SFG3851 REV

World Bank Financed Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project

Environmental and Social Management Plan

Management agency: Zhejiang Province Municipal Engineering & Environmental Protection Project Leading Group Office

Prepared by: Zhejiang Huanke Environment Consulting Co., Ltd.

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Contents

Foreword

This Environmental and Social Management Plan (ESMP) is the integrated environmental and social management plan of World Bank Loan Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project. As a stand-alone document, the ESMP covers all the environmental protection actions to be implemented in the design stage, construction stage and operation stage of the Project and provides an action benchmark and work framework for the mitigations measures, environment management and environment monitoring activities to be implemented in the construction stage and operation stage of the Project.

High-quality feasibility design and stringent environmental impact assessment have been carried out for all the subprojects aiming to minimize adverse impacts on society and environment from the construction of the Project and address the outstanding environmental issues through the implementation of the corresponding environmental countermeasures. To address the inevitable environmental impacts in the Project, a set of practical, feasible and operable environmental countermeasures applicable to the construction stage and the operation stage of the Project has been developed. These environmental actions have been identified in the environmental impact assessment (EIA) process and are proposed in a reasonable and feasible way in the Environment Management Plan to be applicable to both the construction stage and operation stage of the Project.

The function of an EMP is to list these environmental countermeasures and the monitoring and institutional measures to be implemented in the construction and operation stages of the Project to avoid or control the negative environmental impacts of the Project and propose specific actions for implementing such measures. The EMP will become an important link between the environmental impacts and the environmental countermeasures and actions identified in the EIA process aiming to attain the environmental countermeasures through the actions included in the EMP.

Having studied and discussed in detail the Environmental and Social Management Plan Zhejiang Provincial PMO and Chun'an County Subproject PMO and Jiande City Subproject PMO accept and confirm the contents of this ESMP and are committed to implement the environmental mitigation measures and environmental management activities included the ESMP in the implementation process of the Project.

1. Project description

1.1 Project background

Located on the south wing of the Yangtze River Delta on the southeast coast of China facing the East China Sea to the east, Zhejiang Province borders on Fujian to its south, Jiangxi and Anhui to its west and Shanghai and Jiangsu to its north. Spanning a straight-line distance of around 450km east to west and also south to north, Zhejiang Province has a land area of 101,800 km^2, accounting for 1.06% of the land area of the nation as a whole and being the smallest province of China in terms of land area. By the end of Year 2011, Zhejiang Province had achieved an urbanization rate of 62.3%, greater than the national average of 51.27% by approximately 11 per cents.

Zhejiang Province is topographically complicated, with 70.4% of its land area being mountains and low hills, 23.2% plains and basins and 6.4% rivers and lakes while the arable land only amounts to 2,081,700 h.a, giving birth to the saying of “70% mountains, 10% water and 20% farmland”. With a terrain inclining from southwest towards northeast, Zhejiang Province roughly comprises of six terrain zones, namely, the plains in northern Zhejiang, low hills in eastern and western Zhejiang, and Jinqu Basin in the middle, the mountainous areas in southern Zhejiang, the plains on the southeastern coast and the coastal islands. There are eight water systems in the Province, namely, Qiantang River, Ou River, Ling River, Tiaoxi Stream, Yong River, Feiyun River, Ao River and Beijing-Hangzhou Great Canal (Zhejiang Section).

Over the past decades, greater social and environmental challenges have been brought about by the fast growth of Chinese economy, in particular in terms of the increased water consumption and pollutant discharge as well as ecological degradation. The PRC government has included water resource management, environmental protection and ecological protection into its important political agenda and developed specific objectives in its 13th Five-year Plan (2016-2020) in order to reduce soil erosion, effectively treat urban wastewater, reduce agricultural pollution and improve river management and enhance water resource security.

As the largest fresh water lake in Zhejiang Province, Qiandao Lake faces increasing environmental pressure caused by fast economic growth, urbanization, intensive agricultural production and improving living environment and tourism development. Having become aware of the risks in the face of Qiandao Lake, the National Development and Reform Commission (NDRC), in cooperation with multiple government departments, conducted a comprehensive study and developed a blueprint for sustainable

development of the region.

In such a context, Zhejiang Provincial Government (ZPG) initiated a request for support from the World Bank and the Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project emerged as time requires. The Project proposes to utilize an IBRD loan in integrated management of the entire basin in Chun'an County and Jiande City of Zhejiang Province to reduce pollution and improve forest ecological environment in Qiandao Lake Basin and serve as a demonstration for extended application of the experiences of effective integrated river basin management in the other basins so as to promote the effectiveness and sustainability of river management and ecological environment protection.

1.2 Project components

Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project proposes to utilize an IBRD loan in an amount of US$150 million and a counterpart fund of US$150 million in protection of water resources and ecological environment of Qiandao Lake and Xin'an River Basin. The Project selects 5 small watersheds in Chun'an County and Datong Town, Shouchang Town and Hangtou Town of Jiande City for control of the agricultural NPS pollution and ecological restoration of forestry, revetment reinforcement and river rehabilitation, and rural drinking water safety promotion. See Table 1-1 for specific details.

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
Chun'an County Small Watershed Integrated Improvement	The project area covers 7 towns and townships of Zhongzhou Town, Fenkou Town, Jiangjia Town, Langchuan Township, Anyang Township and Zitong Town and involves 5 watersheds of Wuqiangxi Stream, Yuchuanxi Stream, Liuduyuan River, Shangwuxi Stream and Zitong River. Dikes and revetment at 117 sites with a total length of 68.89km will be constructed (reconstructed or reinforced). 18 new dikes will be constructed; 31 cofferdams will be reconstructed or rehabilitated; river section with a length of 5.00km will be dredged; flood plants at 5 sites will be improved to a flood control standard of 10-year recurrence period. 1. Wuqiangxi Stream: dike (revetment) construction in a full length of 13.10km, including 5 sites with a unit	0	22999

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	length of 76 to 1133m and a total length of 2.67km for the main channel and 12 sites with a unit length of 135 to 1648m and a total length of 10.43km for the tributaries, including 4.43km for Zhangcun River, 1.05km for Xiatongxi River, 2.01km for Yecunxi River and 2.95km for Jiechuanxi River; construction of 5 new cofferdams and rehabilitation of 3 existing cofferdams; 2. Yuchuanxi Stream: dike (revetment) construction in a full length of 29.96km, including 32 sites with a unit length of 82 to 1302m and a total length of 13.75km for the main channel and a total length of 16.20km for the tributaries, including 0.96km for Panjiayuan River, 1.51km for Wanchuanyuan River, 1.14km for Jiekengyuan River, 3.81km for Hengyuan River, 2.18km for Zhuangyuan River, 0.94km for Jiangjiwuxi River, 2.24km for Fuyuan River, 1.02km for Kangtangyuan River, 0.44km for Tangjiayuan River, 1.98km for Shanyuan River; construction of 5 new cofferdams and rehabilitation of 19 existing cofferdams; 3. Liuduyuan River: dike foundation reinforcement for a length of 2.90km; construction of 9.11km long revetment at 32 sites with a unit length of 37 to 3238m; construction of 2 new ecological cofferdams; rehabilitation of 7 existing cofferdams for the main channel; construction of 4.08km long revetment at 13 sites with a unit length of 45 to 967m; construction of 5 new ecological cofferdams; rehabilitation of 3 existing cofferdams and ecological treatment of bottomland at 1 site for the tributaries; 4. Shangwuxi Stream: dike reinforcement for a length of 3.89km; river rehabilitation for a length of 3km at 2 sites, including 3km for rural river dredging and 0.755km for dike reconstruction. 5. Zitongyuan River: dike reinforcement for a length of 3.15km; river rehabilitation at 1 site for a length of		

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	2km, including 2km for rural river dredging and 0.80km for dike reconstruction		
Chun'an County Rural Drinking Water Safety Improvement	The service area of the Subproject covers 188 administrative villages belonging to 18 towns and townships, such as Fengshuling Town, Dashu Town, Lishang Township, Weiping Town, Wangfu Township, Zhongzhou Town, Zitong Town, Jijiang Town and Pingmen Township of Chun'an County. With an existing service population of 201,600 persons and designed service population of 218,100 persons and a total water supply capacity of 38,400m^3/day, the Subproject includes 8 centralized water supply projects for the newly established Kuacun Town (with a unit water supply capacity of 600 to 5000m^3/d and a total capacity of 19,100m^3/d) and 8 pipeline extension and water supply projects of existing WTPs (with a supply capacity of 651 to 7745m^3/d and a total capacity of 19,300m^3/d), including 3 water intake cofferdams, 5 water intake pump houses, 8 water purification plants and 21 relay boosting pump houses. The total length of the water transmission and distribution pipelines amounts to 1680km. The WTP will adopt the conventional water purification process of "Coagulation + precipitation + filtration + disinfection". See Table 3-2 for detail	26749	34996

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
Chun'an County Dike Reinforcement and River Rehabilitation	The construction sites of this Subproject are distributed on 22 rivers in Chun'an County except the five demonstrative river watersheds and involve 16 towns and townships, namely, Langchuan Township, Fenkou Town, Dashu Town, Anyang Township, Lishang Township, Linqi Town, Jiangjia Town, Fuwen Township, Pingmen Township, Weiping Town, Zuokou Township, Fengshuling Town, Wenchang Town, Yaoshan Township, Wangfu Township and Songcun Township. The construction works include dike reinforcement with a length of 38.15km and river rehabilitation with a length of 98.5km, including 98.5km for rural river dredging, 28.71km for reconstruction of dikes, with a flood control standard of 10-year recurrence period. 1. Dike reinforcement in Chun'an County involves a total length of 38.15km, including dike reconstruction at 32 sits with a unit length of 450m to 1621m and a total length of 34.30km, dike reinforcement at 5 sites with a total length of 3.85km. See Table 3-4 for detail. 2. River rehabilitation works involves a total length of 98.5km, including dike reconstruction at 41 sits with a unit length of 100m to 2607m and a total length of 26.21km, dike reinforcement at 9 sites with a unit length of 50 to 580m and a total length of 2.50km, and river dredging with a length of 98.5km. See Annexed Table 3-4 for detail.	0	32635
Chun'an County Agriculture NPS Pollution Control	**1. Environment-friendly plantation demonstration** **Chemical fertilizer reduction for pollution control:** **Extensive application of formulated fertilizers**: Formulated fertilizers are extensively applied for tea, fruit trees and mulberry in the whole county at a rate of 10,000 mu per year, 50kg per mu and totally 500 tons for Year 2018 and 80,000 mu per year, 50kg per mu and totally 4,000 tons per year thereafter; amounting to totally 20,500 tons of formulated fertilizers in 5 years; **Extensive application of organic fertilizers (commercial organic fertilizers)**: Organic fertilizers are extensively applied for tea, grain and oil crop and	**13856**	**16352**

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	vegetables, mulberry and fruit trees at a rate of 20,000 tons per year, amounting to totally 120,000 tons for 6 years. **Distribution of liquid fertilizer:** Liquid fertilizer will be distributed at a rate of 25,000 tons or more per year, amounting to totally 150,000 tons for 6 years. **Ecological interception of nitrogen and phosphate loss in tea gardens**: 1 tea garden will be selected as the pilot tea garden and further extension will be conducted in the tea gardens in the whole province if proven feasible. Adopting the ecological interception ditch and pond system technology, the ecological interception of nitrogen and phosphate loss in tea garden to be implemented under the Project comprises of 5 parts, namely, ditch and pond design, plant design, system construction, system evaluation and testing and system maintenance and management. **Ecological interception and utilization of rice field NPS pollution**: this subproject is designed for the mulberry gardens or tea gardens located on slope land where there is a certain area of rice field down the slope. One base is selected for pilot implementation. The construction contents mainly include rehabilitation of drainage ditches in the mulberry gardens, tea gardens and other plantation basses, rehabilitation of paddy field and ecological compensation. **Pesticide reduction and hazard control:** **Integrated pest management (IPM)**: IPM will be implemented for crops such as tea, grain and oil crops, vegetables, mulberry and fruit trees at a scope of 100,000 mu per year and totally 600,000 mu for 6 years. **Soil erosion prevention and control**: Soil erosion prevention and control works (i.e. grass cultivation technology) will be promoted in an extensive way in fruit gardens and tea gardens in the whole county at a rate of 50,000 mu per year and totally 300,000mu for 6 years. **Harmless treatment of pesticide packaging**		

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	materials: Waste pesticide packaging materials will be recovered in the whole county with an assured recovery rate of greater than 90% and the recovered packaging materials will be substantially subject to harmless treatment. **2. Demonstrative Agriculture and Animal Husbandry Project for Disposal of Livestock and Poultry Wastes** 3 scaled livestock and poultry breeding farms, including Hangzhou Qiandao Lake Wuxi Agriculture Development Co., Ltd., Hangzhou Qiandao Lake Tianping Agriculture Development Co., Ltd., and Chun'an County Weizheng Family Farm will be rehabilitated and liquid storage tanks will be constructed in the digestion tanks and sprinkling irrigation facilities will be installed in the base. In addition, liquid fertilizer pumping and pressuring facilities will be installed.		
Chun'an County Forest Eco-system Restoration	The watersheds for prior water source management include 5 key watersheds of Wuqiangxi Stream, Shangwuxi Stream, Zitong River, Yuchuanxi Stream and Liudu River. The second part is the Lakeside Landscaping and Ecological Conservation Zone covering the ecologically sensitive areas such as the waterfront hilly areas around the lake and lake island, involving totally 20 towns and townships and 187 villages, 16 state-owned forest farms and 61 forest areas. The construction scope of the subproject involves a total area of 167,030mu (11135.33 h.a), including 138,219mu (9214.6 h.a) for ecological restoration of coniferous forest and 28811 mu (1920.73 h.a) for ecological restoration of eulalia. Based on the type of restoration, the construction scope of the subproject comprises of the ecological restoration of 38607mu (2573.8 h.a) low-efficiency coniferous forest, 99612mu (6640.8 h.a) pest-affected coniferous forest, 2534mu (168.93 h.a) unattended and barren artificial forest land, 26277mu (1751.8 h.a) eulalia	32547	39837

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	barren mountains and land.		
Jiande City Water Conservancy Facility Rehabilitation	This subproject involves 6 towns/townships (communities) of Lijia Township, Datong Town, Hangtou Town, and Shouchang Town, Genglou Township and Xin'anjiang Town and 6 small watersheds of Datongxi Stream, Zhenyuan River, Qingtan River, Fengjia River, Wulongxi Stream and Xihu Water System in Shouchang Town. The water conservancy facility rehabilitation includes the construction and rehabilitation of 70.08km long ecological revetment, including 9.3km for Datongxi Stream, 6.57km for Zhenyuan River, 14.87km for Qingtan River, 5.038km for Fengjia River, 24.4km for Wulongxi Stream, 3.5km for Shouchang River main channel, 4.6km for Shimulingxi River, 1.8km for Shouchang River and 1.8km for Donghuagban; construction and rehabilitation of 36 ecological cofferdams with a length of 816m; river dredging with a length of 35.0km and construction of Shouchang River Basin monitoring system, etc. 1. Datong Town 1) Datongxi Stream: To be implemented together with Datong-Shangmaxi Stream dike reinforcement works, involving the rehabilitation of 9.3km long ecological revetment mainly including the addition of landscaping greenbelt; construction of a 30m long flap dam. 2) Zhenyuan River: Ecological rehabilitation of 6.57km long revetment for the Wansheng-Songxi Section; construction of a 8m long ecological dam; rehabilitation of 8 ecological dams with a total length of 67m; river dredging with a length of 5.13km; landscaping site construction at the entrance of Wansheng Village and Tianpengli Village and at 2 sites in Zhenyuan Village. The project area will involve a flood control population of 3,400 persons and the protection of arable land in a total area of 1500mu. 3) Qingtan River: Ecological rehabilitation of 14.87km	10338	13708

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	long revetment for the Shimenzhuang-Xikou Section; construction of 7 ecological dams with a full length of 84m; rehabilitation of 6 ecological dams with a total length of 117m; river dredging with a length of 8.136km; landscaping site construction at the entrance of Chaoyang Village (corridors and landscaping) and at the village committee office and entrance to Qingtan Village. The project area will involve a flood control population of 7,200 persons and the protection of arable land in a total area of 2000mu. 4) Fengjia River: Ecological rehabilitation of 5.038km long revetment for the Shanzhawu Reservoir - Langjia Section; river dredging with a length of 3.038km. The project area will involve a flood control population of 3,800 persons and the protection of arable land in a total area of 2000mu. 2. Hangtou Town 1) Hangchuan Section of the main channel of Shouchang River: Ecological rehabilitation of 3.5km long revetment; construction of a 50m long ecological dam; rehabilitation of 2 ecological dams with a total length of 210m; river dredging with a length of 3.3km. The project area will involve a flood control population of 3,800 persons and the protection of arable land in a total area of 1000mu. 2) Wulongxi Stream: Ecological rehabilitation of 24.4km long revetment for the section from Dadiankou to Hangtou; construction of 5 ecological dams with a full length of 130m; rehabilitation of 4 ecological dams with a total length of 100m; river dredging with a length of 13.1km. The project area will involve a flood control population of 14,800 persons and the protection of arable land in a total area of more than 20000mu. 3) Shimulingxi River: Ecological rehabilitation of 4.6km long revetment; rehabilitation of 1 ecological dam with a total length of 20m; river dredging with a length of 2.3km. The project area will involve a flood control population of 1,800 persons and the protection of arable		

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	land in a total area of 200mu. 3. Shouchang Town Xihu Water System: The project area will involve a flood control population of 2,100persons and the protection of arable land in a total area of 350mu. 4. Shouchang River Basin Monitoring and Evaluation System 1) Reconstruction and upgrading of Shouchang River Hydrological station; 2) Construction of automatic monitoring stations at Genglou, Datong and Lijia Town for automatic monitoring of designed capacity, water level, turbidity and sediment content; 3) Construction of Shouchang River main channel video monitoring system; 4) Addition of some environmental monitoring devices.		
Jiande City Landscaping Afforestation and Forest Form Improvement	Located in Jiande City, the subproject area comprises of the areas on both sides of the Shouchang River, a tributary of Xin'an River mainly involving the barren mountains and land and burned area in the water source protection zone and the ecologically sensitive areas on both sides of the villages, towns and trunk highways, totally involving 3 towns/townships, 13 villages, 2 state-owned forest farms. Landscaping afforestation and forest form improvement covers a total area of 23935mu, including 5116mu for landscaping afforestation and 18819mu for forest form improvement and, based on the locations of construction sites, 9113mu for Datong Town, 6060mu for Hangtou Town, 1850mu for Shouchang Town, 4732mu for Shouchang Forest Farm and 2180mu for Xin'anjiang Forest Farm.	8881	664
Jiande City Municipal Engineering	Located in 4 towns/townships (communities), namely, Datong Town, Hangtou Town, Xin'anjiang Community and Yangxi Community in Jiande City and including forest fire emergency access road construction, bridge rehabilitation and ecological wetland construction. 1. Forest fire emergency access road and	4968	6213

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	mountain-climbing path Forest fire emergency access road: extending from Zhengfa Road of Xin'anjiang Community to Fangcun Village of Gaoling Natural Village in Yangxi Community and then to Shibahu and finally ending at Tongguan Forest Zone (the Lovers Valley Scenic Area), this emergency access road has a full length of 12km and includes 10km long drainage ditches, 8800m^3 of retaining walls, 40 drainage culverts and 4 public toilets. The subproject will benefit forests in a total area of 29km^2. With a designed subgrade width of 4.5m (0.5m wide earth shoulder + 3.5m wide carriageway + 0.5m wide earth shoulder) and a design speed of 20km/h and mainly involving rehabilitation and improvement of existing forest road, this access road will be constructed against the Class III forest area highway standard and adopt the asphalt concrete pavement structure. Mountain-climbing path: This mountain-climbing path to be constructed extends along the mountain ridge for a total length of approximately 9km around Bailingkeng Reservoir in Hangtou Town. With a designed subgrade width of 2.5m, the road will be constructed in three sections with a length of 5.331km, 2.756km and 0.852km respectively. 2. Bridge reconstruction Reconstruction of 12 old bridges over Qingtan River and Zhenyuan River, two tributaries of Datongxi Stream, with a length of 16m to 36m using simple hollow slabs and a designed bridge width of 4.5m. 3. Ecological wetland construction Hangtou composite ecological wetland works includes the improvement and rehabilitation of the natural wetland in the existing river flood plains with a total area of 16247.2m^2. As the deep purification place for farmland backwater, the wetland will intercept and treat farmland backwater from the farmland around Nanba Village with a total area of approximately 265mu. In addition, the existing rolling dam will be utilized to construct a water diversion gate with a diversion capacity of no less than 1000t/day to serve as the standby water supply of this wetland. Technological process: farmland backwater (supplementing with river water when the water level is low) →→Multi-stage enhanced biofilm system→→ High-efficiency self-purification eco-system →→ composite ecological filter system →→ effluent.		
	4. Shouchang WWTP Phase I expansion Phase I expansion works of Shouchang WWTP of Jiande City is located in Shanfeng Village south of Jiande City (in Shouchang) and close to and within the fencing wall of the existing Phase I WWTP. The existing treatment capacity of Phase I WWTP is 5000m^3/d and the expansion capacity will be 5000 m^3/d, bringing the total treatment capacity of Phase I WWTP up to 10,000m^3/d. Sewage treatment process: biological nitrogen and		

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	phosphorus removal process → deep treatment process → disinfection process. The deep treatment process will comprise of coagulation ramp sedimentation and activated sand filter; the disinfection process will adopt UV disinfection while sludge treatment will adopt the gravity thickening + deep dewatering treatment process. Biological deodorant will be used for odor removal. The design water quality standard is Class IA specified in the "Pollutant Discharge Standard for Municipal Wastewater Treatment Plants". Tail water from the existing Phase I WWTP is discharged into Shouchang River in the middle of the river. The existing river discharge pipelines will be used continuously for the expansion works.		
Jiande City Agricultural NPS Pollution Control	Including 34 villages of Datong Town, 18 villages of Hangtou Town and 23 villages of Shouchang Town, totally 75 villages in 3 towns and townships. 1. Construction components and scope of agricultural NPS pollution control for crop farming: (1) Extensive application of organic fertilizers and soil-based formulated fertilizer: continuous extension of organic fertilizers and formulated fertilizers for 6 years in 3 towns in the project area with a volume of 213000 tons for organic fertilizer and 10800 tons for formulated fertilizers. (2) Green pest management: Solar vibration frequency insecticidal lamps and sticky boards will be applied extensively for food crops, fruit orchards and tea gardens in the project area. The solar vibration frequency insecticidal lamps involve an area of 18911 mu and a total number of 949 lamps, with 1 lamp per 20mu; the sticky boards involve an area of 2730mu (including 1630mu of fruit orchards and 1100mu of tea garden) and 80 pieces per mu, ending up with a total number of 218,400 pieces per year and 1,310,400 pieces totally for continuous extension of 6 years. 2. NPS pollution control for livestock and poultry breeding The NPS pollution control for livestock and poultry breeding involves 19 livestock and poultry breeding households and comprises of two parts, namely, Feces treatment infrastructure improvement and	3817	6030

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	Reconstruction and expansion of pig house fermentation bed and ancillary facilities. (1) Feces treatment infrastructure improvement The feces treatment infrastructure improvement works involves 15 livestock and poultry breeding farms (14 egg chicken farms and 1 sheep farm) and includes the expansion of sedimentation tanks with a total area of 3660m^2, rehabilitation of pollutant discharge pipes with a length of 1400m, construction of the feces cleaning channel canopy with an area of 1500m^2, stormwater ditches with a length of 1000m, feces storage shed with an area of 840m^2; purchase of 2 conveyor belt feces cleaning equipment, 4 feces collection trucks and 8 sewage (Feces and wastewater) tank trucks. (2) Reconstruction and expansion of pig house fermentation bed and ancillary facilities The pig house fermentation bed and ancillary facilities reconstruction and expansion works will support 4 large-scale pig farms and includes the construction of spraying and regulating tanks with a total area of 220m^2, construction of pig house ectopic fermentation beds (tanks) with a total area of 4300m^2, purchase of 2 field transfer forklifts, 3 composting heap turners, 1 high-pressure water jet, 4 mixing pumps, 3 spraying machines, 4 wastewater (mud) cutting pumps, 3 sewage (fertilizer water) tank trucks, 3 organic fertilizer trucks and 4 automatic packing machines. 2. Ecological ditch construction Construction of ecological ditches with a total length of 56207m, including 5823m planned for Shouchang Town, 44999m planned for Datong Town and 5385m planned for Hangtou Town. According to the classification of irrigation and drainage functions, such ecological ditches comprise of irrigation ditches with a total length of 27384m and involving the typical cross section types of 0.4×0.4m, 0.5×0.5m and 0.6×0.6m and drainage ditches with a total length of 28823m and involving the typical cross section types of 0.8×0.8m,		

Table 1-1: Project Overview

Subproject	Construction works	World Bank Fund (CNY10000)	Total Investment (CNY10000)
	0.8×1.0m, 1.0×1.0m, 1.2×1.2m, 1.5×1.5m, 2.0×1.5m and (4.0+2.4)×2.0m.		
Total		101156	1179419

Figure 1.2-1 Location of Zhejiang Province in China

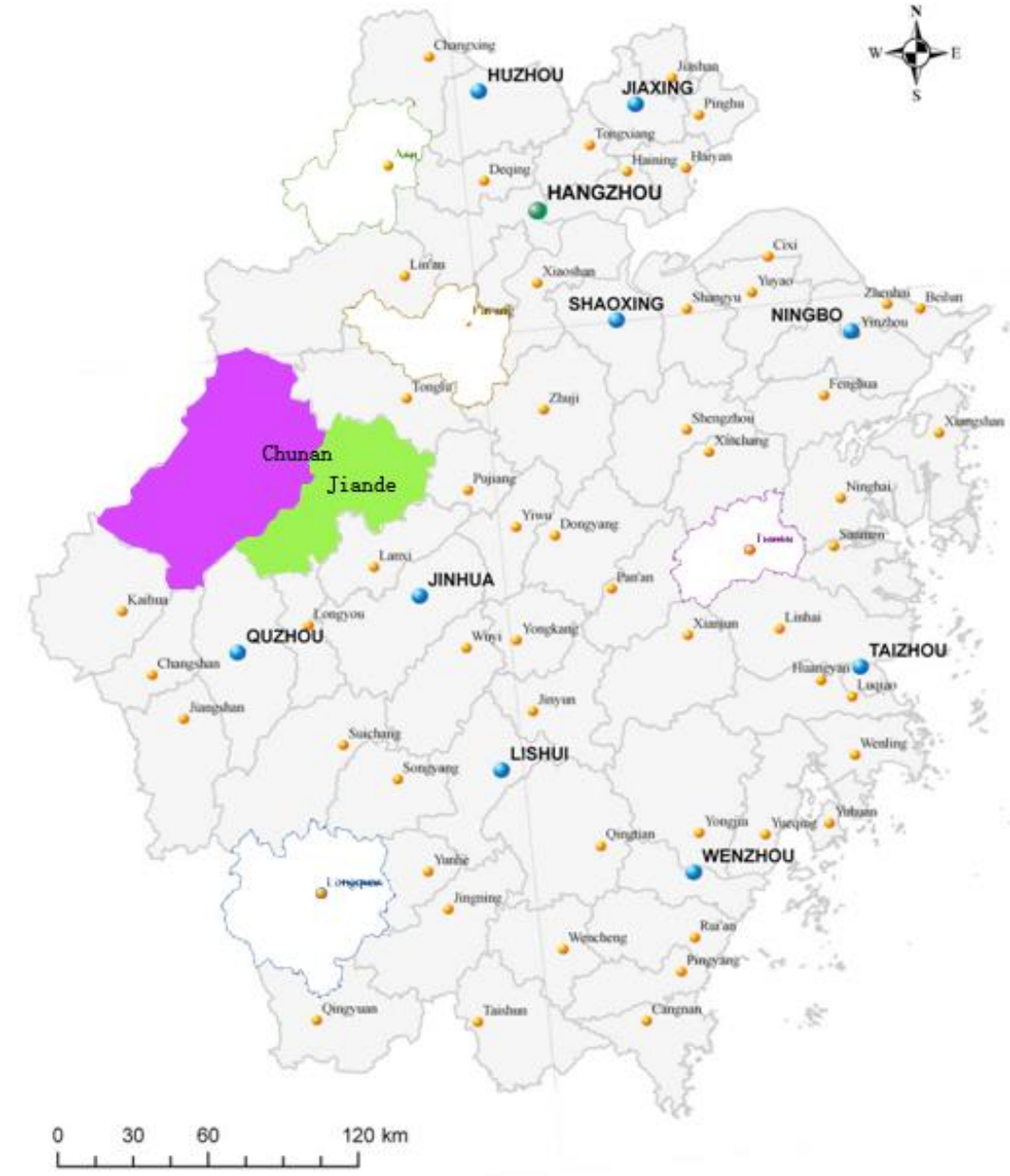

Figure 1.2-2 Location of 2 project-related counties / cities in Zhejiang Province

2. Laws and regulations

This ESMP is prepared based on the requirements of the Law of the People's Republic of China on Environmental Impact Assessment, the Management Regulations on Environment Protection of Construction Projects, and the Notice on Strengthening Management of Environmental Impact Assessment of Construction Projects Utilizing Loans from International Financial Institutions as well as WB Safeguard Policies. The EIA process is carried out not only in accordance with relevant laws and regulations, policies and standards of China, but also the relevant policies of the World Bank

2.1 PRC National Laws and Regulations and Sector Regulations on Environmental Protection

(1) Environmental Protection Law of the People's Republic of China (amended in Year 2014);
(2) Law of the People's Republic of China on Environmental Impact Assessment (amended in Year 2016);
(3) Law of the People's Republic of China on Prevention and Control of Air Pollution (amended in Year 2015);
(4) Law of the People's Republic of China on Prevention and Control of Water Pollution (amended in Year 2008);
(5) Law of the People's Republic of China on Prevention and Control of Noise Pollution (amended in Year 1997);
(6) Law of the People's Republic of China on Prevention and Control of Environmental Pollution of Solid Wastes (amended in Year 2016);
(7) Water and Soil Conservation Law of the People's Republic of China (amended in Year 2011);
(8) Flood Control Law of the People's Republic of China (amended in Year 2015);
(9) Law of the People's Republic of China on Wildlife Protection (August 2004);
(10) Regulations of the People's Republic of China on Protection of Wild Plants (September 1996);
(11) Regulations on Protection of Basic Farmland, State Council Decree No. 257 (December 1998);
(12) Methods for Public Participation in Environmental Protection (MoEP Decree No. (2015)35);
(13) Regulations of Zhejiang Province on Prevention and Control of Air Pollution (Amendment in 2016);
(14) Regulations of Zhejiang Province on Prevention and Control of Environmental Pollution of Solid Wastes, (2006);
(15) Regulations of Zhejiang Province on Prevention and Control of Water

Pollution, (2008);
(16) Methods for Management of Key Ecological Public Forests in Zhejiang Province (Trial) (2005)；
(17) Regulations on Pest Management for Agricultural Crops in Zhejiang Province (2010);
(18) Notice on Strengthening Management of Environmental Impact Assessment of Construction Projects Utilizing Loans from International Financial Institutions (Huanjian Circular No. [1993]324);
(19) Notice by the National Development and Reform Commission on Further Strengthening Management of Projects Utilizing Loans from International Financial Institutions (NDRC Foreign Investment Circular No. [2008]1269);
(20) Management Catalogue of EIA Categories of Construction Projects (Sept. 1, 2017);

2.2 Technical guidelines and specifications of EIA

(1) Technical Guidelines on Environmental Impact Assessment – General (HJ2.1-2016)
(2) Technical Guidelines on Environmental Impact Assessment - Sound Environment (HJ2.4-2009)
(3) Technical Guidelines on Environmental Impact Assessment - Atmospheric Environment (HJ2.2-2008)
(4) Technical Guidelines on Environmental Impact Assessment - Surface Water Environment (HJ / T2.3-93)
(5) Technical Guidelines on Environmental Impact Assessment – Ground Water Environment (HJ610-2016);
(6) Technical Guidelines on Environmental Impact Assessment - Ecological Impact (HJ19-2011)
(7) Technical Guidelines on Environmental Risk Assessment for Construction Projects (HJ/T169-2004);
(8) Technical specifications on determining the suitable areas for environmental noise of urban area (GB/T15190-94);
(9) Technical methods for developing local air pollutant emission standards (GB/T13201-91), 1991;
(10) Technical Specifications For Regionalizing Environmental Noise Function (GB15190-2014);
(11) Technical Specifications on Water and soil conservation in Development and Construction Project (GB50433-2008)

2.3 ENVIRONMENTAL QUALITY AND POLLUTANT DISCHARGE STANDARDS

Based on the features and nature of the Project, a comparative analysis will be carried out in the EIA process of the Project on the PRC national standards on environmental quality and pollutant discharge and the pollutant control

standards and requirements included in General Guidelines on Environment, Health and Safety issued by the World Bank Group and the more stringent ones will be used as the basis for execution of the monitoring and assessment activities.

(1) Ambient Air Environment Quality Standard (GB3095-2012);

(2) Surface Water Environment Quality Standard (GB3838-2002);

(3) Acoustic Environment Quality Standard (GB3096-2008);

(4) Soil Environmental Quality Standard (GB15618－1995)

(5) Hygienic Standard for Design of Industrial Enterprises (TJ36-79)

(6) Integrated Discharge Standard of Air Pollutants (GB16297-1996);

(7) Emission Standard of Odor Pollutants (GB14554-93);

(8) Integrated Wastewater Discharge Standard (GB8978-1996);

(9) Pollutant Discharge Standard for Municipal WWTPs (GB18918-2002);

(10) Environmental Noise Emission Standards for Construction Sites (GB12523-2011);

(11) Ambient Noise Emission Standard on the Boundary of Industrial Enterprises (GB12348-2008);

(12) Urban Wastewater Reuse Standard for Miscellaneous Municipal Purposes (GB/T 18920-2002);

(13) World Bank Group's General Guidelines on Environment, Health and Safety;

Excerptions of the standard limits specified in the environment quality standards applicable to the EIA of the Project are included in Table 2-1 to Table 2-4.

Table 2-1 Surface Water Environmental Quality Standard (GB3838-2002)

Unit: mg/L except pH

SN	Item	Class I	Class II	Class III	Class IV	Class V
1	pH	6～9				
2	DO ≥	Saturationrate:90% (or 7.5)	6	5	3	2
3	COD_{Mn} ≤	2	4	6	10	15
4	BOD_5 ≤	3	3	4	6	10
5	NH_3-N	0.15	0.5	1.0	1.5	2.0

SN	Item	Class I	Class II	Class III	Class IV	Class V
6	Total Phosphorus (TP)	0.02 0.01 for reservoir and lake	0.1 0.025 for reservoir and lake	0.2 0.05 for reservoir and lake	0.3 0.1 for reservoir and lake	0.4 0.2 for reservoir and lake
7	TN (lake, reservoir, N)≤	0.2	0.5	1.0	1.5	2.0
8	Copper ≤	0.01	1.0	1.0	1.0	1.0
9	Zinc ≤	0.05	1.0	1.0	2.0	2.0
10	Fluoride ≤	1.0	1.0	1.0	1.5	1.5
11	Arsenic ≤	0.05	0.05	0.05	0.1	0.1
12	Mercury ≤	0.00005	0.00005	0.0001	0.001	0.001
13	Cadmium ≤	0.001	0.005	0.005	0.005	0.01
14	Hexavalent Chromium ≤	0.01	0.05	0.05	0.05	0.1
15	Cyanide ≤	0.005	0.05	0.2	0.2	0.2
16	Volatile phenol ≤	0.002	0.002	0.05	0.01	0.1
17	Petro ≤	0.05	0.05	0.05	0.5	1.0
18	Anionic Surfactant ≤	0.2	0.2	0.2	0.3	0.3
19	Sulfide ≤	0.05	0.1	0.2	0.5	1.0
20	Fecal coliforms (No./L) ≤	200	2000	10000	20000	40000

Table 2-2 Acoustic environment quality standard (GB3096-2008)

Unit: dB (A)

Class	Day	Night	Basis
1	55	45	Acoustic Environment Quality Standard (GB3096-2008)
2	60	50	
3	65	55	
4a	70	55	

Table 2-3 Ambient Air Environment Quality Standard

Pollutant	Value time	Standard concentration limit (mg/m^3)		Basis
		Class I	Class II	
Sulphur dioxide (SO_2)	Hourly average	0.15	0.50	Ambient Air Quality Standard (GB3095-2012)
	Daily average	0.05	0.15	
	Yearly average	0.02	0.06	
Nitrogen dioxide (NO_2)	Hourly average	0.240	0.20	
	Daily average	0.08	0.08	
	Yearly average	0.04	0.04	
Total suspended	Daily average	0.12	0.30	

Pollutant	Value time	Standard concentration limit (mg/m^3)		Basis
		Class I	Class II	
particles (TSP)	Yearly average	0.08	0.20	
Inhalable particulate matters (PM_{10})	Daily average	0.05	0.15	
	Yearly average	0.04	0.07	
H_2S	Once	0.01		Hygienic Standard for Design of Industrial Enterprises (TJ36-79)
NH_3	Once	0.20		

Table 2-4: Soil Environmental Quality Standard (GB15618-1995)

Unit: mg/kg

Item \ Class / pH		I	II			III
		Natural background	<6.5	6.5~7.5	>7.5	>6.5
Lead ≦		35	250	300	350	500
Zinc ≦		100	200	250	300	500
Mercury ≦		0.15	0.30	0.50	1.0	1.5
Nickel ≦		40	40	50	60	200
Copper	Farmland ≦	35	50	100	100	400
	Orchard ≦	-	150	200	200	400
Chromium	Paddy field ≦	90	250	300	350	400
	Dry field ≦	90	150	200	250	300

According to the characteristics and pollution discharge condition of the Project, the Project is located in the neighborhood of water bodies with a Class II water quality target and allowing no discharge of pollutants. Wastewater generated in the construction stage shall be treated against the national standard for “Reuse of urban recycling water --- Water quality standard for urban miscellaneous water consumption” (GB/T18920-2002) and then reused in construction and production processes, site water spraying or farmland and landscaping fertilization, etc. In the other areas with a Class III water quality target, the wastewater generated in the construction stage shall be discharged after treated to the Class I standard specified in the “Integrated Wastewater Discharge Standard” (GB8978-1996); in urban areas where the wastewater can be discharged into the

municipal sewage network, wastewater generated in the construction stage shall follow the Class III standard specified in “Integrated Wastewater Discharge Standard” (GB8978-1996). Exhaust gas in the construction areas and river dredging during the construction stage shall respectively follow the requirements of the "Integrated Discharge Standard of Air Pollutants" (GB16297-1996) and the concentration limit for discharge without organized monitoring and control specified in the "Emission Standard of Odor Pollutants" (GB14554-93). The noise limits specified in the Environmental Noise Emission Standards for Construction Sites (GB12523-2011) shall apply in the construction stage. Excerpts of emission standards executed in the construction stage of the Project are shown in Table 2-5 to 2-9.

Table 2-5: Water quality standard for urban miscellaneous water consumptions

SN	Item	Toilet flushing	Road cleaning, fire fighting	Urban landscaping	Car washing	Building construction
1	pH	6.0~9.0				
2	Chroma ≤	30				
3	Odor≤	Without unpleasantness				
4	Turbidity(NTU)≤	5	10	10	5	20
5	Total dissolved solids(mg/L)≤	1500	1500	1000	1000	--
6	BOD_5(mg/L)≤	10	15	20	10	15
7	NH_3-N(mg/L)≤	10	10	20	10	20
8	Anionic surfaceactive agent(mg/L)≤	1.0	1.0	1.0	0.5	1.0
9	Fe(mg/L)≤	0.3	--	--	0.3	--
10	Mn(mg/L)≤	0.1	--	--	0.1	--
11	Dissolved oxygen(mg/L)≥	1.0				
12	Total residual chlorine	After 30min contact≥1.0，pipeline end≥0.2				
13	Total coliform group(No./L)≤	3				

Table 2-6: Integrated wastewater discharge standard

Unit: mg/L (except pH)

SN	Pollution index	Class I	Class II	Class III
1	pH	6～9	6～9	6~9
2	SS	70	200	400
3	BOD5	30	60	300
4	COD	100	150	500

SN	Pollution index	Class I	Class II	Class III
5	Phosphate(P)	5	10	-
6	Petro	5	10	20
7	NH_3-N	15	25	45*

*Note: NH_3-N follows the “Water quality standard for sewage discharged into urban sewers” (GB/T 31962-2015).

Table 2-7: Environmental Noise Emission Standards for Construction Sites

Unit: dB (A)

Standard	Item	Standard value
GB12523-2011 Environmental Noise Emission Standards for Construction Sites	Day [dB(A)]	70
	Night [dB(A)]	55

Table 2-8： Integrated Discharge Standards for Air Pollutants

Unit: mg/m^3

SN	Pollutant	Standard limits for monitored concentration of unorganized discharge from new pollution sources	Remarks
1	PM	1.0	In the construction stage, the monitored site is the spot with the highest concentration beyond the periphery.
2	SO_2	0.40	
3	NOx	0.12	
4	TSP	5	

Table 2-9: Discharge standards for odor pollutants (Excerpt)

Unit: (mg/m^3)

Assessment factor	NH_3	Odor	H_2S
Class (category)	II		
Standard concentration limit	1.5	20	0.06

In the operation stage of the Project, tail water and odor emission from Shouchang WWTP shall meet the required discharge limit of Class IA specified in GB18918-2002 “Pollutant discharge standard for municipal WWTPs” while the noise from WWTP, WTP and pump station shall meet Class 1 and Class 2 standards specified in Ambient

Noise Emission Standard on the Boundary of Industrial Enterprises (GB12348-2008). Emission standards to be executed in the operation stage of the Project are described in Table 2-10 to 2-11.

Table 2-10 Pollutant discharge standard for municipal WWTPs

Unit: mg/L except pH

Pollution factor	pH	COD	BOD_5	SS	NH_3-N*	Petro	TP
Class I(A)	6-9	50	10	10	5(8)	1	0.5
Pollution factor	TN	Total mercury	Total cadmium	hexavalent chromium	Total arsenic	Total lead	Total copper
Class I(A)	15	0.001	0.01	0.05	0.1	0.1	0.5
Pollution factor	TZ	LAS	Total coliform group				
Class I(A)	1.0	0.5	1000 No. /L				

Table 2-11: Ambient Noise Emission Standard on the Boundary of Industrial Enterprises (GB12348-2008)

Unit: dB (A)

Class	Day	Night
1	55	45
2	60	50
3	65	55
4	70	55

2. 4 WB SAFEGUARD POLICIES AND GUIDELINES

The correlation of the project and the WB's safeguards policy / procedure is analyzed. The results are shown in Table 2-12 below.

Table 2-12 Correlation Analysis of the Project and the WB Safeguard Policies

WB Safeguard policies	Triggered	Explanation (Optional)
Environmental Assessment OP/BP/GP 4.01	√ Yes	The project triggers OP 4.01 Environmental Assessment to ensure that it is environmental sound. By demonstrating the integrated landscape management approach in the watershed, the project is designed as environmental friendly investments in Chun'an County and Jiande City of Zhejiang

Table 2-12 Correlation Analysis of the Project and the WB Safeguard Policies

		Province and aims at the reduction of pollutants entering Qiandao Lake and Xin'an Riverand the improvement of local ecological environment. The proposed investments include small scale drinking water facilities in rural areas, river rehabilitation of the selected small tributaries (including dredging, embankment reinforcement and greening, weir construction and rehabilitation), forest restoration and rehabilitation, improvement of wastewater collection system for towns, non-point source pollution control through the improvements of agricultural practice and wastewater management, small-scale wetland construction around the lake/rivers, construction/rehabