training**

21. There will be three IAs: Donggang City Municipal Management Department, Linghai City Municipal Management Department, and Kazuo County Construction and Investment Company Limited for the core subprojects. An assessment undertaken during the project preparatory technical assistance (PPTA) indicates that these IAs lack capacity in environmental management and monitoring. For proper implementation of the EMP, it is necessary to build up and strengthen the capacity of the implementation and supervision agencies for all subprojects. The IAs will therefore need EMP training (see Table A2.5). This will also be an element in the policy dialogue on the institutional component.

22. With the help of the EMCs and support from the loan consultancy services, the local PMOs and the IAs will develop expertise in efficient operation of the completed facilities. The capacity building will be provided during the PPTA and loan stages.

23. Loan consultants will train environmental specialists of local EPBs and IAs in environmental management, monitoring and supervision, mitigation planning, emergency response, environmental policy making, and other environmental management techniques. Funding for this training will be included in the project budget and in the O&M budgets during the operational phase.

**Table A2.5: Project-Level Institutional Strengthening and Training**

<b>Strengthening Activities</b>	<b>Agencies</b>	<b>Strengthening Plan</b>	<b>Timing</b>			
Capacity building	Liaoning PMO, local PMOs, IAs	Institutional organization, development of responsibilities for each position	During project preparation and implementation			
Monitoring	Local PMOs, IAs, contractors	Procurement of related monitoring instruments and equipment	During project preparation and implementation			
<b>Training</b>	<b>Attendees</b>	<b>Contents</b>	<b>Period (days)</b>	<b>Number of person</b>	<b>Cost (CNY/ person/ day)</b>	<b>Total Cost (CNY 10,000)</b>
EMP implementation and adjustment, settlement of disputes, environmental policies and plans	Local PMOs, IAs, contractors	Development and adjustment of the EMP, emergency response, environmental laws and regulations, environmental management	5	40	500	10
Environmental pollution control technology	Local PMOs, IAs, contractors, O&M companies	Engineering and pollution control technologies; equipment selection and procurement; O&M of pollution control equipment	10	60	500	60
Environmental monitoring	Local PMOs, IAs, contractors, O&M companies	Monitoring methods, data collection and processing, reporting systems	5	30	500	15
Water course management	Donggang PMO and IA	Hydrodynamic monitoring and maintenance of water courses	5	10	500	5
Traffic and safety management	Local PMOs and IAs, contractors	Study of traffic and road safety management, temporary traffic management during construction	5	30	500	15
Environmental awareness training	Local citizens and government officials	Environmental pollution, protection and conservation	1	100	500	30
						<b>135</b>

EMP = environmental management plan, IA = implementing agency, O&M = operation and maintenance, PMO = project management office.

Source: Project preparatory technical assistance.

24. The Project's institutional components will also involve significant training by loan consultants in O&M of completed facilities. Part of this training will focus on teaching staff how to use a set of indicators to monitor performance of the completed facilities. These indicators will be designed by loan implementation consultants prior to operation start-up. All IAs will also receive environmental training on the relevant ADB procedures during project implementation.

## VII. REPORTING AND SUPERVISION

25. The compliance monitoring reports will include (i) the project background, (ii) construction 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 Liaoning PMO will submit compliance monitoring reports to ADB as appropriate.

26. During the construction period, results from internal monitoring by contractors and construction supply companies will be reflected in weekly 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.

27. The contractors will be trained to take immediate actions to remedy unexpected adverse impacts or ineffective or insufficient mitigation measures, as required by the EMP. The local PMOs and IAs will also respond to these reports in order 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 compliance monitoring and weekly construction reports are appropriately addressed.

28. Results from the detailed internal environmental monitoring program and mitigation actions for both construction and operational phases will be submitted monthly by the contractors and IAs to Liaoning PMO and Liaoning EPB through local EPBs and PMOs. Liaoning EPB and/or ADB may request that further environmental mitigation actions be taken, as they deem necessary, and may determine further mitigation measures for different stages, if necessary.

29. The Liaoning PMO will submit to ADB the EMP progress reports and information on project implementation and the environmental performance of the contractors, IAs, and EMCs. These reports will include (i) semiannual environmental reports on EMP implementation, and (ii) a project completion report to be submitted no later than 3 months after completion of the Project. Progress reports will emphasize (i) monitoring results, (ii) implementation of mitigation measures, (iii) environmental compliance, (iv) training, and (v) capacity-building progress.

30. The local PMOs, with the assistance of the project consultants, will monitor and assess overall project activities under the DMF, including environmental targets. The Liaoning PMO will report to ADB twice a year on the physical implementation, including environmental aspects of the Project, to ensure that the Project's progress and impacts are monitored and reported in line with ADB requirements.

## VIII. WORK PLAN

31. Before project facilities construction, IAs will develop detailed responsibilities and requirements for contractors, who will revise the EMP accordingly and will provide detailed cost estimates of mitigation measures and environmental monitoring in the construction contracts. The local PMOs and IAs also will detail the responsibilities and prepare the work schedules of their environmental management offices.

32. Before startup of project facilities operation, IAs will develop detailed work plans for environmental management and monitoring during operation based on the EMP. These work plans will be submitted to local EPBs and PMOs to help them to supervise implementation.

#### **IX. PROCUREMENT PLAN AND COST ESTIMATES**

33. The IAs will develop detailed plans for procurement of equipment and materials and civil works for implementing mitigation measures and monitoring plans. These plans will be incorporated into the project contracts.

34. Cost estimates for mitigation measures and monitoring plans are summarized in Tables A2.1 and A2.2. Compliance monitoring costs will be borne by the IAs, which must ensure that budget funds are available. Internal monitoring costs will be borne by the IAs, contractors, and construction supply companies during construction, and by the IAs or O&M companies during operation. The IAs or O&M companies will ensure that the necessary budgets are available. Before implementing the monitoring plan, agencies responsible for project environmental monitoring will also present a more detailed breakdown of the estimated budget. During project implementation, the budgets will be adjusted based on actual requirements. A detailed breakdown of the internal monitoring cost estimates will be prepared by the design institutes. Costs for all mitigation measures during construction will be included in the tender and contract documents and be borne by contractors. Costs related to mitigation measures during operation will be borne by the IAs or O&M companies. Costs for the EMCs and for the training will be borne by the Project as a whole.

#### **X. MECHANISMS FOR FEEDBACK AND ADJUSTMENT**

35. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. Adjustments to the EMP will be made, if necessary. Liaoning EPB and Liaoning PMO will play critical roles in this feedback and adjustment mechanism, as shown in Figure A2.5.

36. There will be two tiers of feedback and adjustment. If EMP modification is requested by the contractors and/or IAs, the Liaoning EPB will review their proposals in detail. If the modifications are approved in principle, specific modifications will then be submitted by contractors and IAs to Liaoning EPB for further review. Comments and suggestions from Liaoning EPB and ADB will also be considered by local EPBs and revisions to the EMP made as necessary. Contractors and IAs will then implement the modifications.

