Environmental Assessment Report

Summary Environmental Impact Assessment
Project Number: 42383
October 2008

People’s Republic of China: Shanxi Small Cities and Towns Development Demonstration Sector Project

Prepared by the Shanxi 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 17 October 2008)

Currency Unit – yuan (CNY)
CNY1.00 = $0.1461
$1.00 = CNY6.8435

ABBREVIATIONS

ADB – Asian Development Bank
BOD5 – 5-day biochemical oxygen demand
ClO2 – chlorine dioxide
CO2 – carbon dioxide
CODCr – chemical oxygen demand determined through the dichromate reflux method
CSC – construction supervision company
DMF – design and monitoring framework
EA – executing agency
EAMF – environmental assessment and management framework
EIA – environmental impact assessment
EMC – environmental management consultant
EMP – environmental management plan
EPB – environmental protection bureau
FSR – feasibility study report
GDP – gross domestic product
GHG – greenhouse gas
HDPE – high-density polyethylene
IA – implementing agency
LDI – local design institute
MSW – municipal solid waste
NH3-N – ammonia nitrogen
NOx – nitrogen oxides
O&M – operation and maintenance
pH – a unit of acidity
PM10 – particulate matter ≤10 micrometers in diameter
PMO – project management office
PPTA – project preparatory technical assistance
PRC – People’s Republic of China
RP – resettlement plan
SEIA – summary environmental impact assessment
SO2 – sulfur dioxide
SPG – Shanxi provincial government
SS – suspended solids
TN – total nitrogen
TP – total phosphorus
TSP – total suspended particulates
UNESCO – United Nations Educational, Scientific and Cultural Organization
WTP – water treatment plant
WWTP – wastewater treatment plant
WEIGHTS AND MEASURES

°C – degree Celsius
dB(A) – A-weighted decibel
ha – hectare
kg – kilogram
km – kilometer
km² – square kilometer
L_{eq} – equivalent continuous noise level (in decibels)
m – meter
m² – square meter
m³ – cubic meter
m³/d – cubic meters per day
mm – millimeter
m/s – meters per second
MW – megawatt
t/a – tons per annum
tCO₂e – tons of carbon dioxide equivalent
t/d – tons per day
t/hr – tons per hour

NOTE
In this report, “$” refers to US dollars.
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I. INTRODUCTION

1. The Shanxi Small Cities and Towns Development Demonstration Sector Project in the People’s Republic of China (PRC) is one of three sector loan projects prepared under a project preparatory technical assistance (PPTA) from the Asian Development Bank (ADB) that also covered sector projects in Hebei and Liaoning provinces. Sector lending is a form of ADB assistance for project-related investments based on considerations relating to an entire sector or subsector. A sector loan is provided to assist in the development of a specific sector or subsector by financing part of the investment in the sector. The loan is expected to improve sector policies and strengthen institutional capabilities. Such lending is appropriate particularly when a large number of subprojects in the sector or subsector are to be financed.

2. The Project will (i) support the development of selected small cities and towns in Shanxi Province to induce the development of other cities and towns in the province and elsewhere in the PRC; (ii) demonstrate how small cities and towns can achieve urban development that is economically, socially, and environmentally sustainable; (iii) support the provision of reliable, good-quality infrastructure including roads and water supply, wastewater, district heating, and solid waste facilities; (iv) support the incorporation of environmental and social considerations in urban planning and development; (v) provide better infrastructure and municipal services to enable the small cities and towns to achieve greater economic efficiency and sustainable development; and (vi) promote the integration of various infrastructure services to maximize the benefits from individual sector improvements. Wutong town, Youyu county, and Pingyao county have been selected as the core subproject areas (Map) to be supported by the Project. Several noncore subprojects will also be selected and implemented later on. The environmental assessment of the Project was based on the environmental impact assessments (EIAs) for the core subprojects and the environmental assessment and management framework (EAMF) for noncore subprojects.

3. This summary EIA (SEIA) for Shanxi Province summarizes the results of eight EIA reports and environmental management plans (EMPs) for the core subprojects prepared by the Taiyuan Science and Engineering University (for Wutong), the Shanxi Environmental Science Research Institute (for Youyu), and the Shanxi Sanitation Bureau (for Pingyao), and contains the EAMF. It explains (i) the sector project approach; (ii) the sector conditions; (iii) the project interventions, benefits, and impact; (iv) the subproject selection procedure; and (v) the selection, review, and appraisal of noncore subprojects according to the EAMF. The individual EIAs incorporated most of the EMP clauses. The other EMP items were developed jointly by the PPTA team and the institutes. The individual EIAs and feasibility study reports (FSRs) went through several rounds of revision suggested by the PPTA team specialists. The EIAs have been reviewed by the Government.

4. The urban population of the PRC has more than tripled since 1980, reaching 577 million in 2006. It is 45% of the total population today and is expected to exceed 50% by 2015. The PRC has 660 cities and about 20,000 towns, with an average population of 32,000 and a total population of 640 million. Urban households have an average disposable income about 3.3 times that of rural households. With increasing mechanization and labor efficiency in the agriculture sector, the urban areas have been swamped by waves of rural migrants in search of work. The PRC must create jobs for 150 million rural people and house twice that number over the period 2000–2020. Its cities cannot absorb all 300 million. The towns, a largely untapped urban resource in the PRC, must now build up their physical and institutional infrastructure for economic and urban growth, and assist the country in coping with its greatest urbanization challenge so far.
5. The Government of the PRC views urbanization as a means of increasing national economic productivity and promoting “harmonious development” and more equitable sharing of the benefits of economic growth. The 11th Five-Year Plan (2006–2010) continues the urban policy tradition in the PRC of promoting the development of small cities and towns, which can raise the standard of living of rural in-migrants without worsening infrastructure fatigue and other problems afflicting large cities. The towns have untapped potential to increase national economic productivity while narrowing the urban-rural income gap, thereby contributing to social stability.

6. Shanxi Province, with an area of 156,000 square kilometers (km²), is 1.6% of the size of the PRC. Its population is 33.75 million, mostly Han Chinese, but also Hui and other ethnic minorities. The population living in urban areas was 58% of the total in 2006 and is expected to rise to 63% by 2010. In 2006, about 6.2% of the population of Shanxi had incomes below the official poverty line, compared with 2.5% in the PRC.

7. Located in northern PRC with the Yellow River flowing along its western border, Shanxi is a cultural cradle of Chinese civilization, having written historical records that date back 3,000 years. The province is rich in cultural heritage and is known as the museum of ancient Chinese culture. Of the 35 sites in the PRC designated as World Heritage Sites by the United Nations Educational, Scientific and Cultural Organization (UNESCO), two are in Shanxi: the Pingyao Ancient City and the Yungang Grottoes of fifth-century Buddhist cave art in Datong City. Shanxi is also rich in energy and metal resources especially coal and aluminum. Proven coal reserves, spread over more than 90 counties, amount to 300 billion tons, one third of the proven reserves in the PRC. The industries in the province are predominantly related to the mining of coal and metals, coking, and metallurgy. These industries cause considerable pollution.

8. Small cities and towns in Shanxi have made substantial progress in recent years in facilitating economic growth. Some have the resources to take advantage of the growth of the mining and metals sectors. Others in metropolitan areas and development corridors have become important manufacturing centers, transportation hubs, or agro-processing sites (for specialty products), and still others have captured multiplier effects in the service sector. On the supply side in particular, town governments provide key inputs to investors, such as serviced land, regulatory support, and labor. In some towns, however, natural resource extraction and industrial development have outstripped infrastructure service provision, resulting in a degraded environment and substandard living conditions for local residents. The challenge here is to deliver better infrastructure services, safeguard the environment, and improve local living conditions. Other towns in Shanxi have not achieved economic growth and generated employment for the surrounding rural population. Economic activity and outside investments are low, households have little disposable income, and there is not enough capital for industrial and commercial development. These towns need to be provided with adequate urban infrastructure and other facilities to attract investment and promote economic growth.

9. Industrialization and intensive resource extraction are taxing the urban environment in Shanxi. The air, water, and land in many areas are highly polluted, seriously threatening human health and life expectancy. In many small cities and towns traffic congestion, inadequate potable water supplies, and poor wastewater collection and treatment are acute problems. Industrialization and population growth through migration to urban areas have exceeded the capacity of local government to provide services.

10. A 2006 audit of the environmental performance of 595 cities nationwide by the Ministry of Environmental Protection found air quality to be below class III standards in 39 cities, 7 of
them in Shanxi. Coal mining, coking, power generation, metallurgy, chemical refinery, and construction materials manufacturing are the dominant industries in Shanxi, and also it is most polluting. In 2005, these six industry groups contributed 97% of industrial sulfur dioxide (SO₂) emissions in the province, 95% of emissions of industrial particular matter smaller than 10 micrometers (PM₁₀), and 83% of industrial wastewater discharge. In 2006, SO₂ emissions in Shanxi amounted to 1.462 million tons, 1.177 million tons of this total (80.5%) from industry. The major sources of SO₂ emissions, in descending order, were power generation, metallurgy, and coking, which together accounted for 79% of industrial emissions in 2006; power generation alone accounted for almost 58%. Emissions in Shanxi per dollar of gross domestic product (GDP) in 2006—were 2.63 times the national average for SO₂ and 1.21 times for PM₁₀. Emissions per unit area were 3.76 times the national average for SO₂ and 1.72 times for PM₁₀.

11. Noise levels, in terms of equivalent continuous noise level (Lₚₑq), averaged 52.6 A-weighted decibels (dB[A]) in Shanxi cities in 2006. Traffic noise levels averaged 66.8 dB(A). Only in Datong City was traffic noise pollution deemed slight.

12. Shanxi has been suffering from a shortage of water. Coal mining has so far destroyed 20,352 km² of water resource areas, 13% of the size of Shanxi. The water resource amounts to 15.24 billion cubic meters (m³), next to last in size in the PRC. Of this total, 8.6 billion m³ is from groundwater but only 45% is extractable. There is only 466 m³ of water per Shanxi resident, 17% of the national average and only 4% of the world average. What is worse, both surface and groundwater qualities are deteriorating because of untreated and undertreated municipal and industrial wastewater discharged, and garbage dumped, into waterways and open areas. The Shanxi provincial government (SPG) monitored water sources in 11 cities in 2006 and found 81.1% potable. The major noncompliant parameters were total hardness, total nitrogen (TN), total phosphorus (TP), sulfate (SO₄), and total petroleum hydrocarbon. Of the groundwater sources monitored in 56 wells in 9 cities, 76.8% met class III Groundwater Quality Standards (GB/T14848-93). The major noncompliant parameters were SO₄, total hardness, and fluoride. SPG also monitored water quality in 102 sections of 26 rivers in 2006; 20.6% were class III (Division Plan of Surface Water Environment Management in Shanxi ) standard or better, 20.6% were in classes IV and V, and 58.8% were below class V. In 2006 Shanxi had 40 municipal wastewater treatment plants (WWTPs) with a total treatment capacity of 1.548 million tons per day (t/d). Shanxi generated 1.029 billion tons of wastewater in 2006 (2.819 million t/d)—588 million tons from municipal sources and 441 million tons from industry. The chemical oxygen demand determined through the dichromate reflux method (CODₐ) was 376,000 tons, 66.43% of this from six cities. Of the CODₐ amount, 158,700 tons came from industry and particularly from five industries—chemical refinery, beverage manufacturing, coking, food processing and production, paper, and metallurgy, in descending order—which accounted for 78% of the industrial CODₐ.

13. Solid waste treatment averages 51.79% nationwide, and 13.12% in Shanxi. In 2004 Shanxi collected 13,800 tons of solid waste per day, 8,900 t/d from urban areas. Shanxi now has 10 solid waste facilities in operation—8 sanitary landfills, an incinerator, and a composting facility—with a total capacity of 2,457 t/d. The 4 sanitary landfills and 3 integrated treatment facilities that are now being built will add 4,390 t/d of capacity. But since solid waste from the urban areas has been projected to reach 16,900 t/d by 2010, capacity will have to increase by 15,000 t/d more between now and 2010 to meet this need.

14. In 2005, centralized heating covered only 46.6% of the built-up urban areas. Without widespread centralized heating and natural gas supply, coal-burning stoves are the main domestic source for heating and cooking. Most households use coal mud, a residue from coal
washing generally with high sulfur content, for that purpose. The practice pollutes the air, both indoors and outdoors, and may cause respiratory disease from coal dust.

15. Shanxi’s policy for the development of its small cities and towns mirrors the national policy. The Directives on Accelerating Development of Small Cities and Towns in Shanxi Province (SPG, 2005) look on small cities and towns as growth engines for the surrounding rural areas that can absorb rural in-migrants and relieve the population pressure on the large cities.¹ City development in the towns and counties therefore contributes directly to the provincial objective of promoting integrated rural-urban development.

16. The environmental, health, and socioeconomic benefits from the Project are substantial. The Project will improve the delivery of urban infrastructure services by implementing subprojects in selected small cities and towns. The subprojects will have one or more investment components in roads, water supply, wastewater, river improvement, district heating and gas supply, and education. These subprojects will increase employment and sustainable economic growth, clean up the urban environment, and improve urban infrastructure and municipal services. Roads will improve the transportation network and connectivity, thereby cutting travel time, reducing vehicle emissions, and helping to mitigate greenhouse gas (GHG) emissions and climate change. Water supply and wastewater treatment will safeguard public health and lessen river and groundwater pollution. Cleaner rivers will provide better protection against floods and the economic losses and public health hazards they bring. District heating and gas supply will improve efficiency, eliminate many small and inefficient boilers, and decrease the use of coal, thus reducing SO₂, PM₁₀, carbon dioxide (CO₂), and other GHG emissions, with positive effects on air quality and climate change. Because many households will no longer have to use coal stoves that burn high-sulfur coal mud for heating and cooking, human health, as well as indoor and outdoor air quality, will improve.

17. The implementation of the mitigation measures recommended in the EMP will render insignificant any adverse impact on the physical and natural environment during the construction and operation of the Project. The incremental costs of implementation are included in the costs of the Project.

II. DESCRIPTION OF THE PROJECT

18. The Project comprises core as well as noncore subprojects. The core subprojects embody the full range of needs, conditions, and possibilities in Shanxi that will face the noncore subprojects to be selected during implementation. The core subprojects are in Wutong, Youyu, and Pingyao. These towns are representative of the small cities and towns in the province, with their various conditions and needs. Wutong, a township administered by Xiaoyi, a county-level city, is in the center of Shanxi Province, in the Taiyuan Basin to the east of the foothills of the Lvliang mountain range, which is known for its rich coal reserves. It is of industrial and agricultural importance and is a major base of the coal, coking, and metallurgical industries. Youyu is a county at the northern border of Shanxi Province, separated from Inner Mongolia by the Great Wall. The Shahukou pass at the Great Wall was of military and trade importance in the Ming Dynasty. Youyu’s rough terrain has been degraded by desertification. In the mid–20th century, 76% of the county area was surfaced with sandy land from wind erosion and desertification. Then about 50 years ago, the county leaders decided to turn the county into a delta in the desert and started extensive planting and landscaping, raising the forest cover in the

county from 0.3% to the present 46%, almost 30 percentage points higher than the national average. This ongoing effort has promoted farming and ranching activities, light industries such as agro-processing, and tourism in recent years because of the close proximity to the Great Wall and the famous Shahukou. Pingyao is in the center of Shanxi Province, on the east bank of the Fen River in the southwestern part of the Taiyuan Basin. It is famous for its ancient city, a walled city within the county proper in the town of Gutao. Built over 2,700 years ago, around 800 BC, Pingyao was designated as a World Heritage Site by UNESCO in 1997. The walled city with its rich ancient culture has been drawing large numbers of tourists to Pingyao.

19. The core subproject areas of Wutong, Youyu, and Pingyao typify the key issues in Shanxi Province. Extreme industrial pollution is causing public health problems in the industrial town of Wutong. Safer areas for the residents and tougher controls on industrial pollution are needed. Clean towns like Youyu provide good environmental quality for the residents and appeal to migrants from the rural areas as well as workers from polluted industrial towns nearby, but are held back by water shortage from developing to accommodate migrants. To keep these towns and eco-cities clean, their citizens and government officials must be made more aware of their environmental responsibilities. Lack of environmental management skills is also causing widespread pollution in historic towns with high tourism potential like Pingyao, putting off tourists. The project intervention specifically addresses these key issues by adopting the following environmental objectives: (i) improving air quality by replacing small boilers and household coal burners with centralized heating, (ii) improving public health by providing a reliable supply of potable water, (iii) collecting and treating wastewater before it is discharged into the natural environment, (iv) improving river quality and flood protection capacity, and (v) improving road network and connectivity.

20. The core subprojects involve the development of primary and secondary urban infrastructure throughout the three subproject areas. The subprojects have to do with the environment (water supply, wastewater collection and treatment, and river improvement). Other investments in district heating and gas supply will allow local residents and business to switch from coal-fired stoves for cooking and heating, thereby improving both indoor and outdoor air quality. The subprojects in Youyu and Wutong involve infrastructure investments (roads, water supply, wastewater, gas, heating, and flood control) to support the opening up of new urban expansion areas.

21. The Project also provides opportunities for capacity building in environmental management, to lay the foundation for future economic growth and sustainable development.

A. Wutong Town

22. Wutong town is in the southeastern part of Xiaoyi City, a major economic and transportation hub in the Lvliang region of Shanxi and a major coal mining city in the PRC, with coal deposits of about 783.5 km², 82.8% of the city area. Wutong has an area of 35.76 km², about 4.14% the size of Xiaoyi. It administers 20 villages with a total population of 27,503 in 2006.

23. Wutong, like dozens of other towns across Shanxi, is savoring a massive economic boom as a result of increased energy production (in particular, coal and coke). But while GDP has increased exponentially since 2000, the town’s ability to manage urban growth and its environmental consequences has not kept pace. Air, land, and water pollution is severe in this major base of the coal, coking, and metallurgical industries. Villages are interspersed with polluting industries in the old parts of town. Investments in environmental infrastructure to
improve the living conditions of residents and safeguard the natural environment are therefore
critical and urgent.

24. Wutong has no central heating and gas supply. The scattered small heat boilers have
very low thermal efficiency and high heat losses. Most boiler stations are outdated and
deteriorated, and cost more to operate and maintain. Most small heat-only boilers have no dust
removal system and no flue gas cleanup. During a site visit to a village in the old town area
under this PPTA, coal mud was observed to be in common use for indoor heating and cooking
(apart from a few households using liquefied petroleum gas). Coal mud, a high-sulfur residue
from coal washing, is a cheap fuel but it produces high levels of SO₂ and coal dust when burned,
causing indoor and outdoor air pollution and respiratory diseases. Some of the metal exhaust
pipes leading from the indoor stoves to the outside of the house were rusty and perforated by
acidic fumes from the coal mud. Piles of coal mud lay along roads and by the village houses,
and children were playing on some of them. Tree trunks and leaves and other roadside
vegetation were covered with coal dust.

25. There is no WWTP. The drainage system is inadequate and does not separate storm
water from wastewater. Untreated wastewater is discharged directly to land or nearby rivers,
affecting river and groundwater quality. The Caoxi River, which runs through Wutong and drains
into the Xiao River, has poor water quality and siltation problems from the untreated wastewater
it receives from nearby buildings. The river is foul-smelling. The major pollutants are 5-day
biochemical oxygen demand (BOD₅), CODₙₐₙ, and ammonia nitrogen (NH₃-N).

26. With support from Xiaoyi City, Wutong proposes to develop a new urban expansion
area 500 meters (m) west of the Caoxi River to house up to 26,000 residents on a 100-hectare
(ha) site upwind of the coke and aluminum plants. This proposal was originally part of the
outline structure plan prepared by AECOM International Development (then PADCO) for the
2005 Towns-Based Urbanization Strategy Study. The Wutong subproject calls for the
construction of basic horizontal and vertical infrastructure (including schools) that will connect
the urbanized area of Wutong with that of the county seat, Xiaoyi. Many of the village
households that are now suffering from appalling environmental and health conditions will be
relocated to this new expansion area away from industrial pollution, where the environmental
conditions and municipal services are much improved.

27. The following investments will be made in the new urban expansion area under the
subproject. Gas and heating investments will allow residents to stop using coal-fired stoves for
domestic cooking and heating and to discard their small heat boilers. Road improvement will
enable better transport and drainage, thus promoting trade and reducing economic losses due
to flooding. A WWTP and educational facilities will also be built under the subproject, further
improving the lives of current and future residents. The Wutong subproject is suitable for
replication in other small cities and towns in Shanxi where economic growth is rapid but
infrastructure investment and institutional capacity building are required for development to be
economically, socially, and environmentally sustainable. The subproject components are
described below.

28. **Caoxi Road and Related Municipal Services Component.** This component entails
the rebuilding of 1.8 kilometers (km) of the Caoxi Road between Shengxi Bridge to the north
and Wutong Street (the southern limit of the new urban expansion area) to the south. Besides
being the main artery connecting Wutong to Xiaoyi, Caoxi Road is also the main thoroughfare in
the planned new urban expansion area. The road, much used by trucks and heavy vehicles, is
now in poor condition. There is no facility for buses and pedestrians. The road improvements
will facilitate traffic circulation and pedestrian movement. Related municipal services include the installation of drainage pipes, street lighting, and landscaping.

29. **District Heating Component.** This component includes the construction of 15.1 km of primary heat supply pipeline and seven secondary heat exchange stations with a total capacity of 57.75 megawatts (MW) in the heat supply districts. The heat source plant (two sets of steam turbines, each with a capacity of 12 MW, and the primary heat station will be installed) that will supply heat to the new urban expansion area will be established by the existing Jinyan Phase 2 Coking Plant located 4.5 km from the new urban expansion area and will be financed separately. This project proposal therefore excludes the expansion of the heat source plant that is already in place, the primary heat station, and the pipeline networks from the substations to the end-use buildings.

30. **District Gas Supply Component.** This component will provide future residents of the new urban expansion area with a new gas supply system for cooking and water heating. The gas source is the existing Jinyan Phase 2 Coking Plant, the same source as that for the district heating component. The new urban expansion area will need a gas supply of 19,180 cubic meters per day (m³/d). The Jinyan Phase 2 Coking Plant produces 300,000 m³/d of gas from coal and will have adequate capacity to supply the households in the area. This component consists of constructing a storage and distribution station (within the Jinyan Phase 2 Coking Plant), four gas regulating stations with auto control systems, and a distribution network with 9.50 km of medium-pressure trunk line and 7.08 km of low-pressure pipeline.

31. **Wastewater Component.** Wutong has no WWTP. As a result, its waterways are polluted. Water quality in the Caoxi River is below class III standards, with different degrees of exceedance in factor of acidity (pH), COD₇₅, BOD₅, suspended solids (SS), and NH₃-N. This component consists of the construction of a 4,000 m³/d WWTP and 12.29 km of pipeline to collect and treat wastewater from the 30,000 residents of the new urban expansion area. The WWTP will be located about 1,500 m northeast of the new urban expansion area, on the south bank of the Xiao River. The treated effluent will be discharged into the Xiao River, which is part of the Yellow River system.

32. **Education Facilities Component.** Three kindergartens, a primary school, and a vocational training center will be constructed. The current schools are directly downtown, downwind of the coal plants. Air quality, environmental, and cleanliness issues are apparent. The new schools will be located away from the direct line of pollutants. Also, the current schools cannot accommodate the influx of new residents. Each classroom is crowded and at maximum capacity.

**B. Youyu County**

33. In 2006 Youyu county ranked 109th out of 119 counties in Shanxi with a population of 109,784. This agriculture-based community with both farming and ranching activities lacks district heat and gas supply, wastewater treatment, and solid waste management infrastructure. A landfill is being built at a site to the northwest of the county and will be completed in 2009. Heating is supplied by six boilers—three with a capacity of 10 tons per hour (t/hr) and three with 6 t/hr—to an area of 280,000 square meters (m²). The boilers have dust removal equipment but no flue gas desulfurization. In addition, there are 22 small, low-efficiency boilers, 60 t/hr in total capacity, with no flue gas desulfurization. Youyu has been suffering from a shortage of water. The largest river is the Cangtou River, a tributary of the Yellow River with an average flow of 0.3 cubic meters per second. The groundwater resource amounts to 330 million m³;
70 million m$^3$ is extractable and about 35.7% of this has been extracted. Surface water is used mainly for irrigation and groundwater is mainly for drinking. Groundwater, with good water quality, is extracted from six wells about 50 m deep with a total capacity of 5,400 m$^3$/d. The water treatment plant (WTP) lies northwest of the county. It only stores and pumps water; it does not disinfect the water. There are 7.755 km of water distribution pipelines in the county, most of which were installed in the early 1970s. Air quality is relatively good since Youyu is located on the windward side of the major coal fields in Shanxi.

34. The county proposes to leverage its superior environmental conditions and good access to markets in order to develop a new light industrial area at the southwestern edge of the county. The subproject includes basic infrastructure to support the development of a new town, where future industrial workers and managers can live. Other investments in flood control, wastewater, and district heating will enhance and sustain urban environmental quality throughout the county. The combination of job opportunities and good living conditions is anticipated to attract rural migrants from villages in northern Shanxi into Youyu. The environmental migration of the working population from the nearby industrial town of Datong is expected to contribute to population growth. Moreover, the new agro-processing facilities will help tie regional farmers to the growing urban economy.

35. **District Heating Component.** This component consists of the construction of a central heat station with two 58 MW thermal water boilers, 12 heat exchange stations, and 9.1 km of double-heating pipeline, to supply heat to an area of 1.5 million m$^2$ in the North Ring and New West districts of Youyu County.

36. **Water Supply Component.** Two new groundwater wells (in the Liujiayao and Wangjiapu groundwater fields), each one with a depth of 50 m and a capacity of 1,920 m$^3$/d, plus 14.41 km of water supply pipelines in the new town and 7.49 km of water supply pipelines in the old town, will be constructed, and a disinfection facility with safety features will be installed at the existing WTP.

37. **Drainage and Wastewater Collection Component.** Youyu has a combined storm-water and wastewater collection system with 36.47 km of pipeline. But nothing has been marked for development in the western part of the city. There is no WWTP and most of the wastewater is discharged into rivers, and the rest into low-lying pits. This component consists of the construction of 14.55 km of storm-water collection pipeline and 12.7 km of wastewater collection pipeline.

38. **Roads and Related Municipal Services Component.** This component consists of the construction of seven new roads in the new town area and the installation of related municipal services including lighting, power cable, and optical fiber cable. The expected benefits from this component include improved traffic mobility and smoother flow, resulting in reduced travel time, vehicle operating cost savings, safer travel, and increased trade and business.

39. **Flood Control Component.** This component consists of the construction of a 4.85 km flood protection channel north of the county, to intercept storm water coming down the mountain range north of the county. The flood protection channel is designed for one-in-50-year storms. Youyu has been growing and the county area now extends almost to the foothills of the mountain range to the north. During the rainy season, storm water comes down the mountain slopes at high speed and can be rather destructive. In view of the water shortage in Youyu and the need to reduce the groundwater demand, the PPTA consultants have suggested the retention of floodwater for use in watering the ground and washing the streets.
C. Pingyao County

40. The Pingyao subproject is in Gutao town in Pingyao county. Gutao is the political, economic, and cultural center of Pingyao county and the location of Pingyao Ancient City, a UNESCO World Heritage Site. In recent years the local government has emphasized tourism-based economic growth. In 2006, the number of tourist arrivals in the county reached 920,000, a 27% increase over the 2005 figure. This influx of visitors resulted in 3,000 new jobs and CNY640 million in tourism-related revenue. Pingyao also used to be well known for its financial establishments. The first modern bank in the PRC was established in Pingyao in 1824 during the Qing Dynasty, when business extended to Japan, Singapore, and Russia in the 1840s. In its heyday, Pingyao was the PRC’s financial center, with 22 banks.

41. River Improvement and Flood Control Component. This component consists of the improvement of a 7.2 km segment of the Huiji River, seepage prevention works, the construction of new brick embankments 2.2 m high and 3.1 km long, and the installation of three rubber dams to store water. The meandering course of the Huiji River has resulted in sluggish water flow through Gutao. Huiji River, near the Pingyao Ancient City, is in very poor condition because of the long-term dumping of garbage and the discharge of untreated municipal and industrial wastewater into the river. The flood protection function of the river has also been seriously compromised by changes in the riverbed topography due to the taking of sand from the riverbed for construction materials and the intrusion of buildings and farmland onto the river banks. This component is designed to improve water quality and to increase flood protection along the Huiji River, thereby improving environmental conditions for residents and tourists alike.

D. Institutional Development and Capacity Building

42. An important objective of the ADB loan is to bring added value to SPG, the local governments, and the implementing agencies (IAs) through capacity building. The Project includes institutional development and capacity building to support project implementation and the sustainable operation of the project components. The Shanxi project management office (PMO), the subproject PMOs, IAs, and operation and maintenance (O&M) organizations have limited experience in internationally funded projects, ADB procedures, and international best practices. Therefore, the Project will provide adequate training to develop and strengthen their capacity during the implementation and operation of the Project, for the long-term operational and financial sustainability of the facilities and services.

43. 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 infrastructure through the delivery of the Project 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 the project facilities to achieve the benefits from the Project and long-term sustainability; and (iv) strengthening the environmental management capacity of the subproject cities and towns in water supply, wastewater treatment, and solid waste management. The institutional strengthening and training requirements related to environmental management are described in the EMP. Similar measures will be implemented for the noncore subprojects through the EAMF.

44. Since Wutong is an industrial town, institutional strengthening and training in environmental management are of particular importance. As discussed with the Wutong
government during the site visit under this PPTA, the project interventions aimed at building capacity for environmental management will include: (i) training in new environmental technologies, (ii) the secondment of international experts to work with the government in environmental improvement and management, (iii) the establishment of an environmental management system (EMS) for the industrial parks in Wutong, and (iv) training in industrial waste recycling.

45. Youyu has been very successful in greening the city through persistent planting and reforestation efforts in the last 50 years. This story needs to be told. The eco-city image and status needs to be maintained. As discussed with government officials during the site visit under this PPTA, the project interventions in this regard will include: (i) the establishment of an educational center at one of the tourist attractions, with movies, posters, and other exhibits to inform the tourists about Youyu’s success story and to educate them in environmental protection and conservation; and (ii) environmental awareness training for the citizens, government officials, and operators of the environmental facilities.

46. In Pingyao, the dumping of garbage into the Huiji River is a very serious problem. The project interventions will include: (i) the building of capacity in solid waste management and river course management, and (ii) environmental awareness training for the citizens.

E. Associated Projects Funded by Others

47. The district heat and gas supply in Wutong will be sourced under an associated project. The Jinyan Phase 2 Coking Plant, an existing facility, has adequate capacity to supply the 10,000 households in the new urban expansion area. The plant uses coal with 1% sulfur content and 20% ash content, and is equipped with dust removal and flue gas cleanup equipment. There will be no additional impact from the demand for heat and gas from the new urban expansion area. Rather, the provision of district heating and gas supply, compared with the use of small boiler stations and household stoves for heating and cooking, is projected to reduce coal use by 49,400 tons per annum (t/a), SO₂ emissions by 1,030 t/a, and total suspended particulates (TSP) emissions by 233.5 t/a.

48. The WWTP construction in Youyu is also an associated project related to the installation of 12.7 km of wastewater collection pipeline. A 10,000 m³/d WWTP using anaerobic, aerobic, and oxidation treatment is planned, at a location near the central heat station. This project is in the project establishment stage, and a detailed feasibility study and an environmental impact assessment are under way. Its completion should tie in with the completion of the wastewater collection pipeline.

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

F. Policy Dialogue

50. Policy dialogue is an important aspect of ADB’s urban development operations in the PRC, 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, new water sources, expansion of water supply and wastewater services, solid waste management, environmental management, eco-city development, and climate change adaptation and mitigation in future urban master plans.
51. More specifically, policy dialogue for this Project will cover: (i) climate change adaptation and mitigation in future urban master plans for small cities and towns in Shanxi; (ii) in Wutong, training in new environmental technologies, the secondment of international experts to work with the government in environmental improvement and management, the setting up of an EMS for the industrial parks, and training in industrial waste recycling; (iii) in Youyu, new water sources, the retention of floodwater for watering and street washing, the establishment of an educational center at one of the tourist attractions, and environmental awareness training for the citizens, government officials, and operators of the environmental facilities; and (iv) in Pingyao, capacity building in solid waste management and river course management, and environmental awareness training for the citizens.

III. DESCRIPTION OF THE ENVIRONMENT

A. Atmosphere and Climate

52. Shanxi has a temperate continental monsoon climate, with distinct seasons and semiarid conditions.

53. Xiaoyi City, where the town of Wutong is located, has strong wind and little rain in the spring, a hot and rainy summer, a cool and wet autumn, and a cold winter with little snow. The annual average temperature is 10.3°C, and the annual average frost-free period is over 170 days. Frozen soil reaches a maximum depth of 0.74 m. Rainfall averages 472.7 millimeters (mm) yearly, and occurs mainly in July, August, and September. The maximum monthly rainfall is 91.5 mm. The dominant wind is from the north and northwest. Strong wind over the eighth level usually occurs in April. Xiaoyi has poor air quality. Monitoring results at three sites (Zhaojiazhuang, Nancao Village, and Zhongwutong) from 3 to 7 January 2008 showed that TSP, PM\(_{10}\), and SO\(_2\) exceeded the class II Environmental Air Quality Standards (GB3095-1996) in every sample. The maximum concentrations exceeded the class II standards by 8.52 times for TSP, 10.06 times for PM\(_{10}\), and 3.44 times for SO\(_2\). Nitrogen dioxide (NO\(_2\)) concentrations were within the class II standards. These results show severe air pollution caused by the industries.

54. The main climate features of Youyu are its long cold winter and hot and rainy summer with frequent flooding. The temperature can range from −29.6°C to 37°C, and averages 3.6°C yearly. The average annual precipitation is 443 mm and the average annual evaporation capacity is 1,761.3 mm with a relative humidity of 54%. The average depth of seasonal frozen soil is 170 centimeters (cm) and the frost season is from early October to late April. The wind is predominantly from the west-northwest and east-northeast with a maximum speed of 29 meters per second (m/s) and average annual speed of 3.0 m/s. Youyu has poor air quality in the winter heating season, with TSP and SO\(_2\) exceeding class II Environmental Air Quality Standards because of coal burning. But in other seasons the air quality is good.

55. Gutao in Pingyao has a cold winter with little snow, a dry spring with wind, and large temperature differences between day and night. In addition, it is hot and rainy in the summer, and cool and lovely in autumn. The average annual temperature is 10.4°C. The extreme maximum temperature is 39.6°C and the extreme minimum temperature is −24.1°C. There is sufficient sunshine, averaging 2,433.2 hours yearly. The average annual precipitation is 439 mm and the average annual evaporation capacity is 1,771.9 mm, with a relative humidity of 60%. The average depth of seasonal frozen soil is 54 cm and there are 158 frost-free days during the

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2 The environmental context of noncore subprojects will be analyzed according to the EAMF in the same way as the core subprojects, as discussed in this chapter.
B. Topography and Geology

56. Xiaoyi City is on the east wing of the Lvliang anticline, with a gradual single inclination formation from the northwest to the southeast. The hilly landform is mainly controlled by the prominence of Lvliang Mountain to the west and Huo Mountain to the east, and the new concave of the Fen River. The eastern section of Xiaoyi is part of the Taiyuan Basin and belongs to diluvial inclined plain landform with flat topography and rich soil. The middle part is loess hill, with fragmented landform and scattered terraces. The mountainous northwestern part belongs to the Lvliang Mountain range. The different landform units consist mainly of alluvial plain, diluvial inclined plain, loess long-beam plateau, soil stone low hill, and limestone karst high mountain. Wutong is in the alluvial-diluvial plain area of the eastern foothills of Lvliang Mountain, where the landform is flat and wide. Its topography is high in the northwest and low in the southeast, with a natural slope gradient of 1%–2% and an average altitude of about 740 m. The Project is in the northern suburb of Wutong, where the landform is flat and wide. The town lies in the Fenwei rift valley seismic belt, with nonstop new tectonic movements leading to strong earthquakes. According to the Seismic Intensity Zoning Map of the PRC, Wutong has a basic seismic intensity of over 7 degrees and belongs to high intensity area.

57. Youyu County is surrounded by mountains with the Cangtou River running across the hills. It shows a slow, single-inclination landform, mainly hilly, from the northwest to the southeast. The different landform units are alluvial plain, diluvial inclined plain, loess long-beam plateau, soil stone low hill, and limestone karst high mountain. The natural slope has a gradient of 3%–8% and an altitude of 1,969.3–1,230 m. The soil is of 4 categories and 49 types altogether. According to the Seismic Intensity Zoning Map of PRC, the basic seismic intensity in Youyu is over 7 degrees and Youyu is in the high-intensity area.

58. There are four topographically different areas in Pingyao: low mountain, loess hill, sloping plain, and alluvial plain. The Project is in the plain area. The soils in this region are complex and variable, influenced by natural conditions and human activities including geology, landform, climate, hydrology, and vegetation. There are eight types of soil: eluvial cinnamon soil, mountain cinnamon soil, light cinnamon soil, cinnamon and light-colored meadow soil, light-colored meadow soil, salt and light-colored meadow soil, and light-colored meadow saline soil. Pingyao is in an area of 8 degrees seismic intensity. It is on the southeastern plain of the Taiyuan Basin and on several fracture belts.

C. Noise

59. In Wutong, baseline data on noise conditions were collected at six monitoring locations around the current residential areas. Noise levels in terms of $L_{eq}$ ranged from 57.4 dB(A) to 61.3 dB(A) in the daytime, and from 48.2 dB(A) to 50.4 dB(A) at night. The noise environment in Wutong basically meets the class II Urban Environmental Noise Standards (GB3096-93).

60. The noise pressure level on Youyu County’s main city roads is more than 60dB(A) because of high traffic flow, but in the new town area and surrounding areas the noise environment is good. The Pingyao project site is in the suburban area. On-site noise
monitoring indicated that the noise environment in this area is good and meets the class II Urban Environmental Noise Standards.

D. Surface Water

61. The main rivers in Wutong Town are Xiao River, Caoxi River, and Wenyu River, which all belong to the Fen River branch of the Yellow River system. The Caoxi River flows into the Xiao River, which flows directly into the Wenyu River. The flow of each river has obvious seasonal changes. The flow is greatest in the flood season, when it has obvious flood-river characteristics, with a maximum flood discharge of 250 m³/s. In the non-flood season the flow is small. The Fen River, about 300–600 m wide, comes from Jiexiu, enters Wutong from Qiaotou Village, runs through the east of Nanyao Village, and flows again into Jiexiu 2 km to the East Dongtun Village. The Caoxi Road construction component is on the east bank of the Caoxi River. Water quality monitoring for 3 days at two locations on the Caoxi River found COD Cr, BOD 5, SS, NH ₃-N, and pH higher than the class III standards because of municipal and industrial wastewater discharged into the river.

62. Youyu County is in an area of water shortage. Two rivers run through it. The bigger one is the Cangtou River, which belongs to the Yellow River system. The section flowing through Youyu County is 74.5 km long with a river basin of 1,693 km². The annual runoff is 108.2 million m³, and the average flow is about 0.3 cubic meters per second per year. The other river is the Yuanzi, which belongs to the Hai River system. The section of the river that flows through the southern part of Youyu is 27 km long with a river basin of 271 km². The water in these rivers, used for irrigation, has been deteriorating in quality because of the municipal wastewater discharged into it.

63. The major rivers flowing through Pingyao County are the Fen, Huiji, Liugen, Chengjian, Ciyao, and Lvyuan rivers. The Fen River is the biggest; the section flowing through Pingyao is 25 km long and has an average width of 500 m. The Huiji River, formerly known as the Zhongdu River, has a total length of 44 km, width ranging from 50 m to 200 m, and a 313 km² river basin. The Liugen River, 36.7 km long, has a 215.79 km² river basin. Both the Huiji and the Liugen drain into the Fen River. The Chengjian River is 31.3 km long and about 40–150 m wide, and has a 141.8 km² river basin. The Ciyao River originates from Ciyao 30.7 km and flows through Jiaocheng, Wenshui, and Pingyao into the Fen River at the south bridge of Jiexiu. The Lvyuan River has a total length of 31.5 km with a river basin of 181.5 km². Water quality monitoring data showed that water in the Huiji River is of class V standards and is heavily polluted with excessive concentrations of COD Cr, BOD 5, NH ₃-N, volatile phenols, sulfide, and hexavalent chromium (Cr ⁶⁺). During the site visit to the Huiji River under this PPTA, the riverbanks were covered by an abundance of municipal solid waste (MSW) and wastewater was flowing into the river.

E. Groundwater

64. Wutong has abundant groundwater at a depth of 735–770 m. The groundwater in this area can be divided into loose-pore aquifer, sandstone fissure aquifer, and limestone karst fissure aquifer. The aquifers run from west to east, with gradually thinning beds. Groundwater quantity and quality have both been deteriorating. The Project is in the alluvial-diluvial plain area and the aquifer is mainly Lower Pleistocene confined groundwater, replenished by atmospheric precipitation. Monitoring results showed that water in the wells meets the class III Groundwater Quality Standards (GB14848–93).
65. Youyu’s groundwater usable reserve amounts to 70 million m³, of which 25 million m³ has already been extracted. Groundwater is the main water source. Current water quality is good and meets class III standards. According to monitoring results, Pingyao groundwater also meets class III standards.

F. Solid Waste

66. Wutong has no MSW treatment and disposal facility that meets the regulations. There are several open garbage pits and 20–30 garbage piles around the town. They take up land, draw insects and pests, and produce odor, landfill gas, and leachate, thereby putting the environment and the health of nearby residents at risk.

67. Youyu also has no MSW treatment and disposal facility that meets the regulations. Garbage is transported from garbage cans to a natural ditch northwest of the town. Since no measures are being taken to control the pollution, the site has been seriously polluting the surroundings. A planned landfill that complies with the requirements is under construction and will be ready for use in 2009.

68. In Pingyao, MSW is transported to the county landfill, but there are not enough garbage cans in the town. Because of inadequate collection capacity, garbage may be piled on the streets or dumped into rivers.

G. Ecological Resources

69. Shanxi is an inland province with no big lake. Its rivers are seasonal and polluted. The three subproject towns have no fisheries resource of commercial importance.

70. Wutong has a flat landform that is a poor habitat for wild animals; biodiversity is therefore low. Animals commonly found in Wutong include the rodent, such as rat and the hare. There are also crows, sparrows, pied magpies, cuckoos, and other avifauna. The area has no rare wild animals. Wutong is on a plain area that has been fully developed for agricultural, industrial, and residential purposes. Hence, forest cover is insignificant.

71. Youyu’s wild plants include those used for food, industrial, medicinal, and environmental purposes. Those used for environmental purposes include pine, larch, willow, poplar, acacia, and elm. More than 50 wild animals, including 18 birds, have been recorded. Youyu has plenty of forest resources. Planted forests cover 46% of the land. In 1992, Youyu became the first county to achieve the greening standard in Shanxi Province despite its dry climate and sandy soil.

72. Wild vegetation in Pingyao is distributed in the middle mountain belt at elevations of over 1,700 m. Wood plants are mainly found in this region, including Chinese pine, aspen, birch, and grass-shrub vegetation. The natural vegetation coverage is 70%. Vegetation is rarely planted in the low mountain area, where the elevation is 1,000–1,700 m. Only some Chinese pine and north PRC larch plantations can be found. Wild animals identified in Pingyao include leopard (*Panthera pardus*), wild pig (*Sus scrofa*), red deer (*Cervus elaphus*), blue sheep, wolf, golden eagle (*Aquila chrysaetos*), black stork (*Ciconia nigra*), and sparrow hawk (*Accipter nisus*). The leopard, the golden eagle, and the black stork are listed as first-level protection animals in the PRC; the red deer, the blue sheep, and the sparrow hawk are second-level. Pingyao is in a plain area that has been fully developed for agricultural, industrial, and residential purposes. Therefore, forest cover is insignificant.
No rare or endangered species or protected area has been recorded at the project sites in the three core subproject towns.

H. Economic Development

In Wutong, there are 67 enterprises engaged in coal washing, coking, chemical refining, smelting, building materials, and agricultural product processing, among other activities, and employing more than 5,900. Socioeconomic development in recent years has been fast and stable, and Wutong has become an important industrial town with economic clout and great taxpaying ability. Wutong has been listed among the top 100 key towns in the province since 2000 and, in 2005, was listed as the pilot town in national development and reform. In 2006, the State Council approved the Xiaoyi Economic Development Zone as the provincial economic development zone and named Wutong one of 1,887 key towns in the PRC. In 2006, Wutong enterprises had a total production value of CNY5.5 billion (up by 13.2% over 2005), taxes paid amounted to CNY0.369 billion (up by 10%), the annual per capita income of farmers was CNY5,812 (up by 29%), and rural income totaled CNY1.95 billion.

Youyu has rich reserves of coal—3.4 billion tons—among other minerals. Its main industries are coal mining, machinery, and construction materials manufacturing. In 2006, GDP was CNY782.67 million. Youyu is the only county in Shanxi with equal farming and ranching industries. It has over 53,000 ha of farmland, generating an annual revenue of CNY100.37 million. Rural residents' annual per capita income in 2006 was CNY1,801. Salary income was twice that of the year before and ranching income was 37.4% higher. Urban residents' annual per capita disposable income in 2006 was CNY5,844, a 14.2% increase over 2005.

In 2006, Pingyao’s GDP reached CNY3.9 billion. The tourism industry is important to the city. Food, textiles, and machinery are the leading non-tourism-related industries. The others are mining, metallurgy, coking to rubber, and food and construction materials manufacturing. Enterprises in the new industrial zone are mainly in new materials development, machinery manufacturing, food processing, and textiles. Pingyao also has a fully developed agricultural economy, with 53,600 ha of farmland and annual grain yield of 197,500 tons. Tourism in Pingyao has grown rapidly in recent years. In 2006, 920,000 tourists visited Pingyao (26.78% more than in 2005) resulting in a gate income of CNY73.5 million (27.84% higher than the 2005 figure). The tourism industry created more than 3,000 new jobs. Related income reached CNY640 million, a 21% increase over 2005.

I. Social and Cultural Resources

Wutong has 20 villages and a population of 27,503 (2006). It has a small 800 m² hospital with 8 beds, and 20 village clinics (one in each village). There are 2 junior high schools with 1,640 registered students (2005), 19 primary schools with 2,812 registered students (2005), and 19 kindergartens with 750 registered students (2005). As the south gate of the Lvliang region, Wutong is an important and convenient transportation hub with one railway and several highways.

The centralized heating area in Wutong is about 10% of the total area of the town. There is no central gas supply. Although a few homes use liquefied petroleum gas, the town relies mostly on small boilers and on household stoves burning coal mud for heating and cooking. The small boilers are inefficient and inadequate in dust removal and flue gas cleanup. During the site visit under this PPTA, coal mud was commonly seen piled along the sides of roads and village
houses, some with children playing in it. Coal mud is a residue from coal washing, generally with high sulfur content. The burning of coal mud therefore causes indoor and outdoor air pollution, as well as respiratory diseases. Some metal exhaust pipes from these home stoves were observed to be severely corroded by long-term exposure to sulfur fumes. In winter the air in the town is seriously polluted due by these small boiler stations and household stoves. Roadside trees were observed to be covered with a thin film of black dust.

79. The current water source of Wutong is the Zhangjiazhuang Reservoir, where the water is of good quality. Wutong has not built a complete drainage system. Its present drainage system is a combined storm-water and wastewater system, and only a portion of the roads have drainage. The storm water and industrial and domestic wastewater all drain into the Xiao River. The town has no sewage treatment plant.

80. Youyu County has a population of 109,784 (2006), 43.92% of which is urban. It has 10 township hospitals, 60 village clinics, and a new county disease control laboratory. Youyu recently built a new vocational school and the Mingde primary school. The county also built residential buildings for two middle schools and completed five high-standard residential primary schools. Youyu has an old drainage system in its old town. There is no central heat and gas supply, and no railway connection. National Road 109 and several other roads pass through the county. The new tourist road connects Youyou to nearby Shuozhou City, providing convenience to visitors. Shahukou Pass and the Great Wall are historical relics in Youyu dating from the Qing Dynasty.

81. Pingyao County has an agricultural population of 420,141 (2006) and an urban population of 65,695 (2006). There are 7 county health facilities, 14 township hospitals, 10 health stations, and 331 village clinics. All in all, the county has 1,995 health technicians, 803 beds, and more than 100 medium-size to large health facilities. There are 394 schools, including five high schools. Pingyao has only an old drainage system in its old town. There is no central heat and gas supply. But transportation in Pingyao is convenient. Railways and highways pass through the city, and all the small towns are connected by roads.

82. As one of the World Heritage Sites designated by UNESCO, the Pingyao Ancient City is the most famous and important cultural heritage in Pingyao. There are also two temples (Shuanglin Temple in Xianghuan and Zhenguo Temple in Dapu) that are considered as National Heritage for Protection. At the provincial level, there are six other heritage sites for protection. These are the Dacheng Palace in Wen Temple, the Cixiang Temple, the Qingxu Taoist Temple, the Municipal Building in Gutao, the Rishengchang Piaohao (ancient bank) Relic, and the Jinzhuangwen Temple.

83. All three core subproject areas use power from the national grid. Wutong has a coal-fired power plant.

84. There is no record of sites of archaeological or cultural heritage importance or of land and resources used for traditional purposes by indigenous peoples at any of the project sites in the three core subproject towns.
IV. ALTERNATIVES

A. With-Project and Without-Project Alternatives

85. The three small cities and towns of Wutong, Youyu, and Pingyao have different characteristics. Wutong is an industrial town with polluting industries around its old town area, which lacks environmental infrastructure. Developing a new urban expansion area upwind of these polluting industries will allow the residents of the old town to relocate to new homes with modern environmental infrastructure and education facilities and away from pollution. Without the Project, these Wutong residents will continue to suffer from air and water pollution. Youyu has a fast-growing population and also growing tourism and agro-processing industries. Despite the dominance of coal mining and refining industries in Shanxi, Youyu is relatively free from pollution, with blue skies and good environmental conditions. This environmental quality must be maintained even as the town keeps pace with population and industrial growth. The Project will provide modern environmental and transportation infrastructure in a new town area for migrants, as well as flood protection to prevent the loss of property and adverse effects on the tourism industry. Floodwater retention for use in watering and street washing will reduce the demand for groundwater, and thus ease the water shortage. Without the Project, Youyu’s environmental conditions will deteriorate as the population grows and the tourism industry develops, and demand for groundwater increases. Pingyao is famous for its ancient walled city, which is scenic and rich in culture and attracts large numbers of tourists each year. Yet the nearby Huiji River is unsightly, filled with garbage and polluted by untreated municipal and industrial wastewater. The Project will improve the river, return it to a healthy and aesthetic state, and strengthen its flood protection function. Without the Project, the Huiji River will continue to be an eyesore to local residents and tourists, and to pose a threat to public health and property for nearby residents.

86. Heating is now provided in Wutong and Youyu by small boiler stations. These boilers, old and inefficient and with no dust removal and flue gas desulfurization equipment, cause air pollution. Many households use indoor stoves for heating and cooking, and the stoves burn coal mud, a high-sulfur residue from coal washing. Providing central heating and gas supply to these households through the Project will allow them to set aside the small boiler rooms and to stop using coal mud for heating and cooking. Both indoor and outdoor air quality will improve. Without the Project, the use of small boilers and coal mud will continue, polluting the indoor and outdoor air and causing health problems to the residents.

B. Specific Alternatives

1. Heating

87. For its district heating component, Youyu considered the option of cogeneration. Electricity in Youyu is now supplied from nearby Datong City via the national grid. A major constraint in Youyu is its water shortage. Cogeneration requires large quantities of groundwater for cooling. To get around this constraint and to conserve groundwater, the decision was made to build a central heating station that would supply heat only, with electricity continuing to be supplied via the national grid.

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3 The alternatives considered for the noncore subprojects will be analyzed according to the EAMF in the same way as those for the core subprojects, as discussed in this chapter.
88. Youyu also considered two types of hot-water boilers: sequential batch boilers and recirculating fluidized bed boilers. Although more commonly used than sequential batch boilers, recirculating fluidized bed boilers are less reliable and cost more to operate. The station will use dynamically washed coal as fuel, which has high calorific content and is more suitable for the sequential batch boilers. With the installation of dust removal and flue gas cleanup equipment, the sequential batch boilers can match those recirculating fluidized bed boilers in air emissions. The sequential batch boilers were selected because of their lower cost, better reliability, greater suitability for the calorific content of the fuel, and comparable amount of air emissions.

89. Wutong considered both aboveground and underground heat supply pipeline networks. The underground option was selected because it has no visual impact and does not result in permanent land loss. Two pipeline routes were also considered: one 6.5 km long and the other 5.8 km long. The shorter route was selected because of the lower cost.

2. Gas Supply

90. Wutong considered different compositions of gas supply pipelines for different pressures, including medium-pressure and low-pressure pipes. The decision was to select a combination of medium- and low-pressure pipes because this is the safer option and it provides a larger service area with more stable supply. Different anticorrosion measures for the pipelines were also considered. Polyethylene wrapping was chosen because it is easy to construct and has superior anticorrosion properties.

3. Roads

91. Wutong considered both asphalt and cement as paving materials. Asphalt was selected because of its lower cost.

4. Water Supply

92. Youyu considered different disinfection options—liquid chlorine, ozone, hypochlorite, chlorine dioxide, ultraviolet, and ammonium chloride—for its water supply. Each option has its pros and cons in terms of cost, reliability, safety, and disinfection effectiveness. Chlorine dioxide (ClO2) was selected mainly because it would not react with the organics in the water to form trichloromethane, a by-product of chlorination. It is also a more effective disinfection agent than free chlorine. A reactor will be installed on-site to generate ClO2 through the reaction of sodium chlorite (NaClO2) with an acid. The ClO2 will be generated only when needed and the amount generated will also be controlled to prevent excessive chlorination.

93. Youyu also considered different water pipe materials, including ductile iron pipe, high-density polyethylene (HDPE) pipe, and spheroidal graphite cast-iron pipe. The spheroidal graphite cast iron pipe is commonly used in water pipes and was selected because of ease of installation and maintenance, and lower installation and maintenance costs.

94. Water supply and demand analysis indicates that Youyu’s water demand will reach its supply capacity around the year 2015. Demand for groundwater (including the demand from the Project) from the two groundwater fields in Liujiayao and Wangjiapu has been estimated at 9,000 m³/d. The natural replenishment volume at these two fields has been estimated at 9,442.65 m³/d. Groundwater extraction is therefore approaching the natural replenishment volume and a new water source needs to be found to satisfy the growing demand beyond 2015. Youyu has considered two alternative surface water sources for water supply beyond 2015. One
is the existing Changmenpu Reservoir 15 km from Youyu, which was designed to supply water for irrigation and has an annual output of 2 million m³ (5,480 m³/d). The use of water from the reservoir for irrigation has declined, and this water source can therefore be used in the long term. The other alternative is the Haiziwan Reservoir, which is planned for construction. It will be an aboveground reservoir in Sanhukou village, about 30 km north of the Youyu urban area. Its intended use is for municipal water supply and irrigation. The feasibility of using these two water sources is being investigated. Policy dialogue will include discussions on these new water sources to ensure that (i) groundwater in Youyu will not be over-extracted, (ii) there will be no adverse impact on other water users, and (iii) any environmental impact will be fully mitigated. Loan assurances on the use of these two reservoirs as associated facilities in the long term are given in para. 195.

5. Wastewater

95. Wutong considered two treatment processes for its WWTP: biofilm anaerobic and oxidation (A/O) process and membrane biological reactor (MBR). MBR can achieve a better treatment standard, but it is more costly to operate and requires highly skilled technicians to maintain and operate the system. Since the biofilm A/O process can meet the effluent standard and is easier and cheaper to operate, it was selected as the preferred option.

96. Wutong also considered two types of wastewater pipe materials: reinforced concrete pipe and HDPE pipe. HDPE pipe was selected because it is easy and cheaper to install and has a longer service life than reinforced concrete pipe. However, reinforced concrete pipe will be used for the segment crossing the Caoxi River.

V. ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

97. This chapter discusses the anticipated impact of the Project and the mitigation measures recommended, mainly for the core subprojects. The expected impact and the mitigation measures will be similar to those for the noncore subprojects. This chapter provides a model to guide the formulation of mitigation measures for noncore subprojects.

A. Positive Impact and Environmental Benefits

98. The Project has considerable positive impact and environmental benefits. It provides a sound basis in infrastructure and social service systems for sustainable economic development. The Project can be used to demonstrate how to achieve sustainable economic growth in the process of urbanization, and the example it sets can be replicated in other small cities and towns in Shanxi Province.

99. The Project will deal with the impact of pollution from the coal-based industries in the Wutong area on air quality and the health of nearby residents. Relocating the residents to the new town area will put them upwind of polluting industries, in an area with modern environmental facilities.

100. Providing central gas supply in Wutong will reduce the use of coal in household stoves for cooking by 31,400 t/a, and will thus reduce SO₂ emissions by 1,005 t/a, TSP by 220 t/a, and bottom ash by 6,280 t/a.

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4 The anticipated environmental impact of noncore subprojects will be analyzed according to the EAMF in the same way as the core subprojects, as discussed in this chapter.
101. Providing central heating in Wutong will do away with the need for 13 small boiler stations and more than 120 household stoves. Coal use is expected to go down by 8,000 t/a, water use by 18,000 t/a, electricity use by 2,800,000 kilowatt-hours per annum, SO₂ emissions by 25 t/a, nitrogen oxide (NOₓ) emissions by 35 t/a, TSP emissions by 13.5 t/a, and bottom ash by 3,327 t/a. Centralizing the storage of coal and bottom ash at the coking plant also provides the possibility of reusing the bottom ash as building material.

102. Roadworks in Wutong and Youyu will improve road transport in these small cities and towns. Better roads and shorter travel time will reduce emissions from traffic of the same volume and improve air quality in Wutong and Youyu.

103. Reducing emissions from traffic and from central heat and gas supply will reduce GHG emissions and will thus have a positive effect on climate change.

104. Wutong has no WWTP. Untreated wastewater is discharged directly into waterways. Constructing a WWTP in this Project will reduce the discharge of the following pollutants into the water bodies: BOD₅ by 307 t/a, CODCr by 460 t/a, SS by 416 t/a, TN by 51.5 t/a, NH₃-N by 36.5 t/a, and TP by 5.2 t/a.

105. The water quality improvements and the landscaping of the riverbanks will remove odor and eliminate unauthorised dumpsites, enhancing the aesthetics of these rivers for the enjoyment of nearby residents and tourists.

B. Impact Associated with the Project Location, Planning, and Design

106. The construction of the three core subprojects will have the following resettlement (physical and economic displacement) impact: 1,455 households (5,007 persons) will be affected by permanent land acquisition; 23 households (95 persons) will be relocated to allow the demolition of 5,604 m² of residential structures; and 24 enterprises and shops with 1,151 employees will be affected by the demolition of 13,703 m² of nonresidential structures. In total, 96.53 ha of land will be acquired permanently.

107. The subproject in Wutong will involve the construction of a range of infrastructure facilities, which will require the acquisition of 5.7 ha of land area. All the land areas to be acquired will be farmland belonging to Nancao Village in Wutong Town. No house demolition or relocation will be required. The land acquisition will account for 5.4% of the farmland in Nancao Village, and it will affect all 758 households (2,118 persons) in the village.

108. Youyu will build a range of infrastructure facilities in the new town area of Youyu, as well as others that will affect the existing urbanized area. A flood control component on 32.9 ha of land area is proposed. All the land to be acquired will be farmland and will be acquired permanently. The land belongs to three villages in one town, affecting 116 households (454 persons). No house demolition or relocation, and no temporary land occupation, will be required.

109. The proposed Huiji River improvement in Pingyao will permanently acquire 57.93 ha of land, affecting 579 households (2,435 persons) from six villages in two towns. A total of 19,307 m² of structures will also be demolished—5,604 m² of residential structures, affecting 23 households (95 persons), and 13,703 m² of nonresidential structures, affecting 24 enterprises or shops with 1,151 employees.
110. The central heating stations must be designed to include dust removal and flue gas desulfurization equipment.

111. The roads, including carriageways and pedestrian and bicycle lanes, road lighting, bus stations, and landscaping, must be designed to ensure road safety, encourage nonmotorized traffic with its related environmental benefits, and enhance visual harmony with the surrounding environment.

112. The disinfection facility in the WTP must be designed to include safety features and equipment, such as a chlorine gas detector and alarm system, good ventilation, explosion-safe electrical switches and lighting, and appropriate respirators. The WTP must be able to provide good-quality and reliable water supply to the users and to meet the safety requirements of plant operation.

113. The WWTP must be designed to achieve the desired treatment and meet the required discharge standards and safety of plant operation. This statement also applies to the associated new WWTP project in Youyu.

114. The water supply, wastewater, and heating and gas pipelines must be designed and built to ensure that the supply or connections to existing users will not be adversely affected. Further, the technical design of the gas supply pipeline network must include safety and pressure release valves.

115. The flood protection component in Youyu should consider the design and construction of a holding tank or reservoir to store the floodwater, since Youyu has a water shortage. This water can be used to water plants, thereby reducing the demand for groundwater.

116. The design of the educational facilities in the new town area of Wutong should consider the pretreatment of wastewater generated by canteens and toilets. For the canteens, traps will be installed to remove oil and grease at 96% efficiency. Package treatment plants such as sequential batch reactors could be installed to treat the effluent, which could then be reused to water the plants on school premises.

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

C. Impact and Mitigation Measures during Construction

1. Land and Habitat Loss

118. The Project will result in the permanent loss of about 102.5 ha of land, including 90.9 ha of cultivated land. The temporary land to be occupied will mainly be used for the staging of construction works and equipment, such as a sandstone plant, an asphalt mixture plant, a soil borrow area, production and living areas for construction workers, and temporary roads during construction.

119. There is no record of any heritage or archaeological sites or any threatened or endangered species being present on the project sites.
2. **Roads and Related Municipal Services**

120. The Project involves road construction in Wutong and Youyu. Project interventions will also provide road lighting, traffic signs, landscaping, and drainage pipes.

121. A key impact on the environment during road construction will be on air quality, from dust on construction sites and emissions from asphalt or cement plants. Construction noise is another key environmental impact during road construction and upgrading.

122. Road construction is a linear activity. When a section of road is finished, construction activities move on and away. Therefore, air quality and noise impact on a specific location from these construction activities will be short-term and temporary, lasting from several weeks to a few months. In Wutong, there are five villages that are mainly on the west side of Caoxi Road. Their distance from the road ranges from right by the roadside (Caocun) to 250 m from the road (Bajiazhuang). However, the section of Caoxi Road to be rebuilt under the Project will not go through Caocun. In Youyu, the roads are in the new town area, which is not yet occupied.

123. Dust, noise, construction runoff, and wastewater, including the muddy wastewater from piling works during the construction of bridges might pollute the water in the river and adversely affect its hydraulics. Mitigation measures as well as other good site practices described below will be adopted to avoid any potential adverse impact. In particular, an emergency plan will be developed for dealing with chemical spills on the construction site.

124. Roadworks usually generate large quantities of excavated spoil and require large quantities of fill. A plan for the temporary store, reuse, and disposal of the excavated spoil will need to be developed during detailed design and implemented by the contractor during construction. The primary objective is to reuse as much of the excavated spoil on-site as backfill material as possible. Temporary storage facilities will have to be identified and acquired. The source of fill will also need to be identified. The construction of Caoxi Road in Wutong will generate 53,300 m$^3$ of excavated spoil and will require 217,600 m$^3$ of backfill material. Roadworks in the new town area in Youyu will require 258,300 m$^3$ of fill.

125. Good practices (paras. 126–132) will be adopted during construction to mitigate dust, noise, solid waste, wastewater, sanitation, and construction traffic impact. Water and soil conservation measures will be developed and implemented.

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

127. Noise will be mitigated by using quiet equipment, observing good O&M of machinery, using temporary hoardings or noise barriers to shield off noise sources, and stopping construction between midnight and 8 a.m. near residential areas, hotels, and hospitals. If there are schools and places of worship near construction activities, the contractors will maintain continual communication with these to avoid noisy activities during examination and worship periods.
To minimize adverse impact from the refuse generated by workers and construction and demolition waste, refuse will be stored in closed containers and regularly transported off-site for disposal in landfills. Construction and demolition wastes will be cleared and removed regularly.

The excavated spoil needs to be disposed of safely or stored temporarily for backfilling. Facilities to be used for storage and disposal of excavated spoil and the acquisition of backfill materials will be identified during detailed design. The selection criteria will include environmental considerations, such as favorable geological conditions, land use, habitats and vegetation on-site, impact on affected people, and distance to the project areas.

Uncontrolled wastewater and muddy runoff from construction sites could 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 on-site to treat wastewater and muddy runoff with high concentrations of suspended solids. If necessary, flocculants will be used to facilitate sedimentation.

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.

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 road crossings, building interim roads, selecting transport routes to reduce disturbance to regular traffic, and reinstating the roads as soon as possible.

3. **Central Heating and Gas Supply**

This component involves the construction of a primary heat station in Youyu (the expansion of the primary heat station inside the existing Jinyan Phase 2 Coking Plant in Wutong is not part of the Project), heat exchange substations in Wutong and Youyu, a gas storage facility (inside the existing Jinyan Phase 2 Coking Plant) and gas regulation stations in Wutong, and heat (Wutong and Youyu) and gas (Wutong) distribution pipelines.

Pipeline construction is a linear activity. When a section of the pipeline is finished, construction activities move on and away. Therefore, air quality and noise impact on a specific location from these construction activities will be short-term and temporary, lasting from several weeks to a few months. For example, in Wutong, it has been estimated that the gas pipeline will be built in sections and that the construction of each section will last about 5–7 days. Although the stations and pipeline will be located mostly in the new town areas, with few sensitive receivers, dust and noise mitigation measures as well as other good site practices described above will be adopted to minimize environmental impact.

4. **Water Supply**

This component involves the installation of a disinfection facility with safety features in an existing WTP, two new groundwater wells, and water supply pipelines in both the new town and the old town areas in Youyu. Pipeline construction is a linear activity, and dust and noise impact on 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 above will be adopted to minimize environmental impact.

5. Wastewater

136. This component involves the construction of a 4,000 m$^3$/d WWTP and wastewater collection pipelines in Wutong, and storm-water and wastewater collection pipelines in Youyu. The WWTP in Wutong will be 500 m northeast of the new town area on the south shore of the Xiao River. The treated effluent, which will meet provincial class IA standards, will be discharged into the river. The nearest village is Caocun, 1,500 m northeast. Because of the distance of the WWTP site from the village, the construction is not expected to have any environmental impact on the Caocun residents. Although the pipelines will be located in the new town area, which will not be occupied during construction, dust and noise mitigation measures as well as other good site practices described above will be adopted to minimize environmental impact.

6. River Improvement and Flood Control

137. This component includes improvements in the Huiji River in Pingyao, and the construction of a flood control channel in Youyu. The construction activities in Pingyao include the dredging of the riverbed and the construction of an embankment (including biological slopes). River flow will be diverted and dredging will be carried out on a dry riverbed. Water quality impact should be minimal. The major environmental impact will be noise from dredging and other mechanical equipment, as well as odor from the dredged spoil. Dust and noise mitigation measures as well as other good site practices described above will be adopted to minimize environmental impact.

7. Educational Facilities

138. The kindergartens, the primary school, and the vocational training center will be constructed in the new town area in Wutong, which will not be occupied during construction. Although there will be no sensitive receivers nearby, dust and noise mitigation measures as well as other good site practices described above will be adopted to minimize environmental impact.

D. Resettlement

139. The three core subprojects will affect 1,437 households (5,072 persons) by permanent land acquisition, necessitate the relocation of 23 households (95 persons) to allow the demolition of 5,604 m$^2$ of residential structures, and affect 23 enterprises and shops with 1,178 employees, which will be displaced by the demolition of 13,703 m$^2$ of nonresidential structures.

140. Resettlement plans (RPs) have been prepared for the three subproject towns and cities. The plans describe the resettlement of the affected households and people, and the compensation to be provided. They fully meet the resettlement policies and requirements of the PRC and ADB.
E. Impact and Mitigation Measures during Operation

1. Roads and Related Municipal Services

141. The operational impact from road traffic includes vehicle emissions and traffic noise. The traffic forecast and modeling results indicate that the concentrations of NOx and carbon monoxide from traffic emissions will meet class II Environmental Air Quality Standards at a distance of 30 m from the centerline of Caoxi Road in Wutong within the design horizon of 20 years. The traffic forecast for the roads in Youyu show much smaller traffic flow. Traffic emissions on these roads should meet class II Environmental Air Quality Standards at less than 30 m from the centerline of the roads within the design horizon of 20 years.

142. The traffic noise impact assessment for Caoxi Road in Wutong indicates that traffic noise will meet the class IV Urban Noise Standards of 70 dB(A) in the daytime and 55 dB(A) at night at a distance of 40 m from the roadside within the design horizon of 20 years. For roads in Youyu, traffic noise was assessed to meet class IV Urban Noise Standards at a distance of 20 m from the roadside in the daytime and 30 m at night within the design horizon of 20 years.

143. In view of the mitigation requirement of 30 m buffer distance for air quality and 40 m buffer distance for nighttime traffic noise from the centerline of Caoxi Road, buildings in the new urban expansion area along Caoxi Road will have a setback of at least 40 m from the centerline of the road. Buildings in the new development area in Youyu will have a setback of at least 30 m from the centerline of the roads to mitigate nighttime traffic noise.

2. Central Heating and Gas Supply

144. In Wutong, the source for central heating and gas supply will be the existing Jinyan Phase 2 Coking Plant. Its present capacity is sufficient to supply the new households in the new urban expansion area. The Project will have no other impact on air quality. Each heat exchange substation is expected to generate 35.8 m³/d of backwash effluent, which has relatively low pH. A 50 m³ equalization tank will be built in each substation for pH adjustment before the backwash effluent is discharged into the municipal sewer. These substations will have a buffer distance of at least 15 m from the nearest household and will use low-noise water pumps with noise levels controlled to within 55 dB(A) at a distance of 1 m from the pump house. There will be no operational noise impact from these heat exchange substations. Only a few workers will be kept at the substations and the gas regulation station and there will be no canteen on the premises. The quantities of wastewater and solid waste generated by the workers will be small, and the wastewater will be discharged into the municipal sewer.

145. It is expected that, with the provision of central heating and gas supply in Wutong, at least 13 small boiler stations and 120 household stoves can be eliminated. Doing so will reduce SO2 emissions by 350 t/a, TSP emissions by 1,400 t/a, wastewater from boiler rooms by 9,200 m³ per year, and bottom ash by 10,500 t/a. Considering the amount of coal used to produce this heat, the sulfur (1%) and ash content (20%) of gas, and the resulting emissions, the net reductions that can be achieved per year will amount to 5,708 tons of coal, 18,000 tons of water, 2,800,000 kilowatt-hours of electricity, 74 tons of S02, 210 tons of TSP, and 35 tons of NOx.

146. In Youyu, the coal used to supply district heating has a sulfur content of 0.54% and an ash content of 24.34%. If the central heating station operates 18 hours per day and 150 days a year, it will use about 46,602 tons of coal per year. The central heating station will be equipped
with dust removal at 95% efficiency and flue gas desulfurization at 60% efficiency. Its emissions—161 t/a of SO₂ at a concentration of 229.44 milligrams per cubic meter (mg/m³), and 63.18 t/a of TSP at a concentration of 90 mg/m³—will comply with the class II Air Pollutant Discharge Standards for Boilers.

3. Water Supply

147. Water pipes may leak and burst, causing localized flooding, with environmental and economic impact. Adequately designed pipes, proper piping materials, proper supervision during construction, and proper operation and maintenance will prevent this from happening.

148. A disinfection facility using ClO₂ as the disinfection agent will be installed in the existing WTP in Youyu. ClO₂ will be generated on-site by mixing sodium chlorite with an acid in a reactor. ClO₂ is a toxic and explosive gas, and any accidental release into the atmosphere will be catastrophic. The reactor and safety equipment will be checked and maintained regularly to prevent such an accident. Workers in the plant should be trained in environmental and safety awareness, and emergency response actions.

149. According to the analysis of water supply and demand, water demand in Youyu will exceed its supply capacity around the year 2012. Demand for groundwater (including the demand from the Project) from the two groundwater fields in Liujiaoyao and Wangjiapu has been estimated at 9,000 m³/d. The natural replenishment volume at these two fields has been estimated at 9,442.65 m³/d. Groundwater extraction is therefore approaching the natural replenishment volume. Youyu has identified two alternative surface water sources for water supply beyond 2012. One is the Changmenpu Reservoir, with an annual output of 2 million m³ for municipal water supply and irrigation. The other is the Haiziwan Reservoir, which is planned for construction. It will be an aboveground reservoir in Sanhukou village, about 30 km north of the Youyu urban area. Its intended use is for municipal water supply and irrigation. The feasibility of using these two water sources is being investigated. Policy dialogue will include discussions on these new water sources to ensure that groundwater in Youyu will not be over-extracted. Loan assurances will be developed to ensure that the city’s master plan provides for an adequate surface water source by 2010 to sustain the supply of clean water, with the potential impact satisfactorily mitigated.

4. Wastewater

150. Wastewater pipes may leak or burst, causing environmental pollution and public health hazard. Adequately designed pipes, proper piping materials, proper supervision during construction, and proper operation and maintenance will prevent this from happening.

151. The operation of the WWTP in Wutong will generate air pollutants and solid waste. Small quantities of SO₂ (1.2 t/a) and TSP (0.12 t/a) will be emitted from the boiler. The odor emitted was assessed to comply with the standard at a distance of 150 m from the WWTP, and the new town area is at least 500 m from the plant. The WWTP will generate these types of solid waste each year: 4,526 tons of sludge, 35 tons of boiler bottom ash, 3.65 tons of MSW, and 252 tons of grit and settled solids. These will be taken to a sanitary landfill for disposal. Opportunities to reuse the wastewater sludge will be explored.

152. On the other hand, the operation of the WWTP in Wutong will reduce the discharge of pollutants into the Xiao River, which is part of the Yellow River system. The treated effluent will meet class IA provincial standards since it will be discharged into the Yellow River system.
Given the effluent standards established for the plant and the concentrations of influent pollutants, the provision of the WWTP is expected to achieve the following reductions in the pollutants discharged: BOD\textsubscript{5} by 307.0 t/a, COD\textsubscript{Cr} by 460.0 t/a, SS by 416.0 t/a, TN by 51.5 t/a, NH\textsubscript{3}-N by 36.5 t/a, and TP by 5.2 t/a.

5. River Improvement and Flood Control

153. The improvements in the Huiji River in Pingyao will improve the river flow as well as the floodwater-carrying capacity of this river, thus protecting nearby residents from property and economic losses due to flooding. The same will apply to Youyu with the construction of the flood control channel. The impact is all positive. The key is to end the discharge of untreated wastewater and the dumping of garbage into these water bodies, which will cause water quality to deteriorate. Wutong will be provided with wastewater collection pipelines for the new urban expansion area under the Project. Pingyao plans to construct wastewater collection pipelines to stop the discharge of untreated effluent into the Huiji River. The Project will provide training in solid waste management to the citizens of these three core subproject towns to increase their environmental awareness and lessen the dumping of garbage into water bodies.

6. Educational Facilities

154. These facilities will generate wastewater and solid waste during operation. About 200 m\textsuperscript{3}/d of wastewater and 2 t/d of MSW will be generated on school days by all these facilities combined. The wastewater will contain the following pollutants: about 24 t/a of COD\textsubscript{Cr}, 13 t/a of BOD\textsubscript{5}, 11 t/a of SS, and 2.7 t/a of NH\textsubscript{3}-N. The wastewater will be discharged into the public sewer leading to the WWTP to be constructed under the Project for treatment. The MSW will be taken to the sanitary landfill for disposal.

155. The detailed design of these facilities will include package WWTPs such as sequential batch reactors, to pretreat the wastewater so that the effluent can be reused to water the school grounds. Oil and grease traps will be installed to remove oil and grease in the wastewater from the canteens before it is discharged into the public sewer.

7. Associated Facilities

156. The associated facilities are the existing Jinyan Phase 2 Coking Plant in Wutong, which will supply heat and gas to the new town area, and the WWTP in Youyu, which will be built with funding from other sources. The Jinyan Phase 2 Coking Plant has enough capacity to supply the 10,000 new households in Wutong’s new urban expansion area. For the WWTP in Youyu, the feasibility study, the EIA, and design are under way. The plant will be completed by the time the wastewater pipeline construction under the Project is completed. This plant will produce small quantities of air pollutants from its boilers during operation, as well as sludge. The EIA for this WWTP will address this impact and recommend appropriate mitigation measures. On the other hand, the operation of the WWTP will reduce the discharge of pollutants into the river, especially COD\textsubscript{Cr}, BOD\textsubscript{5}, SS, NH\textsubscript{3}-N, and TP.

F. Climate Change Implications

157. 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 policies and measures to address climate change have been advocated in the
overall context of national sustainable development strategy, to mitigate and adapt to climate change.

158. Most of the global warming over the past 50 years was probably induced by the increase in concentrations of GHGs, such as CO₂, methane (CH₄), and nitrous oxide (N₂O), due to human activities. In the context of global warming, climate in the PRC has changed noticeably over the past 100 years as well. The major observed evidence of climate change in the PRC includes the following.⁵

(i) Annual average air temperature has increased by 0.5°C–0.8°C in the past 100 years, a slightly larger increase than the worldwide average. Most of the rise in temperature was observed over the last 50 years.
(ii) In the past 100 years, there has been no obvious change in annual precipitation in the PRC, but there is considerable variation among the 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 in the last 50 years. Drought in northern and northeastern PRC and flooding in the middle and lower reaches of the Yangtze River and southeastern PRC have become more acute.
(iv) The sea level along the PRC’s coasts has risen 2.5 mm yearly in the past 50 years, slightly higher than the global average.
(v) The mountain glaciers in the PRC have retreated, and the trend is accelerating.

159. Climate warming in the PRC will intensify further in the future. The projections by Chinese scientists indicate that:

(i) The nationwide annual mean air temperature would increase by 1.3°C–2.1°C in 2020 and 2.3°C–3.3°C in 2050 over that in 2000. The warming magnitude would increase from south to north in the PRC, particularly in northwestern and northeastern PRC, where a significant rise in temperature is projected.
(ii) Precipitation in the PRC would increase in the next 50 years, by 2%–3% by 2020 and 5%–7% by 2050. The increase would be most significant in the southeastern coastal regions.
(iii) Extreme weather and climate events would become more frequent in the PRC, with immense impact on socioeconomic development and people’s lives.
(iv) The arid area in the PRC would probably become larger and there would be a greater risk of desertification.
(v) The sea level along the PRC’s coasts would continue to rise.
(vi) The glaciers in the Qinghai–Tibetan Plateau and the Tianshan Mountains would retreat at a faster rate, and some smaller glaciers would disappear.

160. PRC experts estimate that the country’s GHG emissions in 2004 totaled about 6,100 tons of carbon dioxide equivalent (tCO₂e) (5,600 million tons of net emissions)—5,050 million tons of CO₂, 720 million tCO₂e of CH₄, and 330 million tCO₂e of N₂O. From 1994 to 2004, GHG emissions increased by an average of 4% yearly, and the share of CO₂ in total GHG emissions increased from 76% to 83%.

161. The PRC has had very low GHG emissions in the past, and its per capita emissions have been below the world average. Statistics from the International Energy Agency (IEA) indicate that per capita CO₂ emissions from fossil fuel combustion in the PRC amounted to 3.65 tons in 2004, 87% of the world average and 33% of the level in Organization for Economic Co-operation and Development (OECD) countries. Along with the country’s steady social and economic development, emission intensity, defined as CO₂ emissions per unit of GDP, has declined generally. According to the IEA, the PRC’s emission intensity fell to 2.76 kilograms (kg) of CO₂ per dollar of GDP (constant 2000) in 2004 from 5.47 kg in 1990, or by 49.5%. Over the same period, emission intensity dropped only 12.6% worldwide and only 16.1% in the OECD countries.

162. The PRC has become increasingly aware of the adverse effects of its unprecedented industrialization—making the country the world’s second-largest emitter of GHG responsible for climate change—on temperature increase, extreme weather events, biodiversity, livelihoods, and economic development. The State Environmental Protection Administration announced in January 2008 revised criteria for “ecologically sound” provinces, cities, and counties that balance environmental protection objectives with economic growth goals. This emphasis on environmental sustainability in urban and economic development, including the use of sustainable development indicators to assess local governments and officials, is an ongoing trend in government policy. The Chinese Public’s Environment and Inhabitant Livelihood Index 2007, released by the PRC Environmental Culture Promotion Association in January 2008, shows general dissatisfaction among the Chinese people with the degree of air pollution, with 26% saying they are very concerned with air quality. The Government intends to manage natural resources and mitigate climate change in ways that will relieve the negative impact of rapid economic growth.

163. As a developing country of responsibility, the PRC was among the first to formulate a national Agenda 21, soon after the United Nations Conference on Environment and Development in 1992. The country also adopted the following policies and measures, taking into account its specific national circumstances, to mitigate climate change:

(i) Restructuring the economy, promoting technological advancement, and improving energy efficiency.
(ii) Optimizing energy mix by developing low-carbon and renewable energy.
(iii) Launching a nationwide tree-planting and afforestation campaign, and enhancing ecology restoration and protection.
(iv) Effectively controlling the growth rate of the population through family planning.
(v) Strengthening laws and regulations, policies, and measures for dealing with climate change.
(vi) Further improving institutions and mechanisms.
(vii) Attaching great importance to climate change research and capacity building.
(viii) Strengthening education and training in, and public awareness of, climate change.

164. **Project Climate Change Adaptation Issues.** From the foregoing trends and projections, climate change is likely to affect the subproject towns as well as other small cities and towns in Shanxi in a number of ways in 20–50 years. The historical warming trend is more significant in northern, eastern, and western PRC than in areas south of the Yangtze River, with the most significant temperature increase occurring in winter. For that reason, the demand for heating should weaken in Shanxi. Although precipitation has been projected to increase nationwide, it has decreased sharply in northern PRC. Droughts have also intensified in northern PRC. As
such, flooding could become less frequent and severe. But there will be even greater shortage of water in places like Youyu. Long-term planning for the sustainable use of water resource is therefore important. Floodwater retention for use in watering and street cleaning in Youyu will help ease the demand for water and relieve the water shortage due to climate change.

165. The Project supports the PRC’s climate change initiatives to reduce GHG emissions. Because the energy mix in the country is coal-dominated (68.9% in 2005 based on consumption, compared with the world average of 27.8%), the CO₂ emission intensity of energy consumption is relatively high. Any reduction in the use of coal will reduce CO₂ and other GHG emissions. By supplying central heating and gas, the Wutong subproject is expected to reduce coal use by 39,400 t/a. Since every ton of standard coal burned produces about 2,620 kg of CO₂ and 7.4 kg of NOₓ, the reduction would keep about 103,228 t/a of CO₂ and 291.56 t/a of NOₓ out of the atmosphere. Similar benefits will also be achieved in the Youyu subproject.

166. This Project will contribute to climate change control by: (i) reducing GHG emissions and promoting awareness of climate change; (ii) stimulating internal demand for climate change initiatives; (iii) advancing climate change mitigation efforts in the water, wastewater, solid waste, urban roads, and energy management subsectors; (iv) opening up the discussion on climate adaptation; (v) empowering practitioners with user-friendly tools; (vi) shortening travel time per vehicle trip through better roads and connectivity, which would reduce fuel consumption and thus also GHG emissions from vehicles; and (vii) reducing CO₂ and NOₓ emissions through reductions in coal use.

167. The Project will address both climate change adaptation and mitigation issues. Urged along through policy dialogue, future urban planning will incorporate climate change adaptations. Youyu will adapt itself to the heightened water shortage by retaining floodwater for watering plants and cleaning streets, thereby becoming less reliant on the water source for uses other than drinking. The following specific climate change mitigation measures will be supported by the Project: (i) the introduction of climate change issues into urban master plans, favoring the development of energy-efficient technologies; (ii) the adoption of new technologies, such as online real-time energy information systems to determine the best way of reducing and managing utility costs; (iii) water management—longer planning horizons, long-term water availability forecasting, comprehensive water balances, solutions and agreements on necessary follow-ups; (iv) wastewater management—sludge digestion, biogas extraction, and beneficiary use; (v) solid waste management—higher rates of solid waste collection, biogas extraction, and beneficiary use in landfill management; (vi) urban road management—better connectivity and therefore less fuel consumption, cleaner fuel, better-managed car fleet (with proper inspections and better enforcement); and (vii) heating—energy efficiency and use of clean energy (also for water and wastewater utilities and landfills).

VI. ECONOMIC ASSESSMENT

168. The total cost of the Project (including core and noncore subprojects) is estimated at $266.10 million equivalent. ADB will finance $100 million (38.0%), Water Fund Grant will finance $0.25 million (0.1%), and the local governments will finance $165.90 million (61.9%).

169. The Project will generate a number of economic benefits. The river improvement in Pingyao will benefit tourism. The provision of central heating supply in Wutong and Youyu and central gas supply in Wutong will have resource cost saving, environmental, and health benefits. Roads and related municipal services will result in savings in maintenance costs and vehicle
operating costs, shorter travel time and fewer accidents, and higher land values. The water supply and wastewater components will result in more willingness to pay for the benefits.

170. The estimated economic internal rates of return (EIRRs) of the selected core subproject components are shown in the table below. The individual EIRRs are higher than the economic opportunity cost of capital, assumed at 12%, except for the Wutong wastewater component.

<table>
<thead>
<tr>
<th>Core Subproject Component</th>
<th>EIRR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wutong Caoxi Road and Related Municipal Services</td>
<td>19.4</td>
</tr>
<tr>
<td>Wutong District Heating</td>
<td>13.4</td>
</tr>
<tr>
<td>Wutong District Gas Supply</td>
<td>16.4</td>
</tr>
<tr>
<td>Wutong Wastewater</td>
<td>8.9</td>
</tr>
<tr>
<td>Youyu District Heat</td>
<td>16.4</td>
</tr>
<tr>
<td>Youyu Water Supply</td>
<td>20.6</td>
</tr>
<tr>
<td>Youyu Roads</td>
<td>16.6</td>
</tr>
</tbody>
</table>

EIRR = economic internal rate of return.

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

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management

172. The EMP is an important tool for implementing the proposed Project in an environmentally acceptable manner. It describes the procedures and plans for mitigation and monitoring in the current and later stages of the Project, stating clearly who will do what, when and how. The EMP (Appendix 2) in this SEIA was prepared for the core subprojects. EMPs for noncore subprojects will be prepared according to the EAMF.

173. The environmental mitigation measures will cost about $0.687 million equivalent to implement, and environmental monitoring during construction and operation will cost about $0.174 million equivalent. The public consultations will cost about $0.013 million equivalent. Meanwhile, $0.238 million worth of training in capacity building has been proposed to improve the environmental management capabilities of the PMOs, the EAs, the IAs, and the contractors. The total cost of EMP implementation for the core subprojects is about $1.112 million equivalent, about 0.5% of the project cost. This amount does not include the long-term environmental monitoring after the first year of operation, to be conducted by the IAs and the O&M organization’s own environmental staff.

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6 The environmental management of noncore subprojects through the EAMF will be similar to that of the core subprojects as discussed in this chapter.
174. The plan for implementing mitigation measures is organized by potential environmental impact during construction and operation. For each impact, appropriate mitigation measures are described. The plan covers the design, construction, and operation phases. For each mitigation measure, a responsible implementing party is listed. The agency or agencies that will supervise the implementation of each mitigation measure are also listed.

B. Environmental Monitoring

175. The plan for environmental monitoring is specific to each core subproject. The monitoring requirements, including the parameters to be monitored, the number and locations of monitoring stations, the monitoring frequency, and the monitoring duration, are clearly spelled out. For each parameter, the party responsible for carrying out the monitoring is stated so that accountability is not in doubt. The supervising agency or agencies for each parameter are also given.

C. Institutional Enhancement

176. At present, the IAs lack capacity for environmental management and monitoring. To properly implement the EMP, they, as well as the EA, the PMOs, and the contractors, must gain the necessary skills. The EMP describes the institutional strengthening and training requirements. An environmental management office with two environment specialists will be created for each PMO and IA. The institutional organization and the responsibilities of each environmental position in the Xinjiang PMO, the city PMOs, and the IAs will be finalized before the start of construction. The 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. Ten classes will be conducted to cover the topics. The related environmental monitoring equipment must be procured by the city PMOs, the IAs, and the contractors before the start of construction.

VIII. PUBLIC CONSULTATIONS AND INFORMATION DISCLOSURE

A. Public Participation during Project Preparation

177. Two rounds of public consultations were conducted during the EIA and SEIA process. Separate public meetings were held in Wutong, Youyu, and Pingyao. Government employees, local residents, and representatives were at the meetings. The first round gave the stakeholders an opportunity to understand the Project and its various components, their benefits, and the potential environmental impact. The stakeholders also had the chance to express their views, concerns, and suggestions. In the second round the project teams presented the initial findings and environmental mitigation measures, and responded to the views, concerns, and suggestions raised by the stakeholders in the first round.

178. In Wutong, two rounds of public consultations in the form of public forums took place in April 2008. More than 50 people attended each forum. The stakeholders recognized the environmental, social, and economic benefits of the Project and expressed overwhelming support for it. Their concerns included (i) the dust and noise impact during construction and the need to enforce environmental protection measures at that stage, (ii) the need to minimize both permanent and temporary acquisition of land to reduce the impact on farming, (iii) the safety of

7 The public consultations for noncore subprojects will be carried out according to the EAMF.
pipelines and heat exchange stations, and (iv) the affordability of heat and gas supply. These concerns were addressed in the EIA reports and during the second round of public consultations.

179. In Youyu, two rounds of public consultations in the form of public forums were held in January and July 2008. Each forum was attended by more than 100 people. The stakeholders acknowledged the environmental, social, and economic benefits of the Project and gave it their overwhelming support. Their concerns included (i) the strong emphasis that must be placed by the project proponents on environmental protection during construction and operation, (ii) the dust and noise impact during construction and the need to enforce environmental protection measures at that stage, and (iii) the adequacy of environmental control equipment for the purpose of reducing the emission of air pollutants and the discharge of wastewater during operation. This last concern was raised by the residents of Maguantun Village, which is near the central heating station. All of these concerns were addressed in the EIA reports and during the second round of public consultations.

180. In Pingyao, two rounds of public consultations in the form of public forums were held in May and June 2008. There were more than 70 people at each forum. The stakeholders, recognizing the environmental, social, and economic benefits of the Project, expressed their full support. Most wanted to see the early completion of the Project; some doubted whether the Project would bring them jobs. Most were not too concerned about the minor environmental impact that could result from the construction and operation of the Project.

B. Plans for Public Participation

181. In view of the concerns expressed about the construction and its impact, dialogue with the stakeholders throughout the construction is important. Continued public participation will ensure that such dialogue is maintained and that the stakeholders’ concerns are understood and dealt with promptly. The EMP includes plans for public participation in the future.

IX. ENVIRONMENTAL ASSESSMENT AND MANAGEMENT FRAMEWORK

182. This SEIA chapter summarizes the procedures for the selection, review, and appraisal of noncore subprojects, including the preparation and review of EIAs and EMPs. The complete EAMF, including the technical procedures for the conduct of the EIA studies and the preparation of the EIA reports and EMPs, is provided in Appendix 3.

183. The sector project analysis identified three core subprojects in Wutong, Youyu, and Pingyao for ADB funding. The selection of these core subprojects was based on comprehensive selection criteria, including the environmental criteria given in paras. 185–186. The selected subprojects represent the full range of (i) project interventions, (ii) conditions in small cities, and (iii) anticipated benefits and impact. SEIA reports and EMPs were prepared under this PPTA for these core subprojects. The noncore subprojects will also meet all the environmental due diligence and EIA requirements of ADB. The provincial PMO, the subproject PMOs, the EA, the IAs, the local design institutes (LDIs), and ADB will use this EAMF as a guide in selecting and appraising the noncore subprojects, and particularly in preparing and reviewing the EIA reports and the EMPs. The EAMF should ensure that the noncore subprojects strictly meet the required due diligence and procedures for environmental assessment and review.
A. Environmental Criteria for Subproject Selection

184. The selection of subprojects will take place at two levels. First, the subproject cities and towns will be selected by the provincial PMO. Then the subproject components in these subproject cities and towns will be selected by the local PMOs.

185. The review and selection of subproject cities and towns will be based on the following criteria:

(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) soundness of master plans, which should be integrated with the overall planning process; and
(vi) similarity to the core subproject cities in conditions and needs.

186. To be selected, the subproject components must be similar to the core subproject components and have potential environmental improvement benefits. The following principles will be followed in the selection:

(i) The principle of negative impact avoidance should be the top priority. The component facilities should be located away from sensitive areas and habitats such as water gathering grounds, nature conservation areas, protected ecological habitats, and protected heritage sites.
(ii) Water supply projects should improve the environment and the health of the residents by providing reliable and good-quality drinking water, thus delivering environmental and social benefits to the community.
(iii) Wastewater projects should improve the quality of receiving surface and groundwater bodies by providing wastewater collection and treatment facilities. They should also improve sanitation and public health in the community.
(iv) Solid waste projects should improve sanitation in the community and have environmental and public health benefits, including reducing and recycling waste.
(v) Flood control and river improvement projects should help with flood control, thereby reducing the risk of property loss and public health hazards due to flooding.
(vi) District heating projects should reduce reliance on small boiler rooms and household stoves, which are inefficient and polluting. Household stoves burning coal also create indoor and outdoor pollution, as well as respiratory diseases from the inhalation of coal dust. By reducing coal use, district heating will also reduce GHG emissions, with positive effects on climate change.
(vii) Transportation projects that improve road conditions and road networks will result in better connectivity and travel conditions. Travel time per vehicle trip will be shortened, less fuel will be consumed, and vehicle emissions will decrease. The reduction in GHG emissions will have positive effects on climate change.
B. Country’s Environmental Assessment and Review Procedure

187. The Project requires all domestic EIAs to be approved by the provincial environmental protection bureau (EPB). The local practice, however, is to prepare one domestic EIA for each component, so a subproject could have more than one EIA for domestic approval. The PMOs and environmental management consultants (EMCs) will request the LDIs to prepare one EIA (including an EMP) for the subproject if possible, or to minimize the number of EIAs and to combine the EMPs, if time allows.

188. The Project has been classified by ADB as category A. EIA reports and EMPs as described in Appendix 3 are therefore required for all noncore subprojects. Like ADB, the PRC has procedures for determining the EIA requirements for different types of projects according to their potential environmental impact. For projects with substantial impact on the environment (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 impact on the environment (similar to ADB’s category B projects), a project EIA table must be prepared, submitted, and approved. For some noncore subprojects or subproject components, an EIA table alone will suffice under the domestic system, but such a table might not meet ADB’s requirements. The LDIs will provide ADB with the EIAs and EMPs in the format described in Appendix 3.

C. Review and Appraisal Procedures

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

190. **Review and Selection of Subprojects and Subproject Components.** The EMCs will (i) collect and review all the necessary data (FSR, EIA, etc.); (ii) discuss all the related issues with the PMO and other stakeholders; (iii) together with the PMO, review and select the subprojects and subproject components against the criteria given in paras. 185–186; and (iv) submit the subprojects and subproject components selected to ADB. ADB will review and endorse the selection or advise otherwise.

191. **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 reports fully provide the information needs presented in the EAMF and that the implementation of the mitigation measures described will mitigate the impact to acceptable levels. The EIA reports and EMPs will be reviewed and appraised as follows:

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

(ii) The provincial PMO will reject reports that do not meet the information, procedural, and organizational requirements and send them back to be improved and resubmitted. Resubmitted reports will again be reviewed and appraised.

(iii) If the EIA reports and EMPs meet the information, procedural, and organizational requirements, the provincial PMO will sign off on the reports and submit them to the EMCs.

(iv) The PMO will also recommend further processing of subprojects or subproject components that require special attention as described in para. 192. Such subprojects and subproject components will be reviewed and appraised according to the procedures specified in para. 193.
The EMCs will sign off on these recommendations, if appropriate.

The environment specialist of ADB’s operations department will endorse all EIAs and EMPs for subprojects that do not require special attention as described in para. 192, on the basis of the recommendations submitted.

After their EIAs and EMPs are endorsed by ADB, the subprojects that do not require special attention as described in para. 192 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.

The following are the most sensitive components that require special attention:

(i) solid waste component involving incineration;
(ii) solid waste component involving landfill or composting facilities without leachate or methane gas collection and treatment;
(iii) district heating component in which the central heat supply station uses coal as fuel but without dust removal and flue gas desulfurization equipment;
(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 in which the WWTP has a total design capacity of more than 100,000 m³/d and will discharge into a water body categorized as class III or better;
(vii) transportation component in a densely populated area;
(viii) component that would impinge on a water gathering ground, a nature conservation area, a protected ecological habitat, or a protected heritage site; and
(ix) component with other factors that would place it in ADB category A.

The review and appraisal procedures for the EIA reports and EMPs for components that need special attention as specified in para. 192 are as follows:

(i) The EMCs will conduct a separate review and appraisal of the EIA reports and EMPs after the PMO review and recommendations.
(ii) The EMCs will reject EIA reports and EMPs that do not provide sufficient estimates of project impact or adequate monitoring and mitigation of the impact, and therefore do not meet the information, procedural, and organizational requirements of ADB, and send back the reports to be improved and resubmitted. Resubmitted reports will again be reviewed and appraised.
(iii) If the EIA reports and EMPs meet the information, procedural, and organizational requirements of ADB and provide adequate impact assessments as well as monitoring and mitigation arrangements, the EMC will sign off on the reports and submit them to ADB with the recommendation for their Web posting or rejection for stated reasons.
(iv) The environment specialist of ADB’s operations department will approve or reject all EIAs and EMPs as recommended.
(v) After their EIAs and EMPs are approved by ADB, the subprojects 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.
ADB’s operations department will ensure the posting of the noncore subproject EIAs and EMPs on the ADB website within 1 month for a total of 120 days.

Project construction can start when the posting period expires.

X. CONCLUSIONS

A. Project Risks

194. The main project risks are the low institutional capacity for environmental management and the possibility that the PMOs, IAs, and O&M organizations will fail to monitor the environmental impact and implement the EMPs during the construction and operation of the Project and that the associated facilities will not be built on time. These risks will be mitigated through (i) extensive training in environmental management under the Project, (ii) the appointment of qualified project implementation consultants, (iii) appropriate project implementation monitoring and mitigation arrangements, and (iv) project reviews by ADB.

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

(i) SPG 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, Shanxi, and local laws and regulations and standards for 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) SPG will cause each 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 SPG Environmental Protection Bureau as well as the EPBs in Wutong, Youyu, and Pingyao, or other environmental monitoring centers.

(iii) SPG will cause each subproject city and IA to ensure that the Shanxi EPB and PMO review any changes in the project design that could cause negative environmental impact, and to adjust the environmental monitoring and mitigation measures accordingly in consultation with ADB.

(iv) SPG will ensure that each core subproject city takes the necessary actions to minimize the impact of interruptions in water supply, wastewater collection, and other utility services during the construction of the Project.

(v) SPG will ensure that the PMO prepares and submits to ADB semiannual environmental reports in a format acceptable to ADB, until loan closure.

(vi) For the water supply in Youyu, SPG will ensure that:
   (a) A surface water source is developed to supply water to Youyu by 2015.
   (b) The existing Changmenpu Reservoir is used first before the construction of new reservoirs is considered.
   (c) The Changmenpu Reservoir is adequately protected in accordance with the PRC regulation ensuring the safety of water supply.
   (d) The construction and use of the Haiziwan reservoir will require detailed analysis, the mandatory water use authorization permit, and a comprehensive and inclusive EIA (or its update), to be carried out in due time to ensure that the use of this water source for the city’s needs do not adversely affect the downstream and other users of the Cangtou and Maying rivers and the environment. The EIA and water permit studies will
contain comprehensive and inclusive analyses that address the issue of water user balance. The potential adverse impact, if any, will have to be mitigated to safe and acceptable levels according to the PRC regulations and international good practices.

(e) The Haiziwan Reservoir will be adequately protected according to the PRC regulations ensuring the safety of water supply.

(f) The treatment technology to be used in the WTP must be adequate to treat the water from the Changmenpu and Haiziwan reservoirs to drinking-water standards.

(g) The water catchments of these reservoirs must be protected from polluting industries and activities.

(vii) The PRC Government will ensure that the SPG and the PMOs follow the EAMF.

B. Benefits

196. The overall objectives of these subprojects will be to increase employment and sustainable economic growth, improve the urban environment, and improve urban infrastructure and municipal services.

197. The core subprojects have many benefits. Roads will improve the transport network and connectivity, thereby reducing travel time per trip and hence also vehicle emissions per trip, with positive effects on air quality. Water supply and wastewater treatment will improve public health and reduce the discharge of pollutants into rivers and groundwater. The flood control and river and drainage improvements will provide flood protection, thereby reducing economic loss and public health hazard due to flooding. District heating and gas supply will improve efficiency, eliminate a considerable number of small and inefficient boilers, and reduce the quantity of coal used (by 39,400 t/a), thus reducing SO$_2$ emissions (by 1,030 t/a), TSP (by 233.5 t/a), and NO$_x$ (by 35 t/a), as well as the amount of bottom ash (by 9,607 t/a). Households will no longer have to use coal stoves burning high-sulfur coal mud for heating and cooking; human health as well as indoor and outdoor air quality should therefore improve. Centralizing coal use for heat and gas supply will also centralize the storage of bottom ash and facilitate its reuse as building or road paving material.

198. The provision of wastewater treatment and central heating and gas supply has been estimated to achieve at least the following reductions in the water and air pollutants discharged: BOD$_5$ by 307 t/a, COD$_{Cr}$ by 460 t/a, SS by 416 t/a, TN by 51.5 t/a, NH$_3$-N by 36.5 t/a, TP by 5.2 t/a, SO$_2$ by 1,030 t/a, NO$_x$ by 35 t/a, and TSP by 233.5 t/a.

199. This Project will have positive effects on climate change, supporting the PRC’s climate change initiatives. The provision of roads with better travel conditions and connectivity will reduce travel time per vehicle trip. Fuel consumption and therefore GHG emissions will also be reduced. Supplying central heating and gas will allow inefficient small boiler rooms and household stoves to be eliminated, resulting in more efficient use of coal resource. It has been estimated that the Wutong subproject will reduce coal use by 39,400 t/a. About 103,228 t/a of CO$_2$ and 291.56 t/a of NO$_x$ will thus be kept out of the atmosphere.

200. This SEIA 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 in Shanxi that are similarly urbanizing rapidly.
C. Potential Adverse Impact and Associated Mitigation Measures

201. An unavoidable impact of the core subprojects will be the need to resettle 5,167 persons to allow permanent land acquisition and the demolition of residential structures. The RPs have been prepared, and they describe the resettlement of affected households and people, and the compensation to be provided. The RPs fully meet the resettlement policies and requirements of the PRC and ADB.

202. During construction, dust from construction sites, noise from power mechanical equipment, wastewater, solid wastes, and construction traffic will be the main adverse impact. Most of the subproject components will be constructed in new urban expansion or new town areas with no occupants. Good housekeeping and effective mitigation measures will nonetheless be pursued to reduce the impact to acceptable levels.

203. During operation, the main adverse impact will consist of air emissions, wastewater, and solid waste from the central heating and gas supply stations and the WWTP. Air emissions from the boilers in the WWTP will be minor. The central heating and gas supply stations will be equipped with dust removal and flue gas cleanup equipment and their air emissions will comply with the air quality standards. Small quantities of wastewater and solid waste generated from the operation of these facilities will be properly discharged to the public sewer and disposed of at sanitary landfills.

204. The type and magnitude of the potential impact from noncore subprojects should be similar to those from the core subprojects. The impact will be analyzed and mitigation measures will be formulated along with the implementation of the EAMF.

205. Overall, the Project is expected to have no adverse impact provided that the mitigation and monitoring plans are implemented, and the environmental management and institutional capacity of the EA, PMOs, and IAs is built up and strengthened with the establishment of environmental management offices and the conduct of EMP training.

D. Use of Irreplaceable Resources

206. The Project will result in the permanent loss of about 102.5 ha of land and associated habitats. No rare, threatened, or protected species has been recorded in the project areas.

E. Follow-Up Monitoring and Environmental Management Requirements

207. An EMP has been developed for the design, construction, and operation of the core subprojects. The plan includes institutional arrangements and strengthening to enable the implementation of the mitigation measures and environmental monitoring. The EMP will be continuously developed as the Project progresses. EMPs for noncore subprojects will be prepared, reviewed, appraised, and implemented according to the EAMF.
REFERENCES FOR SHANXI PROVINCE

A. References


B. Environmental Regulations and Standards

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 Sites (GB12348-90)
8. Pollution Control Standards for the Storage and Treatment of General Industrial Solid Waste (GB18599-2001)
10. Standards for Noise at the Boundary of Industrial and Enterprise Facilities (GB12348-90)
12. Urban Environmental Noise Standards (GB3096-93)
ENVIRONMENTAL MANAGEMENT PLAN FOR SHANXI PROVINCE

A. Introduction

1. This environmental management plan (EMP) \(^1\) covers the design, construction, commissioning, and operation phases of the Project so that environmental impact is monitored and environmental mitigation measures are implemented. The three core subprojects are shown on maps as follows: Figure A2.1 for Wutong, Figure A2.2 for Youyu, and Figure A2.3 for Pingyao.

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

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

B. Summary of Potential Impact

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

C. Mitigation Measures

5. The mitigation measures will be (i) designed by the 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 and units under the supervision of the Shanxi and local project management offices (PMOs). The effectiveness of these measures will be evaluated on the basis of the results of the environmental monitoring, to determine whether the measures should continue to be implemented without change or they should first be improved. The improvements 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 in their quality of life. Details of the required actions are given in the project resettlement plans.

---

\(^1\) Noncore subprojects will be analyzed according to the environmental assessment and management framework (EAMF) in the same way as the core subprojects, as discussed in this EMP.
## Table A2.1: Summary of Potential Impact and Mitigation Measures for Core Subprojects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Wutong</th>
<th>Youyu</th>
<th>Pingyao</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Design Stage</td>
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<tr>
<td></td>
<td>Emission of PM$_{10}$ and SO$_2$ from the central heating station in Youyu</td>
<td>• Properly design dust removal and flue gas desulfurization equipment</td>
<td></td>
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<td></td>
<td>Emission of chlorine from the WTP disinfection facility in Youyu</td>
<td>• Properly design the chlorine dioxide reactor and all necessary safety features of the disinfection facility</td>
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<tr>
<td></td>
<td>Odor from WWTP in Wutong</td>
<td>• Properly design odor removal system for the sewage intake pump house and sludge drying</td>
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<tr>
<td></td>
<td>Odor from dredged spoil during river improvement works in Pingyao and Youyu</td>
<td>• Properly identify locations for the temporary storage of dredged spoils that are away from residents, hospitals, and schools</td>
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<tr>
<td></td>
<td>Dust from construction activities in Wutong, Youyu, and Pingyao</td>
<td>• Include in tender documents specifications for good construction site practices related to dust control described in the SEIA, such as daily watering of unpaved areas and stockpiles, covering of stockpiles, and control of vehicle speed</td>
<td></td>
<td></td>
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<td></td>
<td>Air</td>
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<tr>
<td></td>
<td>Emission of PM$_{10}$ and SO$_2$ from the central heating station in Youyu</td>
<td>• Properly design dust removal and flue gas desulfurization equipment</td>
<td></td>
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<tr>
<td></td>
<td>Emission of chlorine from the WTP disinfection facility in Youyu</td>
<td>• Properly design the chlorine dioxide reactor and all necessary safety features of the disinfection facility</td>
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<tr>
<td></td>
<td>Odor from WWTP in Wutong</td>
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<tr>
<td></td>
<td>Odor from dredged spoil during river improvement works in Pingyao and Youyu</td>
<td>• Properly identify locations for the temporary storage of dredged spoils that are away from residents, hospitals, and schools</td>
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</tr>
<tr>
<td></td>
<td>Dust from construction activities in Wutong, Youyu, and Pingyao</td>
<td>• Include in tender documents specifications for good construction site practices related to dust control described in the SEIA, such as daily watering of unpaved areas and stockpiles, covering of stockpiles, and control of vehicle speed</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Air</td>
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<tr>
<td></td>
<td>Operational noise from the central heat station and heating substations in Youyu, and the heating substations and WWTP in Wutong</td>
<td>• Select low-noise equipment and design soundproof or noise-absorptive facilities for main noise sources</td>
<td></td>
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</tr>
</tbody>
</table>

Design Institute: XCECMAO, YCDRC, PWAB

Estimated Costs (CNY10,000): Included in the detailed design contract
<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Wutong</th>
<th>Youyu</th>
<th>Pingyao</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Noise from powered mechanical equipment during construction in Wutong, Youyu,</td>
<td>• Include in tender documents specifications for good construction site practices related to noise control, such as the use of low-noise equipment and temporary noise barriers or hoardings, and regular maintenance of equipment</td>
<td></td>
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<tr>
<td></td>
<td>and Pingyao</td>
<td></td>
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</tr>
<tr>
<td>Water</td>
<td>Noncompliance of WWTP effluent discharge in Wutong with standards</td>
<td>• Design dual-power-source supply system to reduce the impact of power blackouts</td>
<td></td>
<td>XCECMAO, YCDRC, PWAB</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Discharge of low-pH backwash effluent from the heat exchange substations in</td>
<td>• Design pH adjustment systems for the effluent, such as adequate equalization tanks for pH adjustment before discharge into public sewer</td>
<td></td>
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<tr>
<td></td>
<td>Wutong and Youyu</td>
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</tr>
<tr>
<td></td>
<td>Wastewater from the education facilities in Wutong</td>
<td>• Properly design oil and grease separator for the school kitchens • Design pretreatment systems for schools’ wastewater to enable effluent reuse for watering the grounds in these schools</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Solid Waste</td>
<td>Disposal of excavated soil, construction and demolition wastes, and dredged</td>
<td>• Identify storage and disposal facilities and specify the use of these facilities in the tender documents</td>
<td></td>
<td>XCECMAO, YCDRC, PWAB</td>
<td></td>
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<tr>
<td></td>
<td>spoil during construction in Youyu and Pingyao</td>
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<tr>
<td></td>
<td>Disposal of WWTP sludge in Wutong, and bottom ash from the central heat station in Youyu</td>
<td>• Identify reuse opportunities and disposal facilities</td>
<td></td>
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</tr>
</tbody>
</table>
## B. Construction Stage

<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Wutong</th>
<th>Youyu</th>
<th>Pingyao</th>
<th>Total</th>
</tr>
</thead>
</table>
| Air     | Dust             | - Adopt advanced construction techniques and select appropriate machinery and transportation vehicles in compliance with national emission standards  
- Organize well material storage; separate stone and sand materials, store concrete in separate storage place, and minimize transportation required; clean up construction and demolition waste promptly  
- Spray water on exposed surfaces and unpaved haul roads  
- Avoid overloading trucks; cover materials during transport; clear the dust promptly and spray water on haul roads  
- Set up hoarding around the construction site, particularly for sensitive receivers near roads, including schools, temples, hospitals, and residential areas  
- Stop construction during strong winds and cover the stockpile  
- Limit vehicle speed on unpaved haul roads to less than 8 km/h                                                   | Contractor XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB                                                                                                                                   |                     | 17 (see note i) 38 (see note ii) | 78     | 133   |
| Noise   | Noise from power mechanical equipment and vehicles | - Strengthen construction management and avoid construction at night (10 p.m.–6 a.m.)  
- Use hydraulic tools instead of pneumatic tools  
- Use low-noise machinery  
- Install temporary noise barrier around noisy machinery  
- Avoid mixing concrete on-site; use                                                                                                           | Contractor XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB                                                                                                                                   | See note i          | See note ii | 20     | 20    |
<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Wutong</th>
<th>Youyu</th>
<th>Pingyao</th>
<th>Total</th>
</tr>
</thead>
</table>
| Water           | Wastewater from construction workers, canteens, and machinery maintenance, and site runoff | - Strengthen management; discharge domestic wastewater into the nearby sewer network or have it treated in on-site package plant  
- Build storage tank, drainage ditch, temporary sedimentation tank to treat wastewater from excavation, as well as equipment cooling or washing, before the wastewater is discharged into the sewer network  
- Locate the storage site and sand mixing site at least 100 m away from water body; spray the site with water regularly during construction to reduce the pollution  
- Enclose the asphalt mixing site downwind at least 500 m away from water bodies to avoid contamination  
- Strengthen water use management, and avoid introducing chemicals when rehabilitating vegetation to reduce water pollution | Contractor XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB | See note i | See note ii | 20 | 20   |
<p>| Solid Waste     | Refuse generated on construction sites,                                           | - Collect and clean up the refuse promptly and dispose of it in                                                                                                                                                     | Contractor XCECMAO, YCDRC, | See note i | See note ii | 10 | 10   |</p>
<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Wutong</th>
<th>Youyu</th>
<th>Pingyao</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>construction and demolition waste, excavated soil</td>
<td>landfills</td>
<td>• Sort the construction and demolition waste and recycle or reuse if possible&lt;br&gt;• Maximize the reuse of excavated soil for backfilling&lt;br&gt;• Dispose of the waste in designated sites only</td>
<td>PWAB, XEPB, YEPB, PEPB</td>
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<tr>
<td>Affected vegetation</td>
<td></td>
<td>• Relocate trees affected by the construction; avoid cutting trees and restore the vegetation when the construction is completed</td>
<td></td>
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<tr>
<td>Soil erosion and water and soil conservation</td>
<td></td>
<td>• Set up hoarding around the construction site; build a temporary drainage ditch and hoarding for temporary living quarters; install hoarding and drainage for temporary roads; water haul roads regularly; cover soil and aggregate materials on trucks during transport&lt;br&gt;• Build a drainage ditch and slope protection during site formation&lt;br&gt;• Develop a construction plan for the rainy season to prevent surface runoff and soil erosion&lt;br&gt;• Protect farmland and channels near construction sites</td>
<td>XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB</td>
<td></td>
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<tr>
<td>Ecology, Habitat and Soil Conservation</td>
<td></td>
<td></td>
<td>Contractor</td>
<td></td>
<td>85</td>
<td>164</td>
<td></td>
<td>249</td>
</tr>
<tr>
<td>Workplace Health and Safety</td>
<td>Health and safety of workers</td>
<td>• Maintain efficient sanitation in the construction area; provide health checks to workers&lt;br&gt;• Strengthen safety training and management to ensure safe construction&lt;br&gt;• Provide construction workers with personnel protection utilities, such as&lt;br&gt;• Provide personal protective equipment (PPE)</td>
<td>XCECMAO, YCDRC, PWAB</td>
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<td>10</td>
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<td></td>
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<td></td>
<td>Contractor</td>
<td></td>
<td></td>
<td></td>
<td>See note i</td>
<td>See note ii</td>
</tr>
<tr>
<td>Subject</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Implementing Agency</td>
<td>Supervising Agency</td>
<td>Wutong</td>
<td>Youyu</td>
<td>Pingyao</td>
<td>Total</td>
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<tr>
<td>Social</td>
<td>Traffic congestion</td>
<td>• Divert or schedule the construction traffic to avoid peak hours</td>
<td>Contractor</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>See note i</td>
<td>See note ii</td>
<td>5</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td>• Build temporary roads</td>
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<td></td>
<td></td>
<td>• Phase construction on roads with busy traffic and shorten the construction period if possible</td>
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<tr>
<td></td>
<td></td>
<td>• Select transport routes to reduce disturbance to regular traffic</td>
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<tr>
<td>Cultural Heritage</td>
<td>Cultural heritage items affected by the construction activities</td>
<td>• Should cultural heritage items be found during the construction, stop construction, protect the site, and report the discovery to the authorities</td>
<td>Contractor</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>See note i</td>
<td>See note ii</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>C. Operational Stage</td>
<td></td>
<td>• Clean up the sludge and dispose of it promptly</td>
<td>XCECMAO, XPMO, XEPB</td>
<td>Included in operating costs</td>
<td>N/A</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Air</td>
<td>Odor from the WWTP in Wutong</td>
<td>• Maintain machinery regularly and keep the equipment in good condition</td>
<td>XCECMAO, XPMO, XEPB</td>
<td>Included in operating costs</td>
<td>N/A</td>
<td></td>
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<tr>
<td></td>
<td>Noise from the WWTP and heat exchange substations in Wutong, and the central heating station and heat exchange substations in Youyu</td>
<td>• Maintain machinery regularly and keep the equipment in good condition</td>
<td>XCECMAO, YCDRC, YPMO, YEPB</td>
<td>Included in operating costs</td>
<td>N/A</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Subject</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Implementing Agency</td>
<td>Supervising Agency</td>
<td>Wutong</td>
<td>Youyu</td>
<td>Pingyao</td>
<td>Total</td>
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<td>------------------------</td>
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</tr>
<tr>
<td>Water</td>
<td>Effluent from the WWTP in Wutong</td>
<td>• Maintain all equipment regularly to ensure normal operation</td>
<td>XCECMAO, YCDRC</td>
<td>XPMO, XEPB, YPMO, YEPB</td>
<td>Included in operating costs</td>
<td>N/A</td>
<td>Included in operating costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wastewater from schools in Wutong</td>
<td>• Maximize effluent reuse after pretreatment for watering the school grounds</td>
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<tr>
<td></td>
<td>Backwash effluent from the heat exchange substations in Wutong and Youyu</td>
<td>• Check and adjust the pH regularly before discharging wastewater into the public sewer</td>
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<tr>
<td>Solid Waste</td>
<td>Bottom ash from the central heating station in Youyu</td>
<td>• Maximize its reuse as building and road paving materials</td>
<td>XCECMAO, YCDRC</td>
<td>XPMO, XEPB, YPMO, YEPB</td>
<td>Included in operating costs</td>
<td>N/A</td>
<td>Included in operating costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sludge from WWTP in Wutong</td>
<td>• Explore and maximize reuse opportunities</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Dispose of the sludge at sanitary landfills</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<td></td>
<td></td>
<td>17</td>
<td>123</td>
<td>327</td>
<td>467</td>
</tr>
</tbody>
</table>

km/h = kilometers per hour, m = meter, N/A = not applicable, PEPB = Pingyao Environmental Protection Bureau, pH = a unit of acidity, PM$_{10}$ = particulate matter ≥10 micrometers in diameter, PWAB = Pingyao Water Affairs Bureau, SEIA = summary environmental impact assessment, SO$_2$ = sulfur dioxide, WTP = water treatment plant, WWTP = wastewater treatment plant, XCECMAO = Xiaoyi City Engineering and Construction Management Affairs Office, XEPB = Xiaoyi Environmental Protection Bureau, XPMO = Xiaoyi (Wutong) Project Management Office, YCDRC = Youyu County Development and Reform Commission, YEPB = Youyu Environmental Protection Bureau, YPMO = Youyu Project Management Office.

Notes:
(i) Included in the total cost of CNY170,000.
(ii) Included in the total cost of CNY380,000.
Sources: EIA reports.
D. Environmental Monitoring

1. 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 estimate for this monitoring program is included in the table. A detailed cost breakdown will be provided when the detailed environmental monitoring program is prepared at the start of project implementation. Compliance 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 emission standards. The local monitoring stations will be responsible for implementing this program of compliance monitoring.

8. At the start of project implementation, the Shanxi PMO, local PMOs, the implementing agencies (IAs) or operation and maintenance (O&M) companies, the environmental management consultants (EMCs), and the construction supervision companies (CSCs) will prepare more detailed internal environmental monitoring programs to be implemented during construction and operation if necessary, through the EMP mechanism of feedback and adjustments. This monitoring will be more frequent than the compliance monitoring. These monitoring programs and budgets will be included in the project tendering documents and budgets, as well as the construction and operation contracts. At the start of project implementation, the Shanxi PMO, local PMOs, IAs, and EMCs will develop (i) comprehensive project design and monitoring framework (DMF) procedures for the Project as a whole to systematically generate data on the inputs and outputs of the project components, and (ii) detailed environmental and related social economic indicators to measure project impact.

9. The DMF indicators for the Project are: (i) public satisfaction with the living environment, (ii) increase in employment, (iii) wastewater collection and treatment rate, (iv) increase in public transport routes, (v) increase in potable water coverage, (vi) increase in heat and gas supply coverage, (vii) increase in local gross domestic product, and (viii) increase in tourism numbers. Under the DMF, 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 DMF will be designed to permit adequate flexibility to adopt remedial action regarding project design, schedules, activities, and development impact. The Shanxi PMO, local PMOs, and IAs will refine the DMF, confirm achievable goals, firm up monitoring and recording arrangements, and establish systems and procedures no later than 6 months after the loan takes effect.

2. Monitoring Management

10. During construction and operation, 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 according to 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 Shanxi EPB as required. When complaints are received from the public, the monitoring staff of the Shanxi EPB or local EPB will conduct additional inspections immediately.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Parameter</th>
<th>Location</th>
<th>Time</th>
<th>Frequency</th>
<th>Implementing Agency</th>
<th>Supervision Agency</th>
<th>Estimated Cost (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wutong – Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, PM&lt;sub&gt;10&lt;/sub&gt;</td>
<td>4 locations close to construction site, including residence, school, and government departments</td>
<td>One day</td>
<td>Once a month</td>
<td>Contractor</td>
<td>XCECMAO, XEPB</td>
<td>8</td>
</tr>
<tr>
<td>Noise</td>
<td>L&lt;sub&gt;eq&lt;/sub&gt;</td>
<td>4 locations including residence, school, and government departments</td>
<td>Once in the daytime, once at night</td>
<td>Once a month</td>
<td>Contractor</td>
<td>XCECMAO, XEPB</td>
<td>2</td>
</tr>
<tr>
<td>Water</td>
<td>pH, TPH, SS</td>
<td>1 location: Xiao River</td>
<td>One day</td>
<td>Once a month</td>
<td>Contractor</td>
<td>XCECMAO, XEPB</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Wutong – Operation Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, CO, HC</td>
<td>1 location at curbside of Caoxi Road in the new urban expansion area</td>
<td>One day</td>
<td>Twice a month</td>
<td>XCECMAO</td>
<td>XPMO, XEPB</td>
<td>21 (for 1st year)</td>
</tr>
<tr>
<td>Noise</td>
<td>L&lt;sub&gt;eq&lt;/sub&gt;</td>
<td>1 location at curbside of Caoxi Road in the new urban expansion area</td>
<td>One day, once in the daytime and once at night</td>
<td>Once a month</td>
<td>XCECMAO</td>
<td>XPMO, XEPB</td>
<td>1.5 (for 1st year)</td>
</tr>
<tr>
<td>Water</td>
<td>pH, COD&lt;sub&gt;Cr&lt;/sub&gt;, BOD&lt;sub&gt;5&lt;/sub&gt;, NH&lt;sub&gt;3&lt;/sub&gt;-N, SS</td>
<td>Discharge point of WWTP</td>
<td>One day</td>
<td>Once a month</td>
<td>XCECMAO</td>
<td>XPMO, XEPB</td>
<td>20 (for 1st year)</td>
</tr>
<tr>
<td><strong>Youyu – Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP</td>
<td>3 monitoring locations: (i) Youyu Second Middle School, (ii) Youyu County Office, and (iii) Maguantun Village</td>
<td>One day</td>
<td>Two days a month</td>
<td>Contractor</td>
<td>YCDRC, YEPB</td>
<td>10</td>
</tr>
<tr>
<td>Noise</td>
<td>L&lt;sub&gt;eq&lt;/sub&gt;</td>
<td>3 monitoring locations: (i) Youyu Second Middle School, (ii) Youyu County Office, and (iii) Maguantun Village</td>
<td>Once in the daytime and once at night on each day</td>
<td>Two days a month</td>
<td>Contractor</td>
<td>YCDRC, YEPB</td>
<td>2</td>
</tr>
<tr>
<td>Subject</td>
<td>Parameter</td>
<td>Location</td>
<td>Time</td>
<td>Frequency</td>
<td>Implementing Agency</td>
<td>Supervision Agency</td>
<td>Estimated Cost (CNY10,000)</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>----------</td>
<td>------</td>
<td>-----------</td>
<td>---------------------</td>
<td>--------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>Youyu – Operation Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, PM$_{10}$, SO$_2$, NO$_2$</td>
<td>At emission points of the central heating station</td>
<td>Continuous online monitoring</td>
<td>YCDRC</td>
<td>YPMO</td>
<td>YEPB</td>
<td>30 (for 1st year)</td>
</tr>
<tr>
<td>Noise</td>
<td>L$_{eq}$</td>
<td>4 locations, one on each of the 4 sides of the central heating station boundary</td>
<td>One day</td>
<td>Once every 3 months</td>
<td>YCDRC</td>
<td>YPMO</td>
<td>5 (for 1st year)</td>
</tr>
<tr>
<td><strong>Pingyao – Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, Odor</td>
<td>3 locations: Yinhui Village, Xiguo Village and Huiji Bridge</td>
<td>One day</td>
<td>Once a month</td>
<td>Contractor</td>
<td>PWAB</td>
<td>PE PB</td>
</tr>
<tr>
<td>Noise</td>
<td>L$_{eq}$</td>
<td>4 locations: Yinhui Village, Xiaocheng Village, Xiguo Village, Huiji Bridge</td>
<td>Once in the daytime, once at night</td>
<td>Once a month</td>
<td>Contractor</td>
<td>PWAB</td>
<td>PE PB</td>
</tr>
<tr>
<td><strong>Pingyao – Operation Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td>pH, COD$_{Cr}$, BOD$_5$, SS, NH$_3$-N, TPH</td>
<td>2 locations: one at Yinhui Reservoir and one at Huiji River</td>
<td>3 consecutive days</td>
<td>Once every 3 months</td>
<td>PWAB</td>
<td>PPMO</td>
<td>PE PB</td>
</tr>
<tr>
<td>Ground-water</td>
<td>pH, NH$_3$-N, NO$_3$-N, NO$_2$-N, F$^-$</td>
<td>3 groundwater well locations: one in Yinhui Village, one in Xiaocheng Village, and one in Xiguo Village</td>
<td>3 consecutive days</td>
<td>Once a year during the dry season</td>
<td>PWAB</td>
<td>PPMO</td>
<td>PE PB</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>118</td>
</tr>
</tbody>
</table>

BOD$_5$ = biochemical oxygen demand, CO = carbon monoxide, COD$_{Cr}$ = chemical oxygen demand, F$^-$ = fluoride, L$_{eq}$ = equivalent continuous noise level (dB), NH$_3$-N = ammonia nitrogen, NO$_3$-N = nitrate nitrogen, NO$_2$-N = nitrite nitrogen, NO$_2$ = nitrogen dioxide, pH = unit of acidity, PEPB = Pingyao Environmental Protection Bureau, PWAB = Pingyao Water Affairs Bureau, PM$_{10}$ = particulate matter with diameter ≤10µ, SS = suspended solids, SO$_2$ = sulfur dioxide, TPH = total petroleum hydrocarbon, TSP = total suspended particulates, WWTP = wastewater treatment plant, XCECMAO = Xiaoyi City Engineering and Construction Management Affairs Office, XEPB = Xiaoyi Environmental Protection Bureau, XPMO = Xiaoyi Project Management Office, YCDRC = Youyu County Development and Reform Commission, YEPB = Xiaoyi Environmental Protection Bureau, YPMO = Xiaoyi Project Management Office.

Notes:
(i) Detailed internal monitoring program during the construction and operation phases will be prepared at the start of project implementation by the PMOs, implementing agencies and units, and EMCs.
(ii) In addition to regular compliance monitoring, other unannounced monitoring will be carried out to determine compliance.
(iii) Indicative cost; will be finalized at a later stage.
(iv) Routine monitoring of river water quality will be done by external agencies.
Sources: Subproject environmental impact assessments, project preparatory technical assistance.
E. Public Consultation

1. Public Consultation during Project Preparation

11. Two rounds of public consultations were conducted in each subproject town. For details, refer to paras. 177–180 of the summary EIA (SEIA).

2. 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 impact and mitigation measures during the construction and operation stages, (ii) evaluating environmental and economic benefits and social impact, and (iii) evaluating the Project after it 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. The IAs will be 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 put up at each construction site to notify the public of the main construction activities and the construction duration. Contact names and telephone numbers will also be posted on the board to enable the public to express their concerns and complaints about construction activities. The costs of public participation activities during project implementation are included in the project funding. The 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

<table>
<thead>
<tr>
<th>Organizer</th>
<th>Approach</th>
<th>Frequency</th>
<th>Subject</th>
<th>Attendees</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Project Preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shanxi PMO, local PMOs, EIA preparation institutes, PPTA consultants</td>
<td>Public meeting</td>
<td>Twice</td>
<td>Environmental quality status; project information; major impact and benefits; mitigation measures; attitudes, comments, and recommendations of the public</td>
<td>Residents, enterprises, NGOs, and other stakeholders within construction and service area; specialists from various sectors</td>
</tr>
<tr>
<td>Local PMOs, local social survey institutes, PPTA consultants</td>
<td>Social survey</td>
<td>Once</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local PMOs, RP preparation institutes, PPTA consultants</td>
<td>Survey on resettlement</td>
<td>As stipulated in the relevant resettlement plan</td>
<td>Comments on resettlement, improvement in living conditions, livelihood, and poverty reduction; comments and suggestions</td>
<td>Persons affected by resettlement and relocation</td>
</tr>
<tr>
<td>Local PMOs, EMDP preparation institutes, PPTA consultants</td>
<td>Public participation</td>
<td>As stipulated in the relevant EMDP</td>
<td>Comments on minority development plan; comments and suggestions</td>
<td>Ethnic minorities in the project areas</td>
</tr>
<tr>
<td>Organizer</td>
<td>Approach</td>
<td>Frequency</td>
<td>Subject</td>
<td>Attendees</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td>-----------</td>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>B. Construction Phase</td>
<td>Shanxi PMO, local PMOs, and IAs</td>
<td>Public consultation and site visits</td>
<td>At least once</td>
<td>Adjustment of mitigation measures, if necessary; construction impact; comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs, and IAs</td>
<td>Expert workshop or press conference</td>
<td>As needed, on the basis of public consultation</td>
<td>Comments and suggestions on mitigation measures; public opinions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs, and IAs</td>
<td>Survey on resettlement</td>
<td>As stipulated in the relevant resettlement plan</td>
<td>Comments on resettlement, improvement in living conditions, livelihood, and poverty reduction; comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs, and IAs</td>
<td>Survey on minorities</td>
<td>As stipulated in the relevant EMDP</td>
<td>Comments on minority development; comments and suggestions</td>
</tr>
<tr>
<td>C. Operation Phase</td>
<td>Shanxi PMO, local PMOs, IAs, O&amp;M companies</td>
<td>Public consultation and site visits</td>
<td>Once in the first 2 years</td>
<td>Effects of mitigation measures; impact of operations; comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs, IAs, O&amp;M companies</td>
<td>Expert workshop or press conference</td>
<td>As needed, on the basis of public consultation</td>
<td>Comments and suggestions on operational impact; public opinions</td>
</tr>
</tbody>
</table>

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, RP = resettlement plan.
Sources: Environmental impact assessments, project preparatory technical assistance.

F. Responsibilities and Authorities

1. Environmental Responsibilities and Institutional Requirements

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

15. Various organizations with different environmental management responsibilities—Shanxi EPB, Shanxi PMO, PMOs and EPBs in Xiaoyi (Wutong), Youyu, and Pingyao, IAs, EIA preparation institutes, EMCs, CSCs, design institutes, and contractors—have been involved in project preparation and will continue to be involved in the implementation of the EMP. The Shanxi PMO, local PMOs, contractors, and IAs will each nominate full-time trained and qualified environment specialists to undertake environmental management activities for the effective implementation of the EMP. Table A2.4 shows the environmental responsibilities in different phases of the Project.
Table A2.4: Environmental Responsibilities

<table>
<thead>
<tr>
<th>Phase</th>
<th>Responsible Agencies</th>
<th>Environmental Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>EIA preparation institutes</td>
<td>Preparation of EIAs</td>
</tr>
<tr>
<td></td>
<td>Shanxi EPB</td>
<td>Review and approval of the EIAs</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, Shanxi EPB, ADB</td>
<td>Review and approval of the SEIA, including the EMP</td>
</tr>
<tr>
<td>Design</td>
<td>Design institutes</td>
<td>Incorporation of mitigation measures into engineering designs and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>contracts</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs, IAs</td>
<td>Review and approval of environmental measures</td>
</tr>
<tr>
<td>Tendering</td>
<td>Contractors, local PMOs, IAs</td>
<td>Incorporation of EMP clauses into bids</td>
</tr>
<tr>
<td>Construction</td>
<td>EMCs, local PMO, IAs</td>
<td>Provision of advice on implementation of mitigation measures</td>
</tr>
<tr>
<td></td>
<td>Contractors, CSC</td>
<td>Implementation of mitigation measures and internal monitoring</td>
</tr>
<tr>
<td></td>
<td>Local EPBs, IAs</td>
<td>Implementation of compliance monitoring</td>
</tr>
<tr>
<td></td>
<td>Local EPBs, IAs, EMCs</td>
<td>Supervision of implementation of mitigation measures and monitoring</td>
</tr>
<tr>
<td>Operation</td>
<td>EMCs, local EPBs</td>
<td>Provision of advice on compliance monitoring and internal monitoring requirements</td>
</tr>
<tr>
<td></td>
<td>IAs, O&amp;M companies</td>
<td>Implementation of mitigation measures and internal monitoring</td>
</tr>
<tr>
<td></td>
<td>Local EPBs, IAs, O&amp;M companies</td>
<td>Implementation of compliance monitoring</td>
</tr>
<tr>
<td></td>
<td>IAs, O&amp;M companies, local EPBs, EMCs</td>
<td>Supervision of implementation of mitigation measures and monitoring</td>
</tr>
</tbody>
</table>

ADB = Asian Development Bank; CSC = construction supervision company; 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 Xiaoyi, Youyu, and Pingyao; O&M = operation and maintenance; PMO = project management office; SEIA = summary environmental impact assessment.

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

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

16. The IAs will be responsible for environmental management and the implementation of mitigation measures. They will see to it 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 impact beyond those foreseen in the EIAs. The IAs will also attend to the environmental protection bureaus and Asian Development Bank (ADB) requests for mitigating measures.

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

18. In accordance with the EMP, the IAs will establish an environmental management office, which 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 the 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 capacity. This will, however, be strengthened by environmental management training provided by the Project, as summarized in Table A2.5. The IAs will incorporate environmental management activities into construction and operation management plans. Local governments will review each year the local regulations for the management of roads and traffic, sewerage, drainage, water supply, solid waste, and central heating, and will see to it that the 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. EMCs will advise the city PMOs, the IAs, and contractors on all aspects of environmental management and monitoring for the project components. The EMCs will (i) review project environmental practices and procedures; (ii) provide guidance in setting environmental standards and assist with implementation procedures; (iii) review the start-up of the wastewater treatment plant, water treatment plant, and landfill facilities; (iv) advice on the management of city roads; (v) advise on mitigation during construction and operation, in accordance with the EMP; and (vi) investigate and make recommendations on other environmental issues.

2. Institutional Strengthening and Training

21. There will be three IAs for the core subprojects: Xiaoyi City Engineering and Construction Management Affairs Office for the Wutong subproject, Youyu County Development and Reform Commission for the Youyu subproject, and Pingyao Water Affairs Bureau for the Pingyao subproject. An assessment undertaken during the project preparatory technical assistance (PPTA) indicates that these IAs lack the necessary capacity for environmental management and monitoring. For the 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 requirement will also be included in the policy dialogue on the institutional component.

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

23. Loan consultants will train environment specialists of local EPBs and the 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: Institutional Strengthening and Training at the Project Level

<table>
<thead>
<tr>
<th>Strengthening Activities</th>
<th>Agencies</th>
<th>Strengthening Plan</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity building</td>
<td>Shanxi PMO, local PMOs, IAs</td>
<td>Institutional organization, development of responsibilities for each position</td>
<td>During project preparation and implementation</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Local PMOs, IAs, contractors</td>
<td>Procurement of related monitoring instruments and equipment</td>
<td>During project preparation and implementation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Training</th>
<th>Attendees</th>
<th>Contents</th>
<th>Times</th>
<th>Number of Person</th>
<th>Cost (CNY/person-day)</th>
<th>Total Cost (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMP implementation and adjustment, settlement of disputes, environmental policies and plans</td>
<td>Local PMOs, IAs, contractors</td>
<td>Development and adjustment of the EMP, emergency response, environmental laws and regulations, environmental management</td>
<td>1</td>
<td>5</td>
<td>40</td>
<td>500</td>
</tr>
<tr>
<td>Environmental technologies and processes</td>
<td>Local PMOs, IAs, contractors, O&amp;M companies</td>
<td>Engineering technologies; controls; equipment selection and procurement; operation, control, and maintenance of wastewater treatment processes and heat and gas supply stations, sludge treatment and disposal process, river management</td>
<td>2</td>
<td>10</td>
<td>60</td>
<td>500</td>
</tr>
<tr>
<td>Environmental monitoring</td>
<td>Local PMOs, IAs, contractors, O&amp;M companies</td>
<td>Monitoring methods, data collection and processing, reporting systems</td>
<td>2</td>
<td>5</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>Wastewater management</td>
<td>Xiaoyi PMO and IA, contractors</td>
<td>Study of wastewater management</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>Solid waste management</td>
<td>Local PMO and IAs</td>
<td>Study of waste collection, recycling, and disposal</td>
<td>2</td>
<td>5</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>Watercourse management</td>
<td>Xiaoyi and Pingyao PMOs and IAs</td>
<td>Hydrodynamic monitoring and maintenance of watercourses</td>
<td>2</td>
<td>5</td>
<td>20</td>
<td>500</td>
</tr>
<tr>
<td>Traffic and safety management</td>
<td>Local PMOs and IAs, contractors</td>
<td>Study of traffic and road safety management, temporary traffic management during construction</td>
<td>2</td>
<td>5</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>Training</td>
<td>Attendees</td>
<td>Contents</td>
<td>Times</td>
<td>Number of Person</td>
<td>Cost (CNY/ person-day)</td>
<td>Total Cost (CNY10,000)</td>
</tr>
<tr>
<td>--------------------------</td>
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<td>-----------------------------------------------</td>
<td>-------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Environmental awareness training</td>
<td>Local citizens and government officials</td>
<td>Environmental pollution, protection, and conservation</td>
<td>6 (twice in each subproject town)</td>
<td>100</td>
<td>500</td>
<td>30</td>
</tr>
</tbody>
</table>

Total 160

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

Source: Project preparatory technical assistance.

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

G. Reporting and Supervision

25. The compliance monitoring reports will go into (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) compliance status with regard to applicable regulations and standards, and (viii) recommendations for improvement. The Shanxi PMO will submit compliance monitoring reports to ADB as appropriate.

26. During the construction period, the results of internal monitoring by contractors and CSCs will be reflected in the weekly construction reports. The reports will summarize (i) environmental issues during construction; (ii) mitigation measures taken, if any; and (iii) consequences of the impact on the environment and surrounding communities.

27. The contractors will be trained to take immediate actions to remedy any unexpected adverse impact or ineffective or insufficient mitigation measures, as required in the EMP. The local PMOs and IAs will also respond to these reports to ensure that contractors have taken appropriate and timely action. Additional measures may be taken, if needed, to ensure that all issues raised by the compliance monitoring and weekly construction reports are appropriately addressed.

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

29. The Shanxi 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 consist of (i) semiannual environmental reports on EMP implementation, and
(ii) a project completion report to be submitted no later than 3 months after the Project. Progress reports will emphasize (i) monitoring results, (ii) the 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 Shanxi 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 impact are monitored and reported on in line with ADB requirements.

H. Work Plan

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

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

I. Procurement Plan and Cost Estimates

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

34. Cost estimates for the 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 funds are available in the budget. Internal monitoring costs will be borne by the IAs, contractors, and CSCs 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, the 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 to suit the actual requirements. A detailed breakdown of the internal monitoring cost estimates will be prepared by the design institutes. The costs of all mitigation measures during construction will be included in the tender and contract documents and will be borne by the contractors. Costs related to the mitigation measures during operation will be borne by the IAs or O&M companies. The costs of the EMCs and the training will be borne by the Project as a whole.

J. Mechanisms for Feedback and Adjustment

35. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. The EMP will be adjusted, if necessary. The Shanxi EPB and the Shanxi PMO will play critical roles in this feedback and adjustment mechanism, as shown in Figure A2.4.

36. There will be two tiers of feedback and adjustment. If EMP modification is requested by the contractors or the IAs, Shanxi EPB will review their proposals in detail. If the modifications
are approved in principle, specific modifications will then be submitted by the contractors and IAs to the Shanxi EPB for further review. Comments and suggestions from the Shanxi EPB and ADB will also be considered by local EPBs and revisions made in the EMP as necessary. The contractors and IAs will then implement the modifications.
Figure A2.1: Wutong City Subproject Location Map

Boundaries are not necessarily authoritative.
Figure A2.2: Youyu City Subproject Location Map
Figure A2.3: Pingyao City Subproject Location Map

- Dam/Reservoir
- National Highway
- Other Road
- Railway
- Flood Control
- River
Figure A2.3: Pingyao City
Subproject Location Map

- Dam/Reservoir
- National Highway
- Other Road
- Railway
- Flood Control
- River

Pingyao City Railway Station
Huiji Reservoir
Huiji River
N
Figure A2.4: Mechanism for Feedback and Adjustment of Environmental Management Plan

Shanxi EPB

ADB

Shanxi PMO, local PMOs, local EPBs

Reportng

Documentation and Project Adjustment

Comments and Suggestions

Contractors

IAs

Implementation of Mitigation Measures and Monitoring Programs

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 FOR SHANXI PROVINCE

A. Introduction

1. This environmental assessment and management framework (EAMF) describes the Asian Development Bank (ADB) requirements for the environmental assessment of sector loan projects, including the 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 environmental management plan (EMP). This report follows ADB’s format in preparing environmental assessment and review procedures for sector loans.

2. The sector project analysis identified three core subprojects in Wutong, Youyu, and Pingyao for ADB funding. These subprojects were selected on the basis of comprehensive selection criteria, including environmental criteria. The selected subprojects represent the full range of (i) project interventions, (ii) conditions in small cities, and (iii) anticipated benefits and impact. A summary EIA (SEIA) report and EMPs have been prepared under this PPTA for these core subprojects meeting ADB requirements. Noncore subprojects coming online and implemented later should also meet the EIA requirements of ADB. The EAMF will ensure that the necessary procedures for the 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 (LDIs), and ADB in the preparation and review of the EIA report and the EMP according to the requirements of ADB.

B. Overview of Types of Subprojects to Be Assessed

3. The subprojects to be assessed relate to urban and environmental infrastructure that will improve the environmental, social, and economic conditions in the small cities and towns, with the aim of increasing employment and reducing poverty. Typical subprojects will be in water supply, wastewater, solid waste, river improvement, transportation, and district heating.

4. A common concern related to 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. The EMP, and its implementation, will therefore be an important tool in reducing and monitoring environmental impact during the construction of the subprojects. Specific activities and the key environmental issues and impact of core and noncore subprojects are described below to provide a standard model of consideration for noncore subprojects. The EIAs and EMPs for noncore subprojects are expected to follow the model and demonstrate the same level of mitigation measures.

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: whether it is surface water or groundwater.
   (ii) Quality of the water: use monitoring data to demonstrate that the quality meets drinking-water standards. If not, what measures or treatment processes will be designed to improve quality? For example, if the water is high in fluoride content, what process will be designed to improve it?
(iii) Verification of the feasibility of using this water source: questions that need to be answered in the EIA report include:
   (a) What is the total supply capacity of this water source?
   (b) What is the existing total extraction quantity of this source?
   (c) How much will be extracted by the project?
   (d) With the project, will there be over-extraction cumulatively?
   (e) If there is over-extraction, what are the mitigation measures?

(iv) Protection of the water source: describe or develop plans to protect this water source from polluting activities in the watershed.

(v) Disinfection: for WTP, what is the disinfection agent and what measures are included in the design to ensure safe storage and application?

(vi) Excavated soil: for pipeline construction, provide information on the following:
   (a) the total quantity of soil to be excavated;
   (b) the quantity to be reused for backfilling;
   (c) the quantity to be disposed of; and
   (d) the name(s), location(s), and capacities of the disposal and 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: provide monitoring data to show the existing quality of surface and groundwater that is receiving wastewater (treated or untreated) now or will be receiving treated wastewater from the project.

   (ii) Treatment process: provide information on the treatment process proposed for the WWTP and the discharge standard to be achieved.

   (iii) Waste reduction: providing the WWTP will reduce what quantities of pollutants discharged into the receiving water bodies per year? The pollutants should include biochemical oxygen demand (BOD₅), chemical oxygen demand (CODₜ), suspended solids (SS), ammonia nitrogen (NH₃-N), total nitrogen (TN), and total phosphorus (TP).

   (iv) Odor: what measures are included in the design for odor removal at the WWTP and pumping stations, and what will the residual odor concentration be after removal?

   (v) Sludge: provide information on the quantity of sludge (after dewatering) produced and how and where the sludge will be reused or disposed of.

   (vi) Disinfection: for WWTP, what is the disinfection agent and what measures are included in the design to ensure safe storage and application?

   (vii) Excavated soil: for pipeline construction, provide information on the following:
      (a) the total quantity of soil to be excavated;
      (b) the quantity to be reused for backfilling;
      (c) the quantity to be disposed of; and
      (d) the name(s), location(s), and capacities of the disposal and temporary storage sites.

7. **Solid Waste.** This includes the provision of solid waste treatment facilities, solid waste collection equipment such as garbage trucks and compactors, waste transfer stations, 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: provide information on how the groundwater underneath the site will be protected from leachate seepage, and how the leachate will be collected and treated (with what treatment process).

(ii) Methane gas collection and treatment of the solid waste treatment facility: provide information on how the methane gas generated will be collected and treated. The use of methane gas to generate electricity for on-site use is encouraged. If the methane gas is allowed to escape into the atmosphere or is flared, implications for greenhouse gas (GHG) emission and climate change need to be assessed.

(iii) Air pollution: provide information on air emissions from the facility. These include dioxin for the incinerator, and odor for landfills and composting plants. Provide information on air pollution and odor control measures and emission concentrations after the provision of these measures.

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

   (i) Dredged river sediment: provide information on:
       (a) the quantity of dredged river sediment,
       (b) the method of dredging (what kind of dredging equipment will be used?),
       (c) the location of temporary storage and dewatering, and
       (d) the location of its ultimate disposal.

   (ii) Water quality: dredging will result in the release of SS to the water column, which will increase the turbidity of river water. Provide information on how the release of SS from dredging activities will be controlled.

   (iii) Odor: river sediment can be anoxic and high in organics and sometimes hydrogen sulfide (H₂S). This results in the release of bad odor when river sediment is disturbed during dredging. Provide information on odor impact 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 stations, heat exchange stations, and heat supply pipelines. Key environmental issues that need to be addressed in the EIA report include the following:

   (i) Coal: 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) Air emissions: provide information on the following:
       (a) the dust removal and flue gas desulfurization equipment at the central heating station; and
       (b) the concentrations of sulphur dioxide (SO₂), total suspended particulates (TSP), and PM₁₀ emitted at the central heating station.

   (iii) Excavated soil: for pipeline construction, provide information on the following:
       (a) the total quantity of soil to be excavated;
       (b) the quantity to be reused for backfilling;
       (c) the quantity to be disposed of; and
       (d) the name(s), location(s), and capacities of the disposal and temporary storage sites.
(iv) Benefits: provide information on benefits that could be achieved by having district heating (and reducing coal burning):
(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 SO$_2$ emissions that will be reduced per year,
(e) the quantity of nitrogen oxide (NO$_x$) emissions that will be reduced per year,
(f) the quantity of TSP and PM$_{10}$ emissions that will be reduced per year, and
(g) the quantity of carbon dioxide (CO$_2$) emissions that will be reduced per year.

10. Transportation. This includes the construction of new roads, the upgrading of existing roads, and the 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 traffic forecast is not environmental, yet it forms the basis for predicting future traffic emissions and traffic noise. Therefore, traffic forecast up to a design horizon of 15–20 years must be provided in 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. Provide information or design requirements for air pollution control, such as dust removal bags. Also provide specifications on where such plants can or cannot be located, given information on the locations of air-sensitive targets such as schools, hospitals, temples, and residential areas.

(iii) Traffic noise during the operation phase: on the basis of the traffic forecast, calculate the traffic noise levels at the identified noise-sensitive targets such as schools, hospitals, temples, and residential areas for the following:
(a) condition at road opening,
(b) intermediate condition (midway between now and the design horizon), and
(c) long-term condition (at the design horizon).

(iv) Mitigation measures, such as double-glazed windows or air-conditioning, should be provided for sensitive targets affected by traffic noise in excess of the standards.

C. Country’s Environmental Assessment and Review Procedure

11. This Project requires all domestic EIAs to be approved by the provincial environmental protection bureau (EPB). However, it is local practice to prepare one domestic EIA for each component, so a subproject might have more than one EIA for domestic approval. The PMOs and environmental management consultants (EMCs) will therefore request the LDIs to prepare one EIA (including EMP) for the subproject if possible, or to minimize the number of EIAs and to combine the EMPs, if time allows.

12. The Project has been classified by ADB as a category A project. EIA reports and EMPs as described in Attachments 1–5 are therefore required for all noncore subprojects. Like ADB,
the People’s Republic of China (PRC) has procedures for determining the EIA requirements for different types of projects according to their potential environmental impact. For projects with substantial impact on the environment (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 impact (similar to ADB’s category B projects), the PRC requires the preparation, submission, and approval of a project EIA table. For some noncore subprojects or subproject components, only an EIA table will suffice under the domestic system. But the EIA table might not meet ADB’s requirements. The LDIs will therefore provide ADB with the EIAs and EMPs in the format described in Attachments 1–5.

D. Responsibilities and Authorities

13. The provincial PMO will be responsible for the selection of subprojects (small cities and towns); the local PMOs of these subproject cities and towns, for selecting the subproject components; and the EAs, for selecting the LDI that will conduct the feasibility studies and the EIA studies and reporting.

14. The LDIs will be responsible for conducting the EIA studies, preparing the EIA reports, and obtaining domestic approval from the provincial EPB for these reports. The LDIs will also be responsible for providing EIA reports and EMPs to ADB in the format described in the EAMF.

15. The provincial EPB will be responsible for approving the domestic EIA reports. The provincial PMO, on the other hand, will be responsible for (i) reviewing and appraising all EIA reports and EMPs to ensure that the procedural and information requirements described in the EAMF are met and that, with the implementation of mitigation measures described, the impact will be acceptable; and (ii) sign off on the reports and submit them to ADB with a recommendation for posting on its website.

16. The EMCs will be responsible for (i) reviewing and appraising the subprojects and subproject components selected, (ii) signing off on the provincial PMO’s recommendations, and (iii) conducting a separate review and appraisal of EIA reports and EMPs for items listed in para. 57.

17. The environment specialist of ADB’s operations department will be responsible for approving all EIA reports and EMPs. The operations department of ADB will be responsible for posting the EIA reports and EMPs on the ADB website.

E. 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) soundness of the small city and town master plans, which should be integrated with the overall planning process; and
(vi) similarity to core subproject cities in conditions and needs.

20. To be selected, the subproject components must be similar to the core subproject components and offer potential environmental improvement benefits. The following principles will be followed in the selection:

(i) For all subproject components, the principle of negative impact avoidance should take top priority. The location of component facilities should avoid sensitive areas and habitats such as water gathering grounds, nature conservation areas, protected ecological habitats, and protected heritage sites.
(ii) Water supply projects should improve the environment and the health of the residents by providing reliable and good-quality drinking water, thus offering environmental and social benefits to the community.
(iii) Wastewater projects should improve the quality of receiving surface and groundwater bodies by providing wastewater collection and treatment facilities. They will also improve sanitation and public health in the community.
(iv) Solid waste projects should improve sanitation in the community and have environmental and public health benefits, including the promotion of waste reduction and recycling.
(v) River improvement and flood control projects should provide flood control benefits, thereby reducing the risks of property loss and public health hazards due to flooding.
(vi) District heating projects should reduce reliance on small boiler rooms and household stoves, which are inefficient and polluting. Household stoves burning coal also create indoor and outdoor pollution, as well as respiratory diseases from inhalation of coal dust. The provision of district heating will economize on coal use, and reduce coal burning and thus GHG emissions, with positive effects on climate change.
(vii) Transportation projects that improve road conditions and road networks will result in better connectivity and travel conditions. Travel time per vehicle trip will be shortened, less fuel will be consumed, and vehicle emissions will be reduced. The reduction in GHG emissions will have positive effects on climate change.

F. Procedures for Environmental Assessment of Subprojects

1. Inception of the Environmental Impact Assessment Study

21. EIA studies usually start near the completion of the feasibility study, after the draft feasibility study report (FSR) has been compiled. This is because the EIA relies much on the information provided in the FSR. Yet the EIA study and the feasibility study should preferably be carried out in parallel rather than in sequence. The EIA team needs information from the feasibility study team. The feasibility study team also needs input from the EIA team on the environmental pros and cons of various design alternatives, as well as the design and specifications of the mitigation measures. If the feasibility study team and the EIA team were to work in parallel interactively, the amount of rework would be reduced and the time and program for these tasks would therefore be shortened.

22. The selection of the right EIA design institute to conduct the EIA study and prepare the EIA report is of utmost importance. The degree of detail 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 feasibility study than what is required locally. In fact, ADB’s “feasibility study” requirement is approximately equivalent to the completion of preliminary design in the PRC. Therefore, the feasibility study 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’s requirements. An institute with general consulting experience will not be able to meet those requirements.

24. At the 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 project 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 project 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 their relative distance to the project sites measured and documented.

(ii) **Baseline monitoring.** Air quality, noise, and water quality (surface or groundwater depending on the project component) monitoring should be conducted 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 used as a substitute. However, such data must be collected from locations relevant to the Project and must have been 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 project 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 take the form of a public forum. More details on public consultation are provided in later sections.

2. **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 in order to meet ADB’s 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). Details of the information required under each chapter are given below.
a. Chapter 1: Introduction

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 having the project, government policies in support of the project, the 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) The status of and statistics on small cities and towns in the province.
(ii) The present problems (economic, social, and environmental) in the small cities and towns in the province.
(iii) Government policies supporting the urbanization of small cities and towns.
(iv) Government actions taken to date related to the urbanization of small cities and towns.
(v) The need for the project, and statistics on the present status of the project in the province. For example, if it is a wastewater treatment project, provide statistics on the amount of wastewater generated in the province last year, the number of WWTPs 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? If it is a solid waste management project, provide statistics on the amount of municipal solid waste (MSW) generated in the province last year, the number of solid waste treatment facilities in operation in the province last year, and the total treatment capacity. The description should be quantitative rather than merely qualitative, and should include relevant statistics.
(vi) The economic, social, and environmental benefits of the project, in brief.

b. Chapter 2: Description of the Project

27. Chapter 2 sets the scene for the project 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 project city or town level. The following information should be provided in this chapter:

(i) A brief description of the project city or town, such as its location within the province, area, population, and economy (e.g., industry, agriculture, tourism).
(ii) A summary of the problems that the project is expected to solve (the need for the project), citing statistics rather than being confined to qualitative statements. For example, if the project is district heating, provide information on the following in the subproject city or town:
   (a) What is the present coverage of central heat supply in the project town or city?
   (b) How many small boiler rooms and household stoves are being used for heating in the project 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; 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 air emission output of the heat supply source at present?
(g) With this project, how many small boiler rooms and household stoves will be eliminated, and by how much will the air pollutant load be reduced as a result?

(h) By how much will coal use be reduced with this project?

(i) By how much will central heat supply coverage increase with this project?

(iii) Describe the technical aspects of the project. For example, for district heating, provide the following information:

(a) How many central heating stations and how many heat exchange stations will be provided, and what are their capacities?

(b) Where will these stations be located?

(c) What dust removal and flue gas desulfurization equipment will be available at the central heating stations?

(d) What heat exchange mechanism will be used at the heat exchange stations?

(e) What is the length (km) of the heat supply pipelines?

C. Chapter 3: Description of the Environment

28. Chapter 3 provides information on the existing environmental conditions of the project city or 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 for each subchapter is described below.

29. Atmosphere and Climate. Provide information specific to the project city or town on the following:

(i) climatic condition;

(ii) annual average temperature, minimum temperature, maximum temperature, relative humidity, number of frost-free days;

(iii) annual average rainfall, minimum rainfall, 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 for air pollutant concentrations); and

(vi) compliance of existing air quality with applicable ambient air quality standards.

30. Topography and Geology. Provide information specific to the project city or town on the following:

(i) topography and landform,

(ii) geological features, and

(iii) soil characteristics.

31. Noise. Provide information specific to the project city or town on the following:

(i) daytime and nighttime environmental noise based on baseline monitoring results conducted under the EIA study (provide dB[A] values),

(ii) daytime and nighttime traffic noise based on baseline monitoring results conducted under the EIA study (provide dB[A] values), and

(iii) compliance of noise levels with the noise standards applicable to the noise functional zones at the respective monitoring locations.
32. **Water.** This includes both surface water and groundwater. Provide information specific to the project city or town on the following:

   (i) rivers, lakes, reservoirs, and marine water (for coastal subproject cities/towns) present in the project cites/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 for 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 for water quality pollutants);
   (v) the total supply capacity and existing extraction amount of surface or groundwater, if 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 WWTP and their total treatment capacity.

33. **Waste.** Provide information specific to the project city or town on the following:

   (i) total quantity of MSW 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 project city or town on the following:

   (i) percentage of forest cover;
   (ii) dominant types of vegetation and plant species;
   (iii) dominant species of animals and wildlife;
   (iv) dominant freshwater or marine species;
   (v) habitats and presence of protected, threatened, or endangered species at the project sites (*note: if absent, state this fact in the report*); and
   (vi) whether the project site or construction works will encroach into protected areas such as nature reserves or water gathering grounds (*note: if no, state this fact in the report*).

35. **Fisheries.** Provide information specific to the project city or town on the following (*note: this section may not be applicable to inland project cities or towns*). The information should include both fresh- and saltwater species of commercial importance, as well as both capture and culture fisheries.

   (i) dominant species of fish and shellfish of commercial importance, and
   (ii) yearly production and revenue from commercial fisheries.

36. **Economic Development.** Provide information specific to the project city or town on the following:

   (i) land use (residential, industrial, agricultural, etc.);
   (ii) transportation infrastructure (road, rail, air, etc.).
(iii) key industrial sectors, key industries, and production statistics;
(iv) agricultural products and production statistics; and
(v) socioeconomic indicators such as gross domestic product (GDP), GDP per capita, urban annual average wage, farmers’ useable income level, unemployment, and poverty levels.

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

(i) population and communities (ethnic groups, number of villages or towns, etc.);
(ii) number and types of health facilities such as hospitals and 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) description of municipal services such as heating supply, power supply, water supply, 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 (*note: if there are none on the project site or if construction activities will not encroach into such sites, state so in the report*).

**d. Chapter 4: Alternatives**

38. Chapter 4 describes various alternatives that were considered during the feasibility study and EIA study. The pros and cons of each alternative should be discussed, to justify the selection of the alternative finally chosen. Provide information on the following:

(i) **With-project and without-project alternatives.** This compares the project with the no-project scenario. Explain the benefits of having the project, and compare them with the disadvantages of not having the project.

(ii) **Specific alternatives.** Describe the alternatives considered for the subproject or subproject component. Depending on the nature of the component, the alternatives may involve: (a) site selection; (b) road or pipeline alignment; (c) treatment technology or process; (d) disinfection technology or process; (e) construction method; (f) construction (e.g., piping, embankment, road surface) material; and (g) environmental protection or emission control technology or process. Explain how and why the chosen alternative was selected.

**e. Chapter 5: Anticipated Environmental Impact and Mitigation Measures**

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

(i) **Positive impact and environmental benefits.** Describe the project’s positive impact and environmental benefits. The description should be both qualitative and quantitative, with numerical values for the reduction in pollutants (e.g., SO$_2$, COD$_{Cr}$), small boiler rooms, and use of coal, the increase in coverage, etc.
(ii) **Environmental standards.** Provide information on national and local standards for air quality, noise, surface and groundwater quality, soil, etc., used in assessing environmental impact in the EIA study. Cite the national or local regulation numbers.

(iii) **Impact and mitigation measures during construction.** Provide information on the results of the assessment of air quality, noise, water (surface and ground) quality, waste, ecology, and cultural heritage during construction. Information that addresses the key environmental issues during the construction of the project (see examples in paras. 5–10) must be included here, and the information should be quantitative as far as possible. The following should be noted:

(a) The assessment results should be quantitative. They should give the concentration of TSP and the construction noise level at No. 4 Primary School 20 meters away from the construction site boundary, the total quantity of excavated soil from wastewater pipeline construction, etc.

(b) These results should be compared with the environmental standards to see if they comply with or exceed the standards.

(c) If there is exceedance, mitigation measures should be proposed to reduce the environmental impact to acceptable levels.

(d) These mitigation measures should be listed in the EMP.

(iv) **Resettlement.** Provide information on the following:

(a) area of land to be permanently acquired for the project,

(b) area of land to be temporarily occupied by the project,

(c) how much of the land to be permanently acquired is cultivated land,

(d) area of buildings to be demolished, and

(e) number of persons to be resettled because of the project.

The land to be permanently acquired represents resources that will be permanently lost and cannot be replaced.

(v) **Impact and mitigation measures during operation.** Provide information on the results of the assessment of air quality, noise, water (surface and ground) quality, waste, ecology, and cultural heritage during operation. Information that addresses the key environmental issues during the operation of the project (see examples in paras. 5–10) must be included here, and the information should be quantitative as far as possible. The following should be noted:

(a) The assessment results should be quantitative. They should give the of BOD₅ and COD₅ₐ loading of wastewater discharged from the WWTP, the traffic noise level at No. 4 Primary School in year 2020 in the daytime and at night, etc.

(b) These results should be compared with the environmental standards to see if they comply with or exceed the standards.

(c) If there is exceedance, mitigation measures should be proposed to reduce the environmental impact to acceptable levels.

(d) These mitigation measures should be listed in the EMP.

(e) The impact of demand on resources should also be assessed, e.g., the quantity of groundwater extracted by the water supply project and the impact of increased demand on this resource.

(f) Pollutant reductions during operation should be described, e.g., the reduction in the amount of BOD₅ and COD₅ discharged into the river due to the provision of WWTP by the project, the number of small boiler rooms demolished and the resultant reduction in how many tons of SO₂ emissions per year due to the provision of district heating.
f. Chapter 6: Economic Assessment

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

g. Chapter 7: Environmental Management Plan

41. A comprehensive EMP has to 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 of the EIA report summarizes the key components of the EMP, as follows:

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

h. Chapter 8: Public Involvement and Disclosure

42. Chapter 8 describes the public consultations conducted during the EIA study. ADB requires two rounds of public consultations. The information to be provided in this chapter includes the following (more information on the conduct of the public consultations will be provided in later sections):

(i) the dates and locations of the two rounds of public consultations;
(ii) the number and makeup (e.g., government representatives, village leaders, private citizens) of participants in each round;
(iii) questions, concerns, ideas, suggestions raised by the participants; and
(iv) the responsiveness of the EIA study and report to the questions, concerns, ideas and suggestions raised by the participants.

i. Chapter 9: Conclusions

43. Chapter 9 summarizes the findings of the EIA study. It should include information on:

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

3. Procedures for Conducting Public Consultation

44. 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 project and to solicit views from the stakeholders so that their concerns, ideas, and suggestions can 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 their concerns and suggestions raised in the first round. Any concerns and suggestions raised in the second round of public consultation should be addressed and incorporated into the final EIA report.

45. Public consultations could be in the form of Internet information disclosure (with a feedback mechanism), questionnaire surveys, workshops, public forum, etc. However, ADB prefers public forums, which provide an opportunity for the project proponent, the EIA design institute, and the stakeholders to interact. 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 project sites, schoolmasters, and hospital administrators.

46. The EIA design institute will be responsible for organizing and conducting the public forum, with assistance from the local PMO, EA, and IA in (i) drawing up the stakeholder contact list; and (ii) setting the 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 project, (ii) its benefits, (iii) the potential environmental impact, (iv) relevant mitigation measures, and (v) a map showing the project location. Since the first round is at EIA inception and the purpose is to solicit initial views, concerns, and suggestions from the stakeholders on the project, the document should focus on project introduction and project benefits, particularly when there will not be any EIA findings on impact and mitigation measures at such an early stage. For the second round, the focus of the document should be on presenting potential environmental impact and mitigation measures, and how the first round queries are dealt with in the EIA study.

47. The invitation letter and the consultation document should be sent to the stakeholders from 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 phone, to ensure that they have received the consultation document and to remind them to attend the forum. Experience indicates that such personal touch would increase the attendance at the forum.

48. 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 will be responsible for taking notes and recording all discussions in the forum, and for producing the meeting minutes for the forum to be included in the EIA report.

4. Procedures for Preparing the Environmental Management Plan

49. 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.

50. The EMP should include a table listing the implementation of the mitigation measures. An example/template 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
projects, dust removal and flue gas desulfurization equipment for central heat supply projects, and safety designs for disinfection facilities involving the storage and use of chlorine in WTP and WWTP projects. It is important to clearly state the responsibilities—who is responsible for implementation and who for 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 (such as the examples mentioned above and roadside landscaping) and for items that are already included in the daily operational costs of the project (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 construction. Examples are the watering of construction site and haul roads to reduce dust, temporary noise barriers around noisy machines, sedimentation basins and perimeter drainage ditch to control muddy site runoff, and temporary chemical toilets for construction workers.

51. On the basis of the results of the impact assessment and the locations of sensitive targets such as residential areas, hospitals, schools, temples, and rivers, an environmental monitoring plan should be compiled for the construction and operation phases. An example/template 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 (km) during construction, there may be no need to conduct air and noise monitoring, or the monitoring could be less frequent. The plan should also be very specific about the parameters to be monitored, the total number of monitoring locations, the exact locations (location and name of each sensitive target) where monitoring is to be carried out, and the frequency and duration of monitoring. The table should also list clearly who is responsible for doing the monitoring and who is responsible for supervision. Cost estimates should be provided for undertaking such monitoring. For the operation phase, cost estimates should be provided for the 1st year, and the need to continue monitoring after that should be reviewed at the end of the year. For example, if monitoring of operational noise from pumping stations shows compliance in the 1st year, it is unlikely that the results would change after that year and such monitoring can therefore stop after 1 year.

52. 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 get the stakeholders involved in the project and informed. An example/template is shown in Attachment 4. Cost estimates for conducting such consultation should also be provided.

53. Institutional strengthening and training of the local PMO, EA, IA, and other parties involved in the project is important in ensuring that they have the capacity to implement the EMP. An example/template for training is shown in Attachment 5, with cost estimates. The training program should be based on the nature of the project (for example, solid waste management training for solid waste projects), the need of the PMO, EA, and IA, etc., and the level of environmental awareness of workers and communities.

G. Confirmation that Environmental Assessment and Review Procedures Conforms to ADB’s Environmental Safeguard Policies

54. There will be two levels of review and appraisal. The first is the review and selection of (i) subproject, and (ii) subproject components. The second is the review and appraisal of the EIA reports and EMPs.
55. **Review and Selection of Subprojects and Subproject Components.** The EMCs will (i) collect and review all necessary data (FSR, EIA, etc.); (ii) discuss with PMO and other stakeholders all relevant issues; (iii) together with the PMO, review and select subprojects and subproject components on the basis of the criteria described in paras. 185–186 of the SEIA; and (iv) submit to ADB recommendations for selecting the subprojects and subproject components. ADB will review and endorse the subprojects and subproject components selection or advise otherwise.

56. **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 any adverse impact is mitigated to acceptable levels with the implementation of the 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 information, 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 information, procedural, and organizational requirements are met, the provincial PMO will sign off on the reports and submit them to the EMCs.
   (iv) The PMO also will submit its recommendation for further processing of the subprojects or subproject components that require special attention as described in para. 57. The review and appraisal procedures for such subprojects and subprojects components will be conducted as specified in para. 58.
   (v) The EMCs will sign off on these recommendations, if appropriate.
   (vi) The environment specialist of ADB’s operations department will endorse all EIAs and EMPs for subprojects not requiring special attention as described in para. 57, on the basis of the recommendations submitted.
   (vii) After the endorsement of EIAs and EMPs by ADB, subprojects not requiring special attention as described in para. 57 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.

57. The following are the most sensitive components requiring special attention:

   (i) solid waste component involving incineration;
   (ii) solid waste component involving landfill or composting facilities without leachate 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 WWTP having a total design capacity of more than 100,000 cubic meters per day and discharging into a water body categorized as class III or better;
   (vii) transportation component located in a densely populated area;
   (viii) a component that would impinge on water gathering ground, nature conservation area, protected ecological habitat and/or protected heritage site; and
(ix) a component with other factors that would place it in ADB category A.

58. The review and appraisal procedures for the EIA reports and EMPs for subprojects and components that need special attention as specified in para. 57 are as follows.

(i) The EMCs will conduct a separate review and appraisal of these EIA reports and EMPs after the PMO review and recommendations.

(ii) The EMCs will reject EIA reports and EMP that do not meet the information, procedural, and organizational requirements of ADB because they do not provide sufficient estimates of project impact or adequately monitor and mitigate the project impact as required by ADB. The EMCs will send back these reports for improvements and resubmission. Resubmitted reports will again be reviewed and appraised.

(iii) If the EIA reports and EMP meet ADB’s information, procedural, and organizational requirements and provide the requisite impact assessment and monitoring and mitigation arrangements, the EMCs will sign off on the reports and submit them to ADB with the recommendation for Web posting or rejection for stated reasons.

(iv) The environment specialist of ADB’s operations department will approve or reject all EIAs and EMPs on the basis of the above recommendation.

(v) After the approval of the 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 the posting of the noncore subproject EIAs and EMPs on the ADB website within 1 month for a total of 120 days.

(vii) The construction of the project can start after the posting period expires.

H. Staffing Requirements and Budget

59. The EAs will bear the costs of preparing the EIA reports and EMPs. The EMPs will itemize the staffing, institutional strengthening and training, and environmental mitigation and environmental monitoring requirements, as well as the costs, implementing agencies, and supervising parties. The EAs will bear all these costs except the cost for the trainer.

60. It is recommended that full-time EMCs 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 noncore subprojects; and (iii) provide training for institutional strengthening and other training needs as identified in the noncore subproject EMPs.
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   3.3 Noise
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      3.6.2 Vegetation
      3.6.3 Wildlife
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      3.6.6 Protected Areas
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\(^1\) Complete table as shown in Attachment 2.
\(^2\) Complete table as shown in Attachment 3.
\(^3\) Complete tables as shown in Attachments 4 and 5.
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9.3 Use of Irreplaceable Resources
9.4 Follow-up Monitoring and Management Requirements

APPENDIXES

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<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impacts</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Estimated Costs (CNY10,000)</th>
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<tr>
<td><strong>A. Design Stage</strong></td>
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<td></td>
<td>Emission of PM$<em>{10}$ and SO$</em>{2}$ from the central heating station in Youyu</td>
<td>• Properly design dust removal and flue gas desulfurization equipment</td>
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<td></td>
<td>Emission of chlorine in the WTP disinfection facility in Youyu</td>
<td>• Properly design the chlorine dioxide reactor and all necessary safety features in the disinfection facility</td>
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<td></td>
<td>Odor from WWTP in Wutong</td>
<td>• Properly design odor removal system for the sewage intake pump house and sludge drying</td>
<td></td>
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<tr>
<td>Air</td>
<td>Odor from dredged spoil during river improvement works in Pingyao and Youyu</td>
<td>• Properly identify locations for the temporary storage of dredged spoils that are away from residents, hospitals and schools</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
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<td></td>
<td>Dust from construction activities in Wutong, Youyu and Pingyao</td>
<td>• 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.</td>
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<tr>
<td>Noise</td>
<td>Operational noise from the central heat station and heating sub-stations in Youyu, and the heating sub-stations and WWTP in Wutong</td>
<td>• Select low noise equipment and design soundproof or noise absorptive facilities for main noise sources.</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
</tr>
<tr>
<td>Subject</td>
<td>Potential Impacts</td>
<td>Mitigation Measures</td>
<td>Implementing Agency</td>
<td>Supervising Agency</td>
<td>Estimated Costs (CNY10,000)</td>
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<tr>
<td>Water</td>
<td>Noise from powered mechanical equipment during construction in Wutong, Youyu and Pingyao</td>
<td>• Include in tender documents specifications on good construction site practices related to noise control, such as the use of low noise equipment and temporary noise barriers or hoardings, and regular maintenance of equipment, etc.</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Wutong</td>
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<tr>
<td></td>
<td>Non-compliance of WWTP effluent discharge in Wutong</td>
<td>• Design dual power source supply system to reduce the impact of power blackout</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
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<td></td>
<td>Discharge of low pH backwash effluent from the heat exchange substations in Wutong and Youyu</td>
<td>• Design pH adjustment systems for the effluent, such as adequate equalization tanks for pH adjustment before discharging into public sewer</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
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<td></td>
<td>Wastewater from the education facilities in Wutong</td>
<td>• Properly design oil and grease separator for the school kitchens • Design pre-treatment systems for schools’ wastewater to enable effluent reuse for irrigation of landscape at these schools</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
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<tr>
<td>Solid Waste</td>
<td>Disposal of excavated soil, construction and demolition wastes, and dredged spoil during construction in Youyu and Pingyao</td>
<td>• Identify storage and/or disposal facilities and specify the use of these facilities in the tender documents</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
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<td></td>
<td>Disposal of WWTP sludge in Wutong, and bottom ash from the central heat station in Youyu</td>
<td>• Identify reuse opportunities and disposal facilities</td>
<td>Design Institute</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in the detailed design contract</td>
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<td>Subject</td>
<td>Potential Impacts</td>
<td>Mitigation Measures</td>
<td>Implementing Agency</td>
<td>Supervising Agency</td>
<td>Estimated Costs (CNY10,000)</td>
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<td></td>
<td></td>
<td>- Adopt advanced construction technique and select appropriate machinery and transportation vehicles in compliance with national emission standard;</td>
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<td></td>
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<td>- 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;</td>
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<td></td>
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<td>- Spray water on exposed surface and unpaved haul roads</td>
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<td>- Avoid truck overloaded, cover material during transport; timely clear the dust and spray water on haul road;</td>
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<td></td>
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<td>- Set up hoarding around construction site, particularly for sensitive receivers nearby roads, including school, mosque, hospital, residential areas;</td>
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<td></td>
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<td>- Stop construction during strong wind and cover the stockpile;</td>
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<td></td>
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<td>- Limit vehicle speed on unpaved haul roads to &lt; 8 km/h.</td>
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<tr>
<td></td>
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<td>- Strengthen construction arrangement and avoid construction in night time (2200 hr – 0600 hr)</td>
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<tr>
<td></td>
<td></td>
<td>- Substitute pneumatic tools with hydraulic tools</td>
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<td></td>
<td></td>
<td>- Use low noise machinery</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>- Install temporary noise barrier around noisy machinery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Avoid concrete mixing, use pre-mixed concrete</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. Construction Stage**

- Contractor: XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB

- Wutong: 17
- Youyu: 38
- Pingyao: 78
- Total: 17 + 38 + 78 = 133

- Estimated Costs: CNY10,000

**Noise from power mechanical equipment and vehicles**

- Contractor: XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB

- Included in above: 20
<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impacts</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Estimated Costs (CNY10,000)</th>
</tr>
</thead>
</table>
| Water   | Wastewater from construction workers, canteens and machinery maintenance, and site runoff | • Traffic control on site and limit the horning  
• During transportation, loading and unloading of construction materials, hornig is prohibited when vehicles pass through sensitive receivers.  
• Liaise with nearby schools to avoid noisy activities during examination periods  
• Strengthen management, discharge domestic wastewater to the nearby sewer network or have it treated by on-site package plant;  
• Build storage tank, drainage ditch, temporary sedimentation tank to treat wastewater from excavation, equipment cooling or washing before discharging to sewer network;  
• Regular maintenance of construction equipment to avoid accident during construction;  
• 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;  
• 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;  
• Strengthen water use management, and avoid introduction of chemicals during the vegetation rehabilitation work to reduce water pollution. | XCECMO, YCDRC, PWAB, XEPB, YEPB, PEPB | Included in above | 20 |
<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impacts</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Estimated Costs (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste</td>
<td>Refuse generated on construction sites, construction &amp; demolition waste, excavated soil</td>
<td>• Collect and timely cleanup the refuse and dispose of in landfill&lt;br&gt;• Sort the construction waste and recycle or reuse if possible&lt;br&gt;• Maximize the reuse of excavated soil for backfilling&lt;br&gt;• Dispose the waste to designated sites only</td>
<td>Contractor</td>
<td>XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB</td>
<td>Included in above 10</td>
</tr>
<tr>
<td></td>
<td>Affected vegetation</td>
<td>• Relocate the trees affected by the construction, avoid trees cutting and restore the vegetation on completion of construction</td>
<td>Contractor</td>
<td>XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB</td>
<td>Included in above 164</td>
</tr>
<tr>
<td>Ecology, Habitat &amp; Soil Conservation</td>
<td>Soil erosion and water/soil conservation</td>
<td>• 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&lt;br&gt;• Build drainage ditch and slope protection during site formation&lt;br&gt;• Develop rainy season construction plan to prevent surface runoff and soil erosion;&lt;br&gt;• Protect farmland and channels near construction sites</td>
<td>Contractor</td>
<td>XCECMAO, YCDRC, PWAB, XEPB, YEPB, PEPB</td>
<td>Included in above 85</td>
</tr>
<tr>
<td>Workplace Health and Safety</td>
<td>Health and safety of workers</td>
<td>• Maintain efficient sanitation in the construction area; provide health check to workers;&lt;br&gt;• Safety training and management should be strengthened to ensure the safe construction;&lt;br&gt;• Construction workers should be equipped with personnel</td>
<td>Contractor</td>
<td>XCECMAO, YCDRC, PWAB</td>
<td>Included in above 10</td>
</tr>
</tbody>
</table>
### Subject | Potential Impacts | Mitigation Measures | Implementing Agency | Supervising Agency | Estimated Costs (CNY,000) |
|---|---|---|---|---|---|
| **Social** | Traffic congestion | - Divert or schedule the construction traffic to avoid peak hours  
- Build temporary roads  
- Phased construction in busy traffic road and reduce the construction period  
- Select transport routes to reduce disturbance to regular traffic | Contractor | XCECMAO, YCDRC, PWAB | Included in above | 5 |
| **Cultural Heritage** | Culture heritage items affected by the construction activities | - Should **culture heritage items** be discovered during the construction, stop construction, protect the site and report to the authority | Contractor | XCECMAO, YCDRC, PWAB | Included in above | 20 |

### C. Operational Stage

#### Air
- Odor from the WWTP in Wutong
  - Timely clean up the sludge and dispose them in order to avoid the odor impact
  - Implementing Agency: XCECMAO  
  - Supervising Agency: XPMO, XEPB  
  - Estimated Costs: Included in operating costs

#### Noise
- Noise from the WWTP and heat exchange substations in Wutong, and the central heating station and heat exchange substations in Youyu
  - Regular maintenance on machinery and keep the equipment in good condition
  - Implementing Agency: XCECMAO, YCDRC  
  - Supervising Agency: XPMO, XEPB, YPMO, YEPB  
  - Estimated Costs: Included in operating costs

#### Water
- Effluent from the WWTP in Wutong
  - Regular maintenance to ensure the normal operation of all equipment
  - Implementing Agency: XCECMAO, YCDRC  
  - Supervising Agency: XPMO, XEPB, YPMO, YEPB  
  - Estimated Costs: Included in operating costs
- Wastewater from schools in Wutong
  - Maximize effluent reuse after pre-treatment for irrigating landscape on school premises
  - Implementing Agency: XCECMAO, YCDRC  
  - Supervising Agency: XPMO, XEPB, YPMO, YEPB  
  - Estimated Costs: Included in operating costs
<table>
<thead>
<tr>
<th>Subject</th>
<th>Potential Impacts</th>
<th>Mitigation Measures</th>
<th>Implementing Agency</th>
<th>Supervising Agency</th>
<th>Estimated Costs (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste</td>
<td>Backwash effluent from the heat exchange substations in Wutong and Youyu</td>
<td>• Regularly check and adjust the pH before discharging into public sewer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom ash from the central heating station in Youyu</td>
<td>• Maximize its reuse as building and road paving materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sludge from WWTP in Wutong</td>
<td>• Explore and maximize reuse opportunities</td>
<td>XCECMAO, YCDRC</td>
<td>XPMO, XEPB, YPMO, YEPB</td>
<td>Included in operating costs</td>
</tr>
</tbody>
</table>

PEPB = Pingyao Environmental Protection Bureau, PWAB = Pingyao Water Affairs Bureau, XCECMAO = Xiaoyi City Engineering and Construction Management Affairs Office, XEPB = Xiaoyi Environmental Protection Bureau, XPMO = Xiaoyi (Wutong) Project Management Office, YCDRC = Youyu County Development and Reform Commission, YEPB = Youyu Environmental Protection Bureau, YPMO = Youyu Project Management Office.

Sources: EIA reports.
### Attachment 3 - Environmental Monitoring Program

<table>
<thead>
<tr>
<th>Subject</th>
<th>Parameter</th>
<th>Location</th>
<th>Time</th>
<th>Frequency</th>
<th>Implementing Agency</th>
<th>Supervision Agency</th>
<th>Estimated Cost (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wutong - Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, PM(_{10})</td>
<td>4 locations close to construction site, including residence, school, and governmental departments</td>
<td>One day</td>
<td>Once per month</td>
<td>Contractor</td>
<td>XCECMAO, XEPB</td>
<td>8</td>
</tr>
<tr>
<td>Noise</td>
<td>L(_{eq})</td>
<td>4 locations including residence, school and governmental departments</td>
<td>Once during daytime, once at nighttime</td>
<td>Once per month</td>
<td>Contractor</td>
<td>XCECMAO, XEPB</td>
<td>2</td>
</tr>
<tr>
<td>Water</td>
<td>pH, TPH, SS</td>
<td>1 location: Xiao River</td>
<td>One day</td>
<td>Once per month</td>
<td>Contractor</td>
<td>XCECMAO, XEPB</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Wutong – Operation Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, CO(<em>{2}), NO(</em>{2}), Odor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21 (for first year)</td>
</tr>
<tr>
<td>Noise</td>
<td>L(_{eq})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5 (for first year)</td>
</tr>
<tr>
<td>Water</td>
<td>pH, COD(<em>{5}), BOD(</em>{5}), NH(_{3})-N, SS</td>
<td>Discharge point of WWTP</td>
<td>One day</td>
<td>Once per month</td>
<td>XCECMAO</td>
<td>XPMO XEPB</td>
<td>20 (for first year)</td>
</tr>
<tr>
<td><strong>Youyu – Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP</td>
<td>3 monitoring locations: (i) Youyu Second Middle School, (ii) Youyu County Office, (iii) Maguantun Village</td>
<td>One day</td>
<td>Two days per month</td>
<td>Contractor</td>
<td>YCDRC, YEPB</td>
<td>10</td>
</tr>
<tr>
<td>Noise</td>
<td>L(_{eq})</td>
<td>3 monitoring locations: (i) Youyu Second Middle School, (ii) Youyu County Office, (iii) Maguantun Village</td>
<td>Once in day time and once in night time each day</td>
<td>Two days per month</td>
<td>Contractor</td>
<td>YCDRC, YEPB</td>
<td>2</td>
</tr>
<tr>
<td><strong>Youyu – Operation Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>TSP, PM(<em>{10}), SO(</em>{2}), NO(_{2})</td>
<td>At emission points of the central heating station</td>
<td>Continuous via online monitoring</td>
<td></td>
<td>YCDRC</td>
<td>YPMO YEPB</td>
<td>30 (for first year)</td>
</tr>
<tr>
<td>Subject</td>
<td>Parameter</td>
<td>Location</td>
<td>Time</td>
<td>Frequency</td>
<td>Implementing Agency</td>
<td>Supervision Agency</td>
<td>Estimated Cost (CNY10,000)</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>--------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td>----------------------------</td>
<td>---------------------</td>
<td>--------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Noise</td>
<td>$L_{eq}$</td>
<td>4 locations, one on each of the 4 sides of the central heating station boundary</td>
<td>One day</td>
<td>Once every 3 months</td>
<td>YCDRC</td>
<td>YPMO, YEPB</td>
<td>5 (for first year)</td>
</tr>
</tbody>
</table>

**Pingyao – Construction Phase**

| Air          | TSP, Odor | 3 locations: Yinhui Village, Xiguo Village and Huiji Bridge               | One day                       | Once per month             | Contractor          | PWAB, PEPB         |                        |
| Noise        | $L_{eq}$  | 4 locations: Yinhui Village, Xiaocheng Village, Xiguo Village, Huiji Bridge | Once during daytime, once at nighttime | Once per month             | Contractor          | PWAB, PEPB         | 10                      |

**Pingyao - Operation Phase**

| Surface water | pH, COD$_{Cr}$, BOD$_5$, SS, NH$_3$-N, TPH | 2 locations: one at Yinhui Reservoir and one at Huiji River | 3 consecutive days | Once every three months | PWAB               | PPMO, PEPB         |                        |
| Ground water  | pH, NH$_3$-N, NO$_3$-N, NO$_2$-N, F$^-$  | 3 groundwater well locations: one in Yinhui Village, one in Xiaocheng Village, and one in Xiguo Village | 3 consecutive days | Once per year during the dry season | PWAB               | PPMO, PEPB         | 7 (for first year)      |

**Total**

BOD$_5$ = biochemical oxygen demand, CO = carbon monoxide, COD$_{Cr}$ = chemical oxygen demand, F$^-$ = fluoride, $L_{eq}$ = equivalent continuous sound pressure level, NH$_3$-N = ammonia nitrogen, NO$_3$-N = nitrate nitrogen, NO$_2$-N = nitrite nitrogen, NO$_2$ = nitrogen dioxide, pH = unit of acidity, PEPB = Pingyao Environmental Protection Bureau, PPMO = Pingyao Project Management Office, PWAB = Pingyao Water Affairs Bureau, PM10 = particulate matter with diameter ≥10µ, SS = suspended solids, TPH = total petroleum hydrocarbon, TSP = total suspended particulates, WWTP = wastewater treatment plant, XCECMAO = Xiaoyi City Engineering & Construction Management Affairs Office, XEPB = Xiaoyi Environmental Protection Bureau, XPMO = Xiaoyi Project Management Office, YCDRC = Youyu County Development & Reform Commission, YEPB = Xiaoyi Environmental Protection Bureau, YPMO = Xiaoyi Project Management Office.

Notes: (i) Detailed internal monitoring program during the construction and operation phases will be prepared at the beginning of project implementation by PMO, implementing agencies/units, and EMCs.

(ii) In addition to regular compliance monitoring, other unannounced monitoring will be carried out to determine compliance.

(iii) Indicative cost and will be finalized at late stage.

Sources: Subproject EIAs, PPTA.
## Attachment 4 - Public Consultation Plan

<table>
<thead>
<tr>
<th>Organizer</th>
<th>Approach</th>
<th>Times</th>
<th>Subject</th>
<th>Attendees</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Project Preparation</strong></td>
<td>Shanxi PMO, local PMOs, EIA preparation institutes, PPTA Consultants</td>
<td>Public meeting</td>
<td>Twice</td>
<td>Environmental quality status; project information; major impacts and benefits; mitigation measures; attitudes, comments, and recommendations of the public</td>
</tr>
<tr>
<td></td>
<td>Local PMOs, local social survey institutes, PPTA Consultants</td>
<td>Social survey</td>
<td>Once</td>
<td>Environmental quality status; project information; major impacts and benefits; mitigation measures; attitudes, comments, and recommendations of the public</td>
</tr>
<tr>
<td></td>
<td>Local PMOs, RP preparation institutes, PPTA Consultants</td>
<td>Survey on resettlement</td>
<td>As required by relevant resettlement plan</td>
<td>Comments on resettlement, improvement of living conditions, livelihood and poverty reduction; comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Local PMOs, EMDP preparation institutes, PPTA Consultants</td>
<td>Public participation</td>
<td>As required by relevant EMDP</td>
<td>Comments on minority development plan, comments and suggestions</td>
</tr>
<tr>
<td><strong>B. Construction Phase</strong></td>
<td>Shanxi PMO, local PMOs and IAs</td>
<td>Public consultation and site visits</td>
<td>At least once</td>
<td>Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs and IAs</td>
<td>Expert workshop or press conference</td>
<td>As needed based on public consultation</td>
<td>Comments and suggestions on mitigation measures, public opinions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs and IAs</td>
<td>Survey on resettlement</td>
<td>As required by relevant resettlement plan</td>
<td>Comments on resettlement, improvement of living conditions, livelihood, and poverty reduction; comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs and IAs</td>
<td>Survey on minority</td>
<td>As required by relevant EMDP</td>
<td>Comments on minority development, comments and suggestions</td>
</tr>
<tr>
<td><strong>C. Operation Phase</strong></td>
<td>Shanxi PMO, local PMOs, IAs, O&amp;M Companies</td>
<td>Public consultation and site visits</td>
<td>Once in the first 2 years</td>
<td>Effects of mitigation measures, impacts of operation, comments and suggestions</td>
</tr>
<tr>
<td></td>
<td>Shanxi PMO, local PMOs, IAs, O&amp;M Companies</td>
<td>Expert workshop or press conference</td>
<td>As needed based on public consultation</td>
<td>Comments and suggestions on operational impacts, public opinions</td>
</tr>
</tbody>
</table>

EIA = environmental impact assessment, IA = implementing agency, PMO = project management office, PPTA = project preparatory technical assistance.
Sources: EIAs, PPTA.
## Attachment 5 - Institutional Strengthening and Training

<table>
<thead>
<tr>
<th>Strengthening Activities</th>
<th>Agencies</th>
<th>Strengthening Plan</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Building</td>
<td>Shanxi PMO, local PMOs, IAs</td>
<td>Institutional organization, development of responsibilities for each position</td>
<td>During project preparation and implementation</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Local PMOs, IAs, Contractors</td>
<td>Procurement of related monitoring instruments and equipment</td>
<td>During project preparation and implementation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Training</th>
<th>Attendees</th>
<th>Contents</th>
<th>Times</th>
<th>Number of person</th>
<th>Cost (CNY/person/day)</th>
<th>Total Cost (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMP implementation and adjustment, settlement of disputes, environmental policies and plans</td>
<td>Local PMOs, IAs, Contractors</td>
<td>Development and adjustment of the EMP, emergency response, environmental laws and regulations, environmental management</td>
<td>1</td>
<td>5</td>
<td>40</td>
<td>500</td>
</tr>
<tr>
<td>Environmental technologies and processes</td>
<td>Local PMOs, IAs, Contractors, O&amp;M companies</td>
<td>Engineering technologies; control; equipment selection and procurement; operation, control and maintenance of wastewater treatment processes and heat and gas supply stations, sludge treatment/disposal process, river management</td>
<td>2</td>
<td>10</td>
<td>60</td>
<td>500</td>
</tr>
<tr>
<td>Environmental monitoring</td>
<td>Local PMOs, IAs, Contractors, O&amp;M companies</td>
<td>Monitoring methods, data collection and processing, reporting systems</td>
<td>2</td>
<td>5</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>Wastewater management</td>
<td>Xiaoyi PMO and IA, Contractors</td>
<td>Study of wastewater management</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>Solid waste management</td>
<td>Local PMO and IAs,</td>
<td>Study of waste collection, recycling and disposal</td>
<td>2</td>
<td>5</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>Water course management</td>
<td>Xiaoyi and Pingyao PMOs and IAs</td>
<td>Hydrodynamic monitoring and maintenance of water courses</td>
<td>2</td>
<td>5</td>
<td>20</td>
<td>500</td>
</tr>
<tr>
<td>Traffic and safety Management</td>
<td>Local PMOs and IAs, Contractors</td>
<td>Study of traffic and road safety management, temporary traffic management during construction</td>
<td>2</td>
<td>5</td>
<td>30</td>
<td>500</td>
</tr>
</tbody>
</table>
### Training Attendees Contents Times Period Number Cost Total
<table>
<thead>
<tr>
<th>Training</th>
<th>Attendees</th>
<th>Contents</th>
<th>Times</th>
<th>Period (days)</th>
<th>Number of person</th>
<th>Cost (CNY/ person/day)</th>
<th>Total Cost (CNY10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental awareness training</td>
<td>Local citizens and government officials</td>
<td>Environmental pollution, protection and conservation</td>
<td>6 (twice in each subproject town)</td>
<td>1</td>
<td>100</td>
<td>500</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>160</strong></td>
</tr>
</tbody>
</table>

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

Source: Project preparatory technical assistance.