**Figure A2.1: Donggang City - Location of Works**

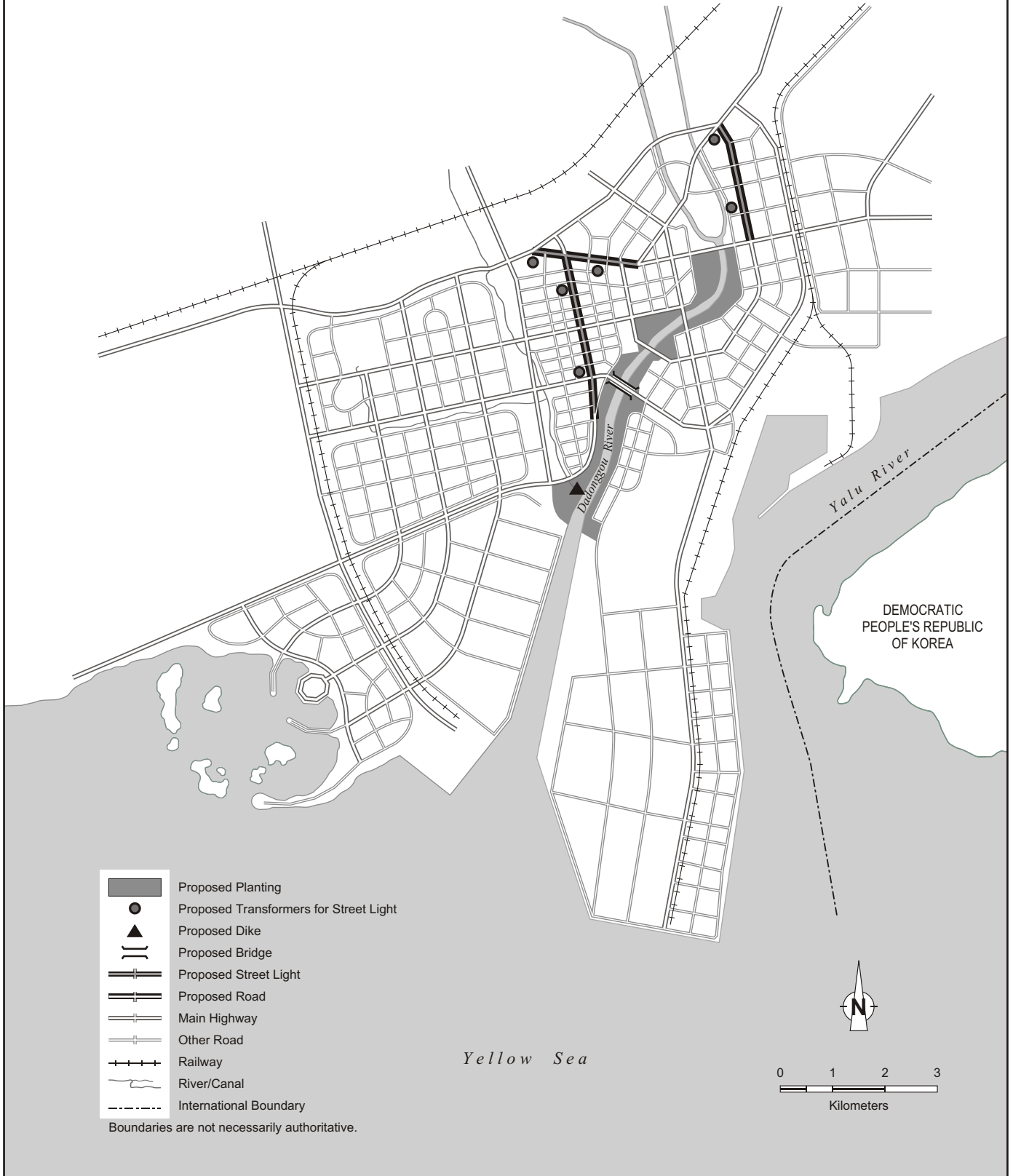
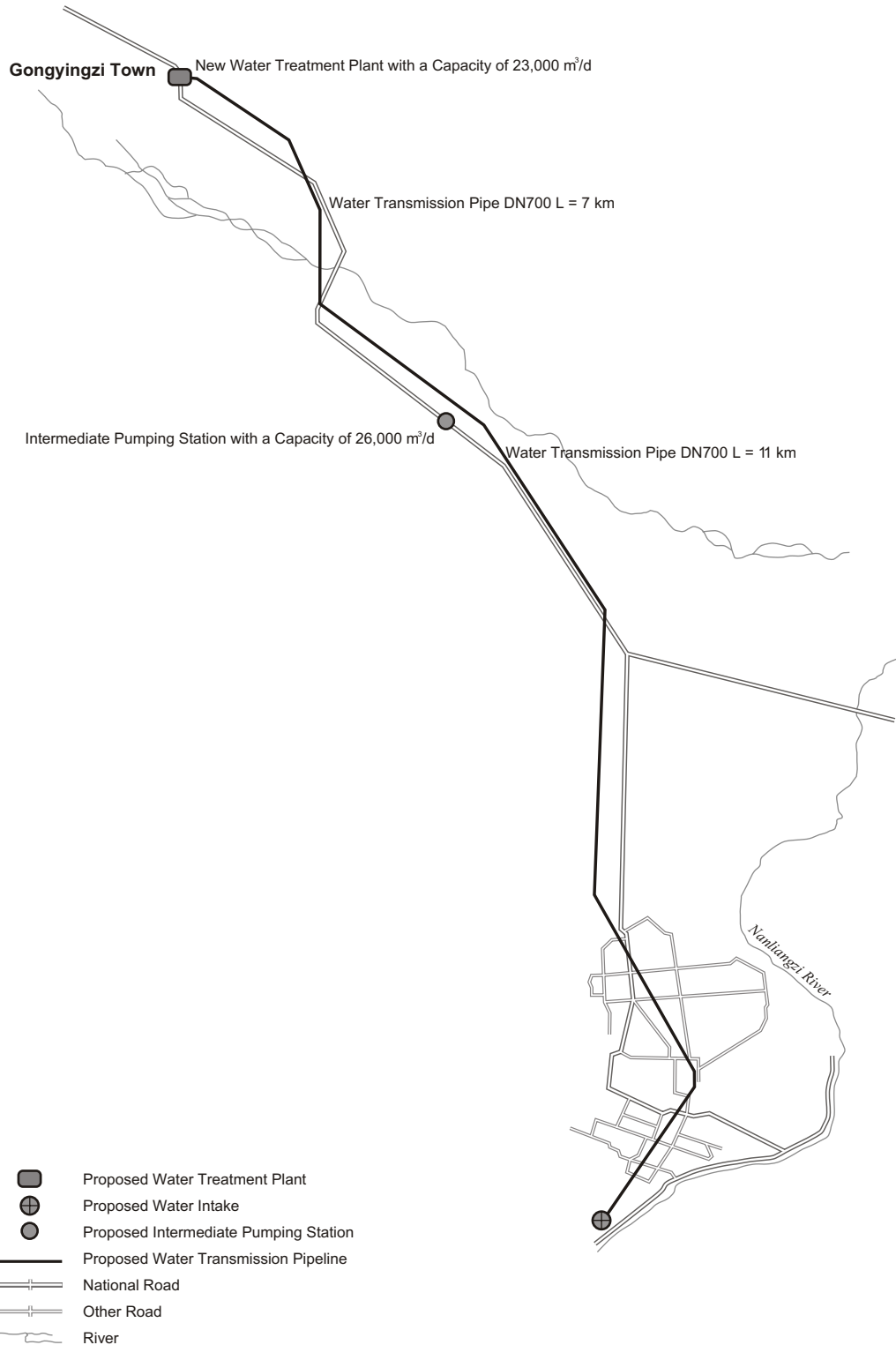


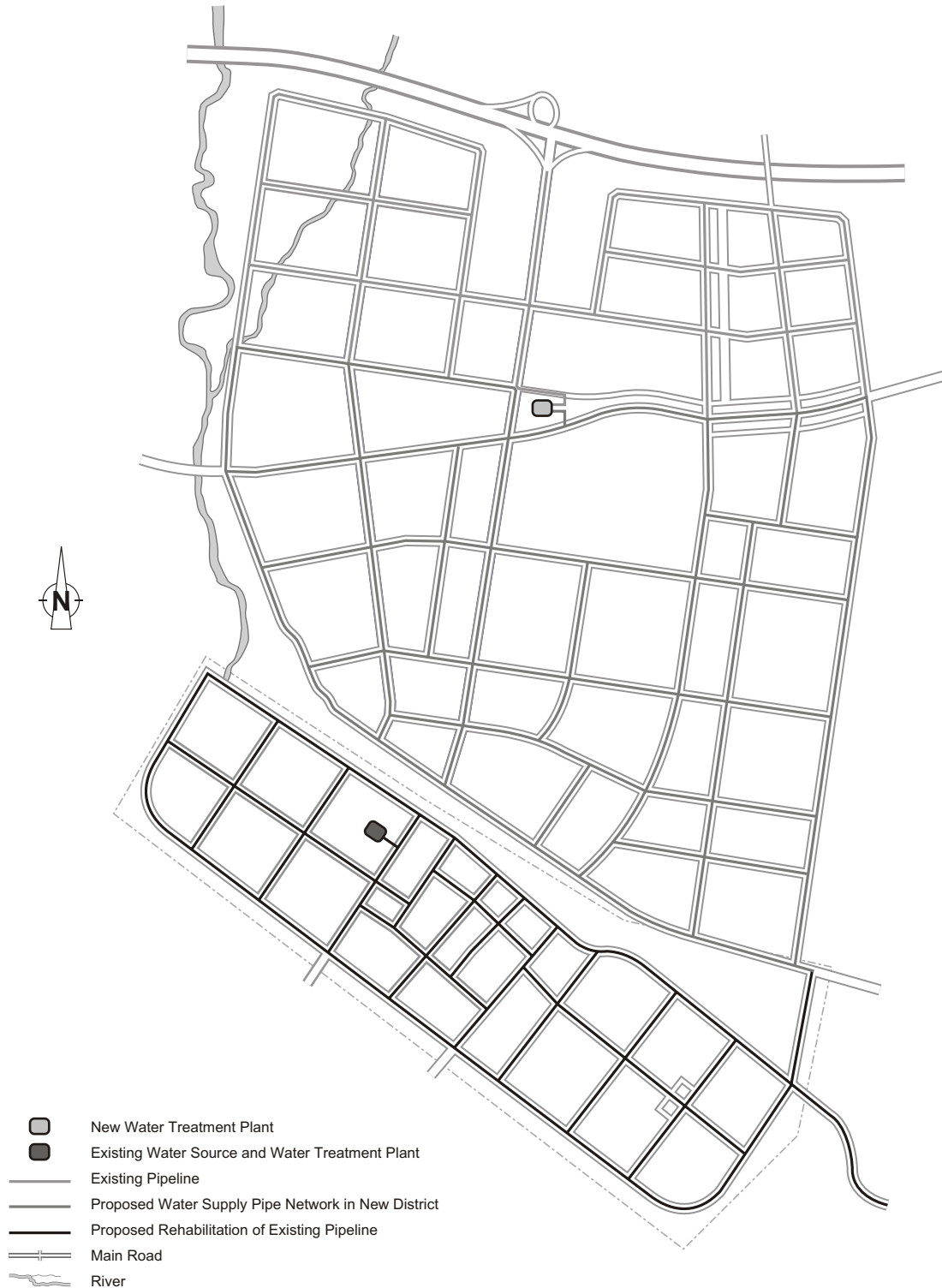
Figure A2.2: Linghai City - Location of Works



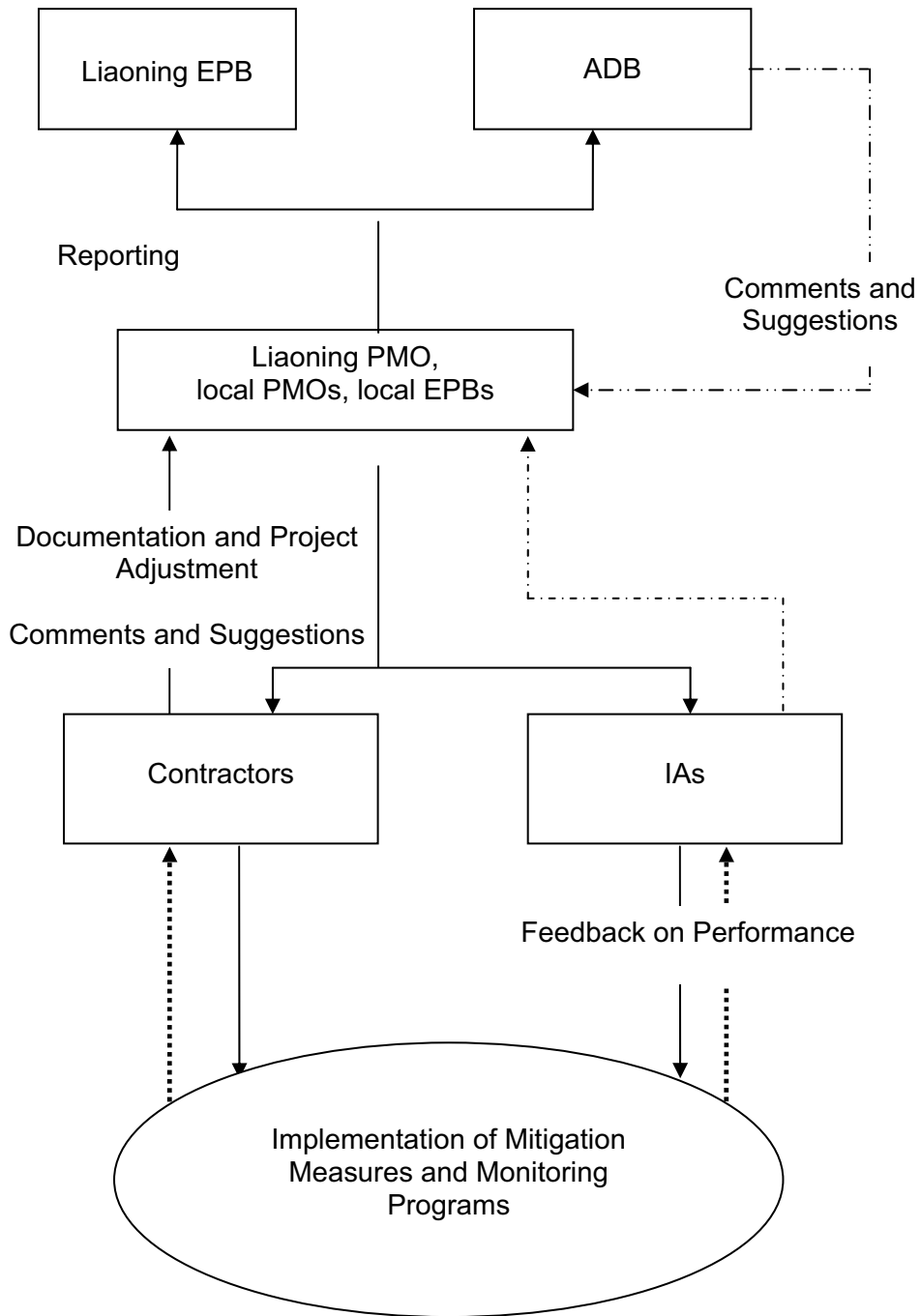
**Figure A2.3: Kazuo Mongolian Autonomous County:  
Water Supply Layout**



**Figure A2.4: Kazuo Mongolian Autonomous County:  
Water Supply Distribution Network**



**Figure A2.5: Mechanism for Feedback and Adjustment of Environmental Management Plan**



ADB = Asian Development Bank, EPB = Environmental Protection Bureau, IA = implementing agency, PMO = project management office.

Source: Project preparatory technical assistance.

## ENVIRONMENTAL ASSESSMENT AND MANAGEMENT FRAMEWORK LIAONING PROVINCE

### I. INTRODUCTION

1. This environmental assessment and management framework (EAMF) describes the Asian Development Bank's (ADB) requirements in conducting environmental assessment on sector loan projects, including responsibilities and authorities in the preparation, review, and approval of environmental impact assessments (EIAs); environmental criteria in selecting subprojects; key environmental issues of different subprojects; and steps in conducting the EIA study and preparing the EIA report and environment management plan (EMP). This report follows ADB's format for preparing environmental assessments and reviewing procedures for sector loans.

2. The sector project analysis identified three core subprojects in Donggang City, Kazuo Mongolian Autonomous County, and Linghai City for ADB funding under the Liaoning Small Cities and Towns Development Demonstration Sector Project (the Project). These subprojects were chosen based on comprehensive selection criteria, including environmental. The selected subprojects represent the full scope of (i) project interventions, (ii) conditions of small cities, and (iii) anticipated benefits and impacts. Summary EIA reports and an EMP have been prepared under this project preparatory technical assistance for these core subprojects meeting ADB requirements. Noncore subprojects coming online and implemented later should also meet ADB's EIA. The EAMF will ensure that the necessary procedures for environmental assessment and review of noncore subprojects will be strictly met by the provincial project management office (PMO), the subproject PMOs, the executing agencies (EAs), the implementation agencies (IAs), the local design institutes, and ADB in the preparation and review of the EIA report and the EMP according to ADB requirements.

### II. OVERVIEW OF TYPE OF SUBPROJECTS TO BE ASSESSED

3. The type of subprojects to be assessed is related to urban and environmental infrastructure that will improve the environmental, social, and economic conditions of small cities and towns, with the aim to increase employment and reduce poverty. Typical subprojects will be in the nature of water supply, wastewater, solid waste, river improvement, transport, and district heating.

4. A common concern of these subprojects is construction impact. This concern was raised by the participants in every public consultation forum conducted under the EIAs for the core subprojects. As such, the EMP will be an important tool in reducing and monitoring environmental impacts during construction of the subprojects. Specific activities and key environmental issues and impacts of core and noncore subprojects are described as follows to provide a standard model of consideration for noncore subprojects. The EIA and EMP for noncore subprojects are expected to follow the model and demonstrate the same level of mitigation measures will be taken.

5. **Water Supply.** This includes the provision of water treatment plants (WTPs), reservoirs, groundwater wells, pumping stations, and transmission and distribution pipelines. Key environmental issues that need to be addressed in the EIA report include the following:

- (i) description of the water source, e.g., surface water or groundwater;

- (ii) quality of the water by using monitoring data to demonstrate that the quality meets drinking water standards or if not, the measures or treatment processes to improve quality;
- (iii) verification of the feasibility of using this water source, including:
  - (a) the total supply capacity,
  - (b) the existing total extraction quantity,
  - (c) the quantity to be extracted,
  - (d) if there is cumulative overextraction, and
  - (e) mitigation measures for overextraction;
- (iv) protection of the water source, i.e., development plans to protect this water source from polluting activities in the watershed,
- (v) for the WTP, the disinfection agent and measures included in the design to ensure safe storage and application;
- (vi) excavated soil, including:
  - (a) the total quantity of soil to be excavated;
  - (b) the quantity to be reused for backfilling;
  - (c) the quantity to be disposed; and
  - (d) the name(s), location(s), and capacities of the disposal and/or temporary storage sites.

6. **Wastewater.** This includes the provision of wastewater treatment plants (WWTPs), pumping stations, and collection pipelines or culverts. Key environmental issues that need to be addressed in the EIA report include the following:

- (i) existing condition of the receiving water body by providing monitoring data to show the existing quality of surface and groundwater that are receiving wastewater (treated or untreated) now and/or will be receiving treated wastewater provided by the subproject;
- (ii) the treatment process proposed for the WWTP, and the discharge standard to be achieved;
- (iii) the quantities of pollutants that will be reduced from discharging into the receiving water bodies per year, including 5-day biochemical oxygen demand, chemical oxygen demand (COD<sub>Cr</sub>), suspended solids, ammonia nitrogen, total nitrogen, and total phosphorus;
- (iv) measures included in the design for odor removal at the WWTP and pumping stations, and the residual odor concentration after removal;
- (v) the quantity of sludge (after dewatering) produced, and how and where the sludge will be reused or disposed of;
- (vi) for the WWTP, the disinfection agent and measures included in the design to ensure safe storage and application;
- (vii) excavated soil for pipeline construction, including:
  - (a) the total quantity of soil to be excavated;
  - (b) the quantity to be reused for backfilling
  - (c) the quantity to be disposed;
  - (d) the name(s), location(s), and capacities the disposal and/or temporary storage sites.

7. **Solid Waste.** This includes the provision of a solid waste treatment facility, solid waste collection equipment such as garbage trucks and compactors, waste transfer station, and dust bins. Key environmental issues that need to be addressed in the EIA report include the following:

- (i) leachate collection and treatment of the solid waste treatment facility, including how the groundwater underneath the site will be protected from leachate seepage and how the leachate will be collected and treated;
- (ii) methane gas collection and treatment of the solid waste treatment facility, including how the methane gas generated will be collected and treated and assessment of implications on greenhouse gas emissions and climate change; and
- (iii) air emissions from the facility, such as dioxin for incinerator and odor from landfills and composting plants, as well as control measures and emission concentrations after the provision of these measures.

8. **River Improvement.** This includes river dredging and realignment, river widening, embankment works, installation of rubber dam, and landscaping of the riverbanks. Key environmental issues that need to be addressed in the EIA report include the following:

- (i) dredged river sediment, including quantity, method, and location for temporary storage, dewatering, and ultimate disposal;
- (ii) how to control the release of suspended solids in the river from dredging activities; and
- (iii) odor impacts during dredging operations and at the dredged spoil temporary storage site, and mitigation measures to control the odor.

9. **District Heating.** This includes the construction of central heating station, heat exchange station, and heat supply pipeline. Key environmental issues that need to be addressed in the EIA report include the following:

- (i) if coal is the fuel source for the central heating station, provide information on the sulfur content of the coal used and the quantity of coal used;
- (ii) dust removal and flue gas desulfurization equipment at the central heating station, and; the concentrations of sulfur dioxide, total suspended particulates, and/or particulate matter with diameter  $\geq 10 \mu$  (PM<sub>10</sub>) emitted at the central heating station;
- (iii) excavated soil for pipeline construction, total quantity to be excavated; the quantity to be reused for backfilling; the quantity to be disposed of; and the name(s), location(s), and capacities of the disposal and/or temporary storage sites.
- (iv) benefits that could be achieved by having district heating, including
  - (a) the number of small boiler rooms and household stoves that will be eliminated,
  - (b) the quantity of coal use that will be reduced per year,
  - (c) the quantity of bottom ash that will be reduced per year,
  - (d) the quantity of sulfur dioxide emissions that will be reduced per year,
  - (e) the quantity of nitrogen oxide emissions that will be reduced per year,
  - (f) the quantity of total suspended particulates and/or PM<sub>10</sub> emissions that will be reduced per year, and
  - (g) the quantity of carbon dioxide that will be reduced per year due to reduced coal burning.

10. **Transport.** This includes the construction of new roads, upgrading of existing roads, installation of municipal services such as cables and pipelines, and roadside landscaping. Key environmental issues that need to be addressed in the EIA report include the following.

- (i) **Traffic forecast.** Although a traffic forecast is not environmental, it forms the basis for predicting future traffic emissions and traffic noise. Therefore, traffic forecast up to a design horizon of 15 to 20 years must be provided by the feasibility study, so that the EIA team can use the figures to predict future traffic emissions and noise, and propose appropriate mitigation measures if needed.
- (ii) **Construction phase air quality.** Asphalt or concrete batching plants are the main air pollution sources during road construction. Information or design requirements on air pollution control requirements, such as equipment with dust removal bags, must be provided as well as specifications on where they can or cannot be sited, based on information on the locations of air-sensitive targets such as schools, hospitals, temples, and residential areas.
- (iii) **Traffic noise during the operation phase.** Based on the traffic forecast, traffic noise levels at the identified noise sensitive targets such as schools, hospitals, temples, and residential areas must be calculated for the: (a) condition at road opening, (b) intermediate condition (between now and the design horizon), and (c) long-term condition (at the design horizon). Mitigation measures, such as double-glazed windows or air-conditioning, should be provided for sensitive targets impacted by excessive traffic noise.

### III. COUNTRY'S ENVIRONMENTAL ASSESSMENT AND REVIEW PROCEDURE

11. This Project requires that all domestic EIAs be approved by the provincial Environmental Protection Bureau (EPB). It is local practice to prepare one domestic EIA for each component, so a subproject might have more than one EIA for domestic approval. PMOs and environmental management consultants will request that the local design institutes prepare one EIA (including EMP) per subproject or to minimize their number and combine the EMPs, if time allows.

12. This Project has been classified by ADB as a Category A project. As such, ADB requires EIA reports and EMPs as described in Attachments 1–5 for all noncore subprojects. Similar to ADB, the People's Republic of China (PRC) has procedures for categorizing the EIA requirements for different types of projects based on their potential environmental impacts. For projects having substantial impacts on the environment (which is similar to ADB's Category A projects), the PRC requires the preparation, submission, and approval of a project EIA report. For projects with less substantial environmental impacts (which is similar to ADB's Category B projects), the PRC requires the preparation, submission, and approval of a project EIA table. Some noncore subprojects or subproject components may only need an EIA table under the domestic system. However, the EIA table might not meet the requirements of ADB, so the local design institutes are required to provide the EIAs and EMPs in the format described in Attachments 1–5.

### IV. RESPONSIBILITIES AND AUTHORITIES

13. The provincial PMO is responsible for the selection of subprojects (small cities and towns). The local PMOs of these subproject cities and towns are responsible for selecting the subproject components. The EAs are responsible for selecting local design institutes to conduct the feasibility studies and the EIA studies and reporting.

14. The local design institutes are responsible for conducting the EIA studies, preparing the EIA reports, and obtaining domestic approval from the provincial EPB on these reports. They are also responsible for providing EIA reports and EMPs to ADB in the format described in the EAMF.

15. The provincial EPB is responsible for approving the domestic EIA reports. The provincial PMO is responsible for (i) reviewing and appraising all EIA reports and EMPs to ensure that the procedural and informational requirements described in the EAMF are met and that the impacts are acceptable with the implementation of mitigation measures described, and (ii) sign off on the reports and submit to ADB with the recommendation for posting.

16. The environmental management consultants are responsible for (i) review and appraisal of the selection of subprojects and subproject components, (ii) signing off on provincial PMOs' recommendations, and (iii) conducting separate review and appraisal on EIA reports and EMPs for items listed in para. 58.

17. The environmental specialist of ADB's Operations Department is responsible for approving all EIA reports and EMPs. The Operations Department of ADB is responsible for posting the EIA reports and EMPs on the ADB website.

## **V. ENVIRONMENTAL CRITERIA FOR SUBPROJECT SELECTION**

18. There will be two levels of subproject selection. The first is the selection of subproject cities and towns by the provincial PMOs. The second is the selection of subproject components in the subproject cities and towns by the local PMOs.

19. The criteria for selecting subproject cities and towns are:

- (i) socioeconomic indicators;
- (ii) level of preparedness to undertake investments in municipal and environmental infrastructure;
- (iii) development of citywide primary and secondary infrastructure, with emphasis on environmental infrastructure;
- (iv) potential for positive environmental improvements;
- (v) sound small city and town government master plans that are integrated with the overall planning process; and
- (vi) similarity to core subproject cities in terms of conditions and needs.

20. For selecting subproject components, a component must be similar to core subproject components and have potential environmental improvement benefits. The following rationale will be used.

- (i) For all subproject components, the principle of negative impact avoidance should take top priority. Siting of component facilities should avoid sensitive areas and habitats such as water gathering grounds, nature conservation areas, protected ecological habitats, and/or protected heritage sites.
- (ii) The water supply subproject will improve the environmental and public health conditions by providing reliable and good quality drinking water, thus having environmental and social benefits to the community.
- (iii) The wastewater subproject will improve the quality of receiving surface and groundwater bodies through the provision of wastewater collection and treatment. It will also improve sanitary and public health conditions of the community.
- (iv) The solid waste subproject will improve the sanitary conditions of the community and have environmental and public health benefits including promotion of waste reduction and recycling.

- (v) The river improvement subproject will provide benefits in flood control, thereby reducing the risks of property loss and public health hazards.
- (vi) The district heating subproject will reduce reliance on small boiler rooms and household stoves, which are inefficient and polluting. The provision of district heating also will economize coal use, reducing coal burning and thus greenhouse gas emissions, with positive effects on climate change.
- (vii) The transport subproject that improves road conditions and the road network will result in better connectivity and travel conditions. This will lead to shorter travel time per vehicle trip, with benefits in less fuel consumption and less vehicle emissions. This will reduce greenhouse gas emissions and therefore will have positive effects on climate change.

## VI. PROCEDURES FOR ENVIRONMENTAL ASSESSMENT OF SUBPROJECTS

### A. Inception of the EIA Study

21. EIA studies usually start near the completion of the feasibility study, after the draft feasibility study report has been compiled. This is because the EIA relies much on the information provided in this report. Yet it is encouraged that the EIA study and the feasibility study be carried out in parallel rather than in sequence. Working in parallel will reduce the amount of work and will shorten the time and program of these tasks.

22. Selection of the right EIA design institute to conduct the EIA study and prepare the EIA report is of utmost importance. The degree of details required by ADB in the EIA report is much more than that required locally. An EIA design institute with internationally funded project experience is preferred. If one cannot be found, the EIA design institute should at least have adequate experience, staffing, and capability to produce all the information mentioned in this report.

23. The selection of the feasibility study design institute is also important, because it will have a direct bearing on the quality of the EIA report. Again, ADB requires much more detail in the study than what are required locally. In fact, ADB's feasibility study requirement is approximately equivalent to the completion of preliminary design in the PRC. Therefore, the design institute for the subprojects must have the experience, staffing, capability, and willingness to complete the preliminary design of the subproject components in order to meet ADB requirements. An institute with general consulting experience will not be able to meet ADB requirements.

24. Upon start of the EIA study, the EIA team should complete the following tasks as soon as possible.

- (i) **Site visit.** The EIA team should visit the subproject sites as soon as possible to get an understanding of the environmental conditions in the vicinity. During the site visit, all targets sensitive to air, noise, and water pollution from the subproject must be identified and documented. Sensitive targets include residential areas, hospitals, schools, temples, cultural heritage sites, protected areas on conservation and ecology, national parks and nature reserves, water gathering grounds, and water bodies such as rivers and streams. These should be photographed and with their relative distances to the subproject sites measured and documented.

- (ii) **Baseline monitoring.** Air, noise, and water quality (surface and/or groundwater depending on the subproject component) should be measured as soon as possible. Monitoring locations should be selected at representative sensitive targets identified in the site visit. Routine monitoring data from the local environmental monitoring station can be substituted. However, such data must be collected from locations relevant to the subproject and must be collected less than 12 months ago.
- (iii) **Public consultation.** ADB requires two rounds of public consultation. The first round should be conducted at EIA inception. The purpose of the first round is to describe the subproject to the stakeholders and to solicit their views, concerns, and suggestions so that these could be adequately considered in the EIA study. It should be conducted as soon as the EIA study is started and should be in form of a public forum. More details on public consultation are provided in later sections.

## B. Procedures for Preparing the EIA Report

25. Attachment 1 provides the content page of the EIA report. It lists the chapters and subchapters that should be in the report to meet ADB requirements. Again, the EIA report can be prepared for a subproject (which might have more than one component and information for each component needs to be provided), or it can be prepared for just one subproject component (in which case more than one EIA report will be prepared to support a subproject if the subproject has more than one component). Detailed information required is described below.

26. Chapter 1 sets the scene for the report. It provides an overview of the big picture from the provincial level. It describes the project background, the reasons and needs for the subproject, government policies in supporting the subproject, present status of infrastructure related to the Project in a provincial setting, and highlights of benefits. The following information should be included in this chapter.

- (i) Describe the status and provide statistics on small cities and towns in the province.
- (ii) Describe the present problems (economic, social, and environmental) in small cities and towns in the province.
- (iii) Describe government policies in supporting the urbanization of small cities and towns.
- (iv) Describe government actions taken to date in the urbanization of small cities and towns.
- (v) Describe the need for the subproject, and provide statistics on the present status of the subproject in the province. For example, if it is a wastewater treatment subproject, provide statistics on how much wastewater was generated in the province last year, how many WWTPs were in operation in the province last year, and the total treatment capacity. How much pollutant was discharged to the water bodies in the province last year? What was the water quality in the rivers in the province last year? The description should be quantitative with the citing of relevant statistics, rather than merely qualitative.
- (vi) Briefly describe the economic, social, and environmental benefits of the subproject.

27. Chapter 2 sets the scene for the subproject and describes its technical aspects. This chapter differs from Chapter 1 in the sense that Chapter 1 looks at the issues from the provincial

level and this chapter looks at the issues from the subproject city/town level. The following information should be provided in this chapter.

- (i) Briefly describe the subproject city/town, such as its location within the province, area, population, and economy (e.g. industry, agriculture, tourism).
- (ii) Describe the need for the subproject by using statistics. For example, if the subproject is district heating, provide information on the following in the subproject city/town:
  - (a) What is the present coverage of central heat supply in the subproject town/city?
  - (b) How many small boiler rooms and household stoves are being used for heating in the subproject area?
  - (c) What and where is the existing heat supply source, and what is its supply capacity?
  - (d) What fuel does the heat supply source use, and if coal, how much coal and what is the sulfur content of the coal?
  - (e) What dust removal and flue gas desulfurization equipment does the heat supply source have?
  - (f) What is the present air emission output of the heat supply source?
  - (g) With this subproject, how many small boiler rooms and household stoves will be eliminated, and how much air pollutant loads will be reduced as a result?
  - (h) How much coal usage will be reduced with the provision of this subproject?
  - (i) How much central heat supply coverage will be increased with the provision of this subproject?
- (iii) Describe the technical aspects of the subproject. For example, for district heating, provide the following information:
  - (a) How many central heating stations and heat exchange stations are there, and what are their capacities?
  - (b) What are their locations?
  - (c) Describe the dust removal and flue gas desulfurization equipment at the central heating stations.
  - (d) Describe the heat exchange mechanism at the heat exchange stations.
  - (e) How many kilometers of heat supply pipelines are there?

28. Chapter 3 provides information on the existing environmental conditions of the subproject city/town, with focus on the component sites. It includes nine subchapters on atmosphere and climate, topography and geology, noise, water, waste, ecology, fisheries, economic development, and social and cultural resources. Information required by each subchapter is described below.

29. **Atmosphere and Climate.** Provide information specific to the subproject city/town on the following:

- (i) climatic condition;
- (ii) annual average temperature, minimum temperature, maximum temperature, relative humidity, and number of frost-free days;
- (iii) annual average rainfall, minimum rainfall, and maximum rainfall;
- (iv) predominant wind direction and wind speed;
- (v) existing air quality based on baseline monitoring results conducted under the EIA study (provide numerical values of air pollutant concentrations); and

- (vi) whether the existing air quality meets or exceeds applicable ambient air quality standards.
30. **Topography and Geology.** Provide information specific to the subproject city/town on the following:
- (i) topography and landforms,
  - (ii) geological features, and
  - (iii) soil characteristics.
31. **Noise.** Provide information specific to the subproject city/town on the following:
- (i) day and night environmental noise based on baseline monitoring results conducted under the EIA study (provide A-weighted decibel [dB(A)] values);
  - (ii) day and night traffic noise based on baseline monitoring results conducted under the EIA study (provide dB[A] values); and
  - (iii) whether the noise levels meet or exceed the noise standards applicable to the noise functional zones of the respective monitoring locations.
32. **Water.** This includes both surface water and groundwater. Provide information specific to the subproject city/town on the following:
- (i) rivers, lakes, reservoirs, and marine water (for coastal subproject cities/towns) present in the subproject cities/towns;
  - (ii) existing surface water quality conditions and the water quality classification of these water bodies based on the baseline surface water quality monitoring conducted under the EIA study (provide numerical values of water quality pollutants);
  - (iii) groundwater aquifer;
  - (iv) existing groundwater quality conditions and the water quality classification based on the baseline surface water quality monitoring conducted under the EIA study (provide numerical values of water quality pollutants);
  - (v) total supply capacities and their existing extraction amount if surface and/or groundwater are used for drinking water;
  - (vi) total quantities of industrial and domestic wastewater generated and discharged into the water bodies each year; and
  - (vii) number of existing WWTPs and total treatment capacity.
33. **Waste.** Provide information specific to the subproject city/town on the following:
- (i) total quantity of municipal solid waste generated each year,
  - (ii) types and number of solid waste treatment facilities and their total treatment capacity, and
  - (iii) present status of waste collection and transfer.
34. **Ecology.** Provide information specific to the subproject city/town on the following:
- (i) percentage of forest coverage;
  - (ii) dominant vegetation types and plant species;
  - (iii) dominant animal and wildlife species;
  - (iv) dominant freshwater and/or marine species;

- (v) habitats and presence of protected, threatened, or endangered species at the subproject sites; and
- (vi) whether the subproject site or construction works will encroach onto protected areas such as nature reserves or water gathering grounds.

35. **Fisheries.** Information should include both fresh and saltwater species of commercial importance, as well as both capture and culture fisheries. Provide information specific to the subproject city/town on the following:

- (i) dominant fish and shellfish species of commercial importance, and
- (ii) commercial fisheries production and revenue each year.

36. **Economic Development.** Provide information specific to the subproject city/town on the following:

- (i) land use such as residential, industrial, and agricultural;
- (ii) transport infrastructure;
- (iii) key industrial sectors, key industries, and production statistics;
- (iv) agricultural products and production statistics;
- (v) socioeconomic indicators such as gross domestic product, urban annual average wage, farmers' useable income level, unemployment, and poverty levels.

37. **Social and Cultural Resources.** Provide information specific to the subproject city/town on the following:

- (i) population and communities (e.g., ethnic groups and number of villages/towns);
- (ii) number and types of health facilities such as hospitals, clinics, and number of hospital beds;
- (iii) number and types of educational facilities such as kindergartens, primary and secondary schools, vocational training institutions, and universities;
- (iv) municipal services such as heating supply, power supply, water supply, and wastewater and solid waste collection and treatment;
- (v) any resources or land being used by indigenous ethnic minority groups; and
- (vi) cultural heritage resources such as archaeological sites, cultural resources, and heritage protection sites.

38. Chapter 4 describes various alternatives that have been considered during the feasibility study and EIA study. The pros and cons of each alternative should be discussed to support the decision on the alternatives selected. Provide information on the following.

- (i) **With-project and without-project alternatives.** This compares the subproject with the no-subproject scenario. Explain the benefits of having the subproject, and compare them with the detriment of not having the subproject.
- (ii) **Specific alternatives discussion.** Describe the alternatives considered for the subproject or subproject component. Depending on the nature of the component, alternatives may involve (a) site selection; (b) road/pipeline alignment; (c) treatment technology/process; (d) disinfection technology/process; (e) construction method; (f) construction (e.g., piping, embankment, road surface) material; and (g) environmental protection/emission control technology/process. Explain how and why the final selection on each alternative was made.

39. Chapter 5 begins by describing the positive impacts and environmental benefits of the subproject, followed by information on the environmental standards used in the EIA study, environmental impacts during construction and operation, mitigation measures needed to reduce such impacts, and resettlement. The following information should be provided.

- (i) **Positive impacts and environmental benefits.** Describe the subproject's positive impacts and environmental benefits. The description should be both qualitative and quantitative, with numerical values on tons of pollutant (e.g., sulfur dioxide or COD<sub>Cr</sub>) reduced, number of small boiler rooms demolished, tons of coal use reduced, and percentage of coverage increased.
- (ii) **Environmental standards.** Provide information on national and local standards on air quality, noise, surface and groundwater quality, and soil used for assessing environmental impacts in the EIA study. Cite the national or local regulation numbers.
- (iii) **Impact and mitigation measures during the construction phase.** Provide information on the assessment results on air quality, noise, water (surface and ground) quality, waste, ecology, and cultural heritage during the construction phase. Information to address the key environmental issues during construction (see examples in paras. 5–10) must be included, and the information should be quantitative as far as possible. The following should be noted.
  - (a) The assessment results should be quantitative.
  - (b) Compare these results with the environmental standards to see if they comply with or exceed the relevant standards.
  - (c) If they do exceed them, propose mitigation measures that will reduce the environmental impact to acceptable levels.
  - (d) Also list these mitigation measures in the EMP.
- (iv) **Resettlement.** Provide information on land area to be permanently acquired by the subproject, land area to be temporarily occupied by the subproject, amount of permanently acquired land is cultivated land, area of buildings to be demolished, and number of persons to be resettled due to the subproject. The land to be permanently acquired represents resources that will be permanently lost and cannot be replaced.
- (v) **Impact and mitigation measures during the operation phase.** Provide information on the assessment results on air quality, noise, water (surface and ground) quality, waste, ecology, and cultural heritage during the operation phase. Information to address the key environmental issues during operation (see examples in paras. 5–10) must be included, and the information should be quantitative. The following should be noted.
  - (a) The assessment results should be quantitative.
  - (b) Compare these results with the environmental standards to see if they comply with or exceed the relevant standards.
  - (c) If they do exceed them, propose mitigation measures that will reduce the environmental impact to acceptable levels.
  - (d) Also list these mitigation measures in the EMP.
  - (e) Assess impact from demand on resources.
  - (f) Also describe pollutant reductions during the operation phase.

40. Chapter 6 describes the economic benefits of the subproject. These may include promotion of tourism or industrial development due to environmental infrastructure provided by the subproject. The economic internal rate of return for the subproject must also be presented.

41. A comprehensive EMP must be prepared as an appendix to the EIA report following the EMP prepared for core subprojects. The requirements of the EMP are described in later sections. Chapter 7 in the EIA report summarizes the key components of the EMP, which include:

- (i) a summary of environmental impacts and their respective mitigation measures,
- (ii) a summary of the environmental monitoring plan,
- (iii) public consultation needs during the construction and operation phases,
- (iv) responsibilities of various parties during the implementation of the EMP, and
- (v) cost estimates for implementing the EMP.

42. Chapter 8 describes the public consultations conducted during the EIA study. ADB requires two rounds of public consultation. Information to be provided in this chapter includes:

- (i) the dates and locations of the two rounds of public consultation;
- (ii) the number and make up (e.g., government representatives, village leaders, private citizens) of participants in each round;
- (iii) questions, concerns, ideas, and suggestions raised by the participants; and
- (iv) how the questions, concerns, ideas and suggestions raised by the participants are answered in the EIA study and report.

43. More information on conducting public consultation will be provided in later sections.

44. Chapter 9 summarizes the findings of the EIA study. It includes information on:

- (i) subproject benefits, including both economic and environmental;
- (ii) summary of significant environmental impacts during the construction and operation phases, and their respective mitigation measures,;
- (iii) the use of irreplaceable resources such as the area of land and associated habitats and resources that will be permanently lost due to permanent land acquisition; and
- (iv) highlights of the EMP, including environmental monitoring requirements.

### **C. Procedures for Conducting Public Consultation**

45. ADB requires two rounds of public consultation during the EIA study. The first round should be conducted shortly after the start of the EIA study. The purpose of the first round is to introduce the subproject and to solicit views from the stakeholders so that their concerns, ideas, and suggestions can and will be addressed during the study. The second round should be conducted after the draft EIA report is completed. The purpose of the second round is to present the EIA findings and mitigation measures to the stakeholders, and to answer concerns and suggestions raised in the first round. Any concerns and suggestions raised in the second round should be addressed and incorporated into the final EIA report.

46. Public consultation could be in form of Internet information disclosure (with a mechanism to receive feedback), questionnaire survey, workshop, or a public forum. However, ADB prefers public forums, which provides an interactive process among the project proponent, the EIA design institute, and stakeholders. Stakeholders invited to the public forum should be representative of various community groups that could be affected by the Project, including government officials, village representatives, private citizens residing within or near the subproject sites, school masters, and hospital administrators.

47. The EIA design institute is responsible for organizing and conducting the public forum, with assistance from the local PMO, EA, and IA on provision of (i) stakeholder contact list; and (ii) venue, date, and time of the forum. The local PMO should prepare an invitation letter listing the venue, date, time, and contact person information for the forum. The EIA design institute should prepare a consultation document (preferably short and not more than four pages) to describe (i) the subproject, (ii) benefits of the subproject, (iii) potential environmental impacts, (iv) relevant mitigation measures, and (v) a map showing the subproject location. Since the first round is at EIA inception and the purpose to solicit initial views, concerns, and suggestions from stakeholders, the document should focus on subproject introduction and benefits, particularly when there will not be any EIA findings on impacts and mitigation measures at such an early stage. For the second round, the focus of the document should be on presenting potential environmental impacts and mitigation measures and how the first round queries are addressed in the EIA study.

48. The invitation letter and the consultation document should be sent to stakeholders, based on the compiled stakeholder contact list, at least 1 week before the date of the forum. Two days before the forum, the EIA design institute should contact the invited participants by telephone, to ensure that they received the consultation document and to remind them to attend the forum. Experience indicated that such a personal touch would increase the attendance rate of the forum.

49. The forum should be chaired by the local EA or IA and conducted by the EIA design institute. The participants should be encouraged to express their views, concerns, ideas, and suggestions. The EIA design institute is responsible for taking notes and recording all discussions in the forum and for producing the meeting minutes to be included in the EIA report.

#### **D. Procedures for Preparing the Environmental Management Plan**

50. The EMP should include four main items. These are (i) environmental mitigation measures, (ii) environmental monitoring, (iii) public consultation, and (iv) institutional strengthening and training. These four items are described below.

51. The EMP should include a table listing the implementation of the mitigation measures. An example is shown in Attachment 2. All mitigation measures mentioned in the EIA report should be listed in this table, covering the detailed design, construction, and operation phases. It is important to include the detailed design phase because some mitigation measures will become part of a facility and will have to be designed and included in the specifications for tendering. Examples are leachate and methane gas collection and treatment systems for landfill subprojects, dust removal and flue gas desulfurization equipment for central heat supply subprojects, and safety designs for disinfection facilities involving the storage and use of chlorine in WTPs and WWTPs. It is important to state the responsibilities for implementation and supervision. Cost estimates also need to be provided. To avoid double counting of costs, costs for items that will become a permanent part of the facility and for items that are already included in the daily operational costs of the subproject (e.g., equipment for online monitoring of air emissions from central heating stations) should not be included in this table, since these should already have been included in the overall project cost. Costs to be included in the table should be mostly temporary measures during the construction stage. Examples are the watering of construction site and haul roads to reduce dust, temporary noise barriers around noisy machines, sedimentation basins and perimeter drainage ditches to control muddy site runoff, and temporary chemical toilets for construction workers.

52. Based on results of impact assessment and the locations of sensitive targets, an environmental monitoring plan should be compiled for the construction and operation phases. An example is shown in Attachment 3. The plan should be impact and location specific. For example, if the facility does not have any sensitive target within 1 kilometer during construction, there may not be any need to conduct air and noise monitoring or the monitoring frequency could be less. The plan should also be very specific on the parameters to be monitored, the total number of monitoring locations, the exact locations where monitoring is to be carried out, and the frequency and duration of monitoring. The table should also list clearly who is responsible for the monitoring and supervision. Cost estimates should be provided for undertaking such monitoring. For the operation phase, cost estimates should be provided for the first year, and the need to continue monitoring after the first year should be reviewed at the end of the first year. For example, if monitoring of operational noise from pumping stations shows compliance in the first year, it is unlikely that the results would change after that and such monitoring can therefore stop.

53. The need for public consultation should be addressed in the EMP, with the numbers and types of public consultation during the construction and operation phases listed. This is an important public relations means to involve stakeholders in the subproject. An example is shown in Attachment 4. Cost estimates for conducting such consultation should also be provided.

54. Institutional strengthening and training of the local PMO, EA, IA, and other parties involved in the subproject is important in ensuring that they have the capacity to implement the EMP. An example for training is in Attachment 5, with cost estimates provided. The training program should be based on the nature of the subproject (for example, solid waste management training for solid waste subprojects); the needs of the PMO, EA, and IA; and the level of environmental awareness of workers and communities.

## **VII. CONFIRMATION THAT ENVIRONMENTAL ASSESSMENT AND REVIEW PROCEDURES CONFORMS TO ADB'S ENVIRONMENTAL AND SOCIAL SAFEGUARD POLICIES**

55. There will be two levels of review and appraisal. The first is the review and appraisal of subproject and subproject components. The second is the review and appraisal of the EIA reports and EMPs.

56. **Review and Selection of Subprojects and Subproject Components.** The environmental management consultants will (i) collect and review all necessary data; (ii) discuss with the PMO and other stakeholders all relative issues; (iii) with the PMO, conduct subproject and subproject components review and selection against the criteria described in paras. 19–20; and (iv) submit to ADB recommendations for selecting the subprojects and subproject components. ADB will review and endorse the subprojects and subproject component selection and/or advise otherwise.

57. **Review and Appraisal of EIA Reports and EMPs.** The provincial PMO will review and appraise all the domestic EIA reports and EMPs against the requirements and formats described in Appendix 3 to ensure that the information needs presented in the EAMF are fully provided and that the impacts are mitigated to acceptable levels with the implementation of described mitigation measures. The procedures for the review and appraisal of EIA reports and EMPs are described below.

- (i) The provincial PMO will review and appraise all EIA reports and EMPs.

- (ii) The provincial PMO will reject reports not meeting the informational, procedural, and organizational requirements and send them back for improvements and resubmission. Resubmitted reports will again be reviewed and appraised.
- (iii) If the EIA reports and EMPs informational, procedural, and organizational requirements are met, the provincial PMO will sign off on the reports and submit them to the environmental management consultants.
- (iv) The PMO will also submit its recommendations for further processing the subprojects or subproject components that requires the special attention described in para. 58. The review and appraisal procedures for subprojects and subproject components requiring special attention will be conducted as specified in para. 59.
- (v) The consultants will sign off on these recommendations, if appropriate.
- (vi) An environmental specialist of ADB's Operations Department will endorse all EIAs and EMPs for subprojects not requiring the special attention described in para. 58, based on the submitted recommendations.
- (vii) After the endorsement of EIAs and EMPs by ADB, the subprojects not requiring special attention as described in para. 58 will be approved by the provincial PMO. This PMO is responsible for incorporating into the subproject design any revisions made in the EIAs and EMPs during EIA appraisal.

58. The following is the list of most sensitive components requiring special attention:

- (i) solid waste component involving incineration;
- (ii) solid waste component involving landfill and/or composting facilities without leachate and/or methane gas collection and treatment;
- (iii) district heating component without dust removal and flue gas desulfurization equipment for the central heat supply station using coal as fuel;
- (iv) water supply component using groundwater as water source;
- (v) water supply component using more than 5% of the surface water flow as water source;
- (vi) wastewater treatment component with treatment plant having a total design capacity of more than 100,000 cubic meters (m<sup>3</sup>) per day and discharging into a Class III or better water body;
- (vii) transport component located in densely populated areas;
- (viii) component that would impinge on water gathering grounds, nature conservation areas, protected ecological habitats, and/or protected heritage sites; and
- (ix) component with other factors involving ADB Category A.

59. The review and appraisal procedures for the EIA reports and EMPs that need special attention as specified in para. 58 are as follows.

- (i) The environmental management consultants will conduct separate review and appraisal of EIA reports and EMPs following the PMO review and recommendations.
- (ii) The consultants will reject EIA reports and EMPs not meeting the informational, procedural, and organizational requirements; not providing sufficient estimates of subproject impacts; and/or not adequately monitoring and mitigating subproject impacts as per ADB requirements, and send them back for improvements and resubmission. Resubmitted reports will again be reviewed and appraised.
- (iii) If the EIA reports and EMPs informational, procedural, and organizational requirements and impact assessments monitoring and mitigation as of ADB

- requirements are met, the consultants will sign off on the reports and submit to ADB with the recommendation for web posting or rejection.
- (iv) An environmental specialist of ADB's Operations Department will approve or reject all EIAs and EMPs based on the above recommendations.
  - (v) After approval of EIAs and EMPs by ADB, the subprojects will be approved by the provincial PMO. This PMO is responsible for incorporating into the subproject design any revisions made in the EIAs and EMPs during EIA appraisal.
  - (vi) ADB's Operations Department will ensure posting of the noncore subproject EIAs and EMPs on the ADB website within 1 month for 120 days duration.
  - (vii) Construction of the subproject can start on the expiration of the posting period.

### **VIII. STAFFING REQUIREMENTS AND BUDGET**

60. The EAs will bear the costs for preparing the EIA reports and EMPs. The EMPs will itemize the staffing requirements, institutional strengthening and training needs, implementation of the environmental mitigation measures and environmental monitoring, costs, IAs, and supervising parties. The EAs will bear all these costs except the cost for the trainer.

61. It is recommended that full-time environmental management consultants be appointed by ADB for the sector loan during loan implementation, to (i) ensure full EMP implementation during design, construction, and operation; (ii) review the EIA reports and EMPs of no-core subprojects; and (iii) provide training for institutional strengthening and other training needs as identified in the noncore subproject EMPs.

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<sup>1</sup> Complete table as shown in Attachment 2.

<sup>2</sup> Complete table as shown in Attachment 3.

<sup>3</sup> Complete tables as shown in Attachments 4 and 5.

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**APPENDIXES**

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### Attachment 2 - Summary Format of Potential Impacts and Mitigation Measures

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY'10,000)		
					Donggang	Linghai	Kazuo
<b>A. Design Stage</b>							
Air	Odor from dredged spoil during river improvement works in Donggang	<ul style="list-style-type: none"> <li>Properly identify locations for the temporary storage of dredged spoils that are away from residents, hospitals and schools</li> </ul>	Design Institute	DMMD, LMMD, KCIC			Included in the detailed design contract
	Dust from construction activities in Donggang, Linghai and Kazuo	<ul style="list-style-type: none"> <li>Include in tender documents specifications on good construction site practices related to dust control described in the SEIA, such as daily watering of unpaved areas and stockpiles, covering of stockpiles, vehicle speed control, etc.</li> </ul>					
Noise	Operational noise from the water supply, storm water and wastewater pumping stations in Donggang, Linghai and Kazuo	<ul style="list-style-type: none"> <li>Select low noise equipment and design soundproof or noise absorptive facilities for main noise sources.</li> </ul>	Design Institute	DMMD, LMMD, KCIC			Included in the detailed design contract
	Noise from powered mechanical equipment during construction in Donggang, Linghai and Kazuo	<ul style="list-style-type: none"> <li>Include in tender documents specifications on good construction site practices described in the SEIA related to noise control, such as the use of low noise equipment and temporary noise barriers or hoardings, and regular maintenance of equipment, etc.</li> </ul>					
Water	Construction site runoff and wastewater from construction workers	<ul style="list-style-type: none"> <li>Include in tender documents specifications on good construction site practices related to construction site drainage and wastewater management described in the SEIA, such as perimeter drainage ditch,</li> </ul>	Design Institute	DMMD, LMMD, KCIC			Included in the detailed design contract

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)				
					Donggang	Linghai	Kazuo	Total	
		sedimentation tanks, and potable chemical toilets, etc.							
	Design of the WTP in Kazuo	<ul style="list-style-type: none"> <li>• Proper design of the WTP to ensure reliable water supply and water quality</li> <li>• Proper design of the chlorine storage and dosing facility to ensure safety and adequate alarm system</li> </ul>							
	Design of water supply, storm water and wastewater pipelines	<ul style="list-style-type: none"> <li>• Properly pipeline design and material selection to prevent pipe burst</li> </ul>							
Solid Waste	Disposal of excavated soil, construction and demolition wastes, and dredged spoil during construction in Donggang, Linghai and Kazuo	<ul style="list-style-type: none"> <li>• Identify storage and/or disposal facilities and specify the use of these facilities in the tender documents</li> </ul>	Design Institute	DMMD, LMMD, KCIC	Included in the detailed design contract				
<b>B. Construction Stage</b>									
Air	Dust	<ul style="list-style-type: none"> <li>• Adopt advanced construction technique and select appropriate machinery and transportation vehicles in compliance with national emission standard;</li> <li>• Well organize material storage; separate stone and sand materials, store concrete in separate storage place and minimize transportation required; timely clean up C &amp; D waste;</li> <li>• Spray water on exposed surface and unpaved haul roads</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB		10	10.2	3	23.2

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
		<ul style="list-style-type: none"> <li>Avoid truck overloaded, cover material during transport; timely clear the dust and spray water on haul road;</li> <li>Set up hoarding around construction site, particularly for sensitive receivers nearby roads, including school, worshipping place, hospital, residential areas;</li> <li>Stop construction during strong wind and cover the stockpile;</li> <li>Limit vehicle speed on unpaved haul roads to &lt; 8 km/h.</li> </ul>						
		<ul style="list-style-type: none"> <li>Strengthen construction arrangement and avoid construction in nighttime (2400 hr – 0800 hr)</li> <li>Substitute pneumatic tools with hydraulic tools</li> <li>Use low noise machinery</li> <li>Install temporary noise barrier around noisy machinery</li> <li>Avoid concrete mixing, use pre-mixed concrete</li> <li>Traffic control on site and limit the honning</li> <li>During transportation, loading and unloading of construction materials, honning is prohibited when vehicles pass through sensitive receivers.</li> <li>Liaise with nearby schools to avoid noisy activities during examination periods</li> </ul>						
Noise	Noise from power mechanical equipment and vehicles		Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	5	3	2	10
Water	Wastewater from construction workers, canteens and machinery maintenance, and site runoff	<ul style="list-style-type: none"> <li>Strengthen management, discharge domestic wastewater to the nearby sewer network or have it treated by on-site package plant;</li> <li>Build storage tank, drainage ditch, temporary sedimentation tank to</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	1.7	3		4.7

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
		<p>treat wastewater from excavation, equipment cooling or washing before discharging to sewer network;</p> <ul style="list-style-type: none"> <li>Regular maintenance of construction equipment to avoid accident during construction;</li> <li>Location of storage site and sand mixing site should be at least 100 m away from water body. Moreover, regular water spraying during construction can reduce the pollution;</li> <li>Asphalt mixing site should be enclosed in the downwind direction at least 500 m away from the water body to avoid the water body from being contaminated;</li> <li>Strengthen water use management, and avoid introduction of chemicals during the vegetation rehabilitation work to reduce water pollution.</li> </ul>						
Solid Waste	<p>Refuse generated on construction sites, construction &amp; demolition waste, excavated soil</p>	<ul style="list-style-type: none"> <li>Collect and timely cleanup the refuse and dispose of in landfill</li> <li>Sort the construction waste and recycle or reuse if possible</li> <li>Maximize the reuse of excavated soil for backfilling</li> <li>Dispose the waste to designated sites only</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	2	6	2	10
Ecology, Habitat and Soil Conservation	<p>Affected vegetation</p> <p>Soil erosion and water/soil conservation</p>	<ul style="list-style-type: none"> <li>Relocate the trees affected by the construction, avoid trees cutting and restore the vegetation on completion of construction</li> <li>Set up hoarding around the construction site, build temporary drainage ditch and hoarding for temporary living quarters, install</li> </ul>	Contractor	DMMD, LMMD, KCIC, DEPB, LEPB, KEPB	26.2	10.8		37

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)			
					Donggang	Linghai	Kazuo	Total
		<p>hoarding and drainage for temporary roads, regularly water haul road, cover the soil and aggregate materials on the truck during transport</p> <ul style="list-style-type: none"> <li>• Build drainage ditch and slope protection during site formation</li> <li>• Develop rainy season construction plan to prevent surface runoff and soil erosion;</li> <li>• Protect farmland and channels near construction sites</li> </ul>						
Workplace Health and Safety	Health and safety of workers	<ul style="list-style-type: none"> <li>• Maintain efficient sanitation in the construction area; provide health check to workers;</li> <li>• Safety training and management should be strengthened to ensure the safe construction;</li> <li>• Construction workers should be equipped with personnel protection utilities, such as earplug, helmet, etc when necessary.</li> <li>• Regular maintenance of construction equipment to avoid accident during construction</li> </ul>	Contractor	DMMD, LMMD, KCIC	8.2	3.6		11.8
Social	Traffic congestion	<ul style="list-style-type: none"> <li>• Divert or schedule the construction traffic to avoid peak hours</li> <li>• Build temporary roads</li> <li>• Phased construction in busy traffic road and reduce the construction period</li> <li>• Select transport routes to reduce disturbance to regular traffic</li> </ul>	Contractor	DMMD, LMMD, KCIC	2	1.2		3.2
Cultural Heritage	Culture heritage affected by the construction activities	<ul style="list-style-type: none"> <li>• Should culture heritage discovered during the construction, stop construction, protect the site and report to the authority</li> </ul>	Contractor	DMMD, LMMD, KCIC				

Subject	Potential Impacts	Mitigation Measures	Implementing Agency	Supervising Agency	Estimated Costs (CNY10,000)		
					Donggang	Linghai	Kazuo
Management	Management on EMP implementation	<ul style="list-style-type: none"> <li>Hire staff on construction site supervision to ensure EMP implementation</li> </ul>			80	80	160
<b>C. Operational Stage</b>							
Air	Potential chlorine leakage in WTP	<ul style="list-style-type: none"> <li>Use only 500 kg chlorine cylinders and store at maximum a 20-day supply</li> </ul>	KCIC	KPMO			Included in operating costs
	Building units affected by traffic noise	<ul style="list-style-type: none"> <li>Install double-glazed windows or air-conditioning at the affected building units in Donggang</li> </ul>	DMMD, LMMD	DPMO, LPMO	192.4	61.7	254.1
Noise	Noise from the water supply, storm water and wastewater pumping stations in Donggang, Linghai and Kazuo	<ul style="list-style-type: none"> <li>Regular maintenance on machinery and keep the equipment in good condition</li> </ul>	DMMD, LMMD, KCIC	DPMO, LPMO, KPMO			Included in operating costs
Water	Water source protection	<ul style="list-style-type: none"> <li>Set up and implement water source protection plan</li> </ul>	KCIC	KPMO			Included in operating costs
Solid Waste	Sludge from WTP in Donggang	<ul style="list-style-type: none"> <li>Dispose at sanitary landfill after dewatering</li> </ul>	KCIC	KPMO			Included in operating costs
<b>Total</b>							<b>514</b>

DEPB = Donggang Environmental Protection Bureau, DMMD = Donggang City Municipal Management Department, DPMO = Donggang Project Management Office, KCIC = Kazuo County Construction and Investment Company Ltd, KEPB = Kazuo Environmental Protection Bureau, KPMO = Kazuo Project Management Office, LEPB = Linghai Environmental Protection Bureau, LMMD = Linghai City Municipal Management Department, LPMO = Linghai Project Management Office, WTP = water treatment plant.  
Sources: EIA reports.

## Attachment 3 - Environmental Monitoring Program

Subject	Parameter	Location	Time	Frequency	Implementing Agency	Supervision Agency	Estimated Cost (CNY10,000)
<b>Donggang - Construction Phase</b>							
Air	TSP, PM <sub>10</sub>	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road and Xincheng Road	Once in the morning and once in the afternoon	Two days per month	Contractor	DMMD, DEPB	3.2
Noise	Leq	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road and Xincheng Road	Once during daytime, once at night time	One day per month	Contractor	DMMD, DEPB	2
<b>Donggang – Operation Phase</b>							
Air	PM <sub>10</sub> , CO, NO <sub>x</sub> , THC	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road and Xincheng Road	24-hr continuous monitoring for 2 consecutive days	Two times per year, once in the spring and once in the autumn	DMMD	DPMO, DEPB	1.2 (for first year)
Noise	Leq	13 locations: same as the baseline monitoring locations in the Donggang EIA report, on Qingnian North Road, Yingbin West Street, Goubei Road and Xincheng Road	Once during day time and once at night time per day for 2 consecutive days	Two times per year	DMMD	DPMO, DEPB	1.2 (for first year)
<b>Linghai – Construction Phase</b>							
Air	TSP, PM <sub>10</sub>	4 locations: Linghai No. 2 Secondary School, Linghai Chinese Medicine Hospital, Dianli residential block, and Mingquyuan residential block	Once in the morning and once in the afternoon	Two days per month	Contractor	LMMD, LEPB	5

Subject	Parameter	Location	Time	Frequency	Implementing Agency	Supervision Agency	Estimated Cost (CNY10,000)
Noise	Leq	6 locations: Linghai No. 1 Primary School, Linghai Chinese Medicine Hospital, Linghai No. 3 Kindergarten, Shijiyuan residential block, Fuhuyuan, and Mingqiuyuan residential block	Once in day time and once at night	One day per month	Contractor	LMMD, LEPB	2
<b>Linghai – Operation Phase</b>							
Air	CO, NO <sub>x</sub> , THC, PM <sub>10</sub>	3 locations: Linghai No. 2 Secondary School, Linghai Chinese Medicine Hospital, Dianli residential block	2 consecutive days with 24 hr continuous monitoring on each day	Two times per year, once in the spring and once in the autumn	LMMD	LPMO, LEPB	5 (for first year)
Noise	Leq	5 locations: Linghai No. 1 Primary School, Linghai Chinese Medicine Hospital, Linghai No. 3 Kindergarten, Shijiyuan residential block, and Fuhuyuan	Two consecutive days with once in day time and once at night on each day	Two times per year	LMMD	LPMO, LEPB	2 (for first year)
<b>Kazuo – Construction Phase</b>							
Air	TSP	At the WTP construction site and along the pipeline route	Once in the morning, once in the afternoon and once at night	Two days per month	Contractor	KCIC, KEPB	6
Noise	Leq	At the WTP construction site boundary and nearby residential areas (Wangjiadian, Fangshanzi, Tabeiyingzi, Shuiquansiju, Erdaomen, Xidi and Nanliangzi)	Once in day time and once in night time each day	Two days per month	Contractor	KCIC, KEPB	3
Surface water	pH, TPH, SS, water quantity	Daling River at 200 m upstream and 500 m downstream of Nanliangzi respectively Mangniu River when pipeline work crosses the Mangniu River, at 200 m upstream	once in the morning and once in the afternoon	Three days per week	Contractor	KCIC, KEPB	1.5

Subject	Parameter	Location	Time	Frequency	Implementing Agency	Supervision Agency	Estimated Cost (CNY10,000)
		and 500 m downstream of the pipeline crossing respectively					
<b>Kazuo - Operation Phase</b>							
Noise	Leq	2 locations: (i) at the WTP boundaries and (ii) at the village of Wangjiadian	3 consecutive days, once in day time and once at night on each day	Twice per year: once during the heating season and once during the non-heating season	KCIC	KPMO, KEPB	1 (for first year)
Surface water	pH, SS, COD <sub>Cr</sub> , NH <sub>3</sub> -N, water quantity	3 locations: at water intake of WTP, 300 m upstream of reservoir, 1000 m downstream of reservoir	2 times per day at water intake  3 consecutive days with once daily on rivers	Daily at water intake  Three times per year on rivers, once in wet season, once in dry season and once in-between wet and dry seasons	KCIC	KPMO, KEPB	5 (for first year)
Ground water	pH, COD <sub>Mn</sub> , NH <sub>3</sub> -N, total hardness, iron, total coliform	3 groundwater well locations: 50 m upstream, and 50 m and 100 m downstream of the WTP-	One day	Twice per year, once in wet season and once in dry season	KCIC	KPMO, KEPB	2.5 (for first year)
<b>Total</b>							<b>40.6</b>

BOD<sub>5</sub> = 5-day biochemical oxygen demand, CO = carbon monoxide, COD<sub>Cr</sub> = chemical oxygen demand, DEPB = Donggang Environmental Protection Bureau, DMMD = Donggang City Municipal Management Department, DPMO = Donggang Project Management Office, KCIC = Kazuo County Construction and Investment Company Ltd, KEPB = Kazuo Environmental Protection Bureau, KPMO = Kazuo Project Management Office, LEPB = Linghai Environmental Protection Bureau, LMMD = Linghai City Municipal Management Department, LPMO = Linghai Project Management Office, NH<sub>3</sub>-N = ammonia nitrogen, NO<sub>2</sub> = nitrogen dioxide, pH = unit of acidity, PM<sub>10</sub> = particular matter with diameter ≥10µ, SS = suspended solids, THC = total hydrocarbon TPH = total petroleum hydrocarbon, TSP = total suspended particulates, WTP = water treatment plant.  
Sources: Subproject EIAs, project preparatory technical assistance.

### Attachment 4 - Public Consultation Plan

Organizer	Approach	Times	Subject	Attendees
<b>A. Project Preparation</b>				
Liaoning PMO, local PMOs, EIA preparation institutes, PPTA Consultants	Public meeting	Twice	Environmental quality status; project information; major impacts and benefits; mitigation measures; attitudes, comments, and recommendations of the public	Residents, enterprises, NGOs and other stakeholders within construction and service area; specialists from various sectors
Local PMOs, local social survey institutes, PPTA Consultants	Social survey	Once		
Local PMOs, RP preparation institutes, PPTA Consultants	Survey on resettlement	As required by relevant resettlement plan	Comments on resettlement, improvement of living conditions, livelihood and poverty reduction; comments and suggestions	Persons affected by resettlement and relocation
Local PMOs, EMDP preparation institutes, PPTA Consultants	Public participation	As required by relevant EMDP	Comments on minority development plan, comments and suggestions	Ethnic minorities in the project areas
<b>B. Construction Phase</b>				
Liaoning PMO, local PMOs and IAs	Public consultation and site visits	At least once	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents adjacent to components, representatives of social sectors
Liaoning PMO, local PMOs and IAs	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on mitigation measures, public opinions	Experts of various sectors, media
Liaoning PMO, local PMOs and IAs	Survey on resettlement	As required by relevant resettlement plan	Comments on resettlement, improvement of living conditions, livelihood, and poverty reduction; comments and suggestions	Persons affected by resettlement and relocation
Liaoning PMO, local PMOs and IAs	Survey on minority	As required by relevant EMDP	Comments on minority development, comments and suggestions	Minorities in the project areas
<b>C. Operation Phase</b>				
Liaoning PMO, local PMOs, IAs, O&M Companies	Public consultation and site visits	Once in the first 2 years	Effects of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to component sites, representatives of residents and representatives of social sectors
Liaoning PMO, local PMOs, IAs, O&M Companies	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on operational impacts, public opinions	Experts of various sectors, media

EIA = environmental impact assessment, IA = implementing agency, PMO = project management office, PPTA = project preparatory technical assistance, RP = resettlement plan.  
Sources: EIAs, PPTA.

### Attachment 5 - Institutional Strengthening and Training

Strengthening Activities	Agencies	Strengthening Plan	Timing				
Capacity Building	Liaoning PMO, local PMOs, IAs	Institutional organization, development of responsibilities for each position	During project preparation and implementation				
Monitoring	Local PMOs, IAs, Contractors	Procurement of related monitoring instruments and equipment	During project preparation and implementation				
Training	Attendees	Contents	Times	Period (days)	Number of person	Cost (CNY/ person/ day)	Total Cost (CNY 10,000)
EMP implementation and adjustment, settlement of disputes, environmental policies and plans	Local PMOs, IAs, Contractors	Development and adjustment of the EMP, emergency response, environmental laws and regulations, environmental management	1	5	40	500	10
Environmental Pollution Control Technology	Local PMOs, IAs, Contractors, O&M companies	Engineering and pollution control technologies; equipment selection and procurement; operation, and maintenance of pollution control equipment	2	10	60	500	60
Environmental monitoring	Local PMOs, IAs, Contractors, O&M companies	Monitoring methods, data collection and processing, reporting systems	2	5	30	500	15
Water course management	Donggang PMO and IA	Hydrodynamic monitoring and maintenance of water courses	2	5	10	500	5
Traffic and safety Management	Local PMOs and IAs, Contractors	Study of traffic and road safety management, temporary traffic management during construction	2	5	30	500	15
Environmental awareness training	Local citizens and government officials	Environmental pollution, protection and conservation	6 (twice in each subproject town)	1	100	500	30
<b>Total</b>							<b>135</b>

EMP = environmental management plan, IA = implementing agency, PMO = project management office.  
Source: Project preparatory technical assistance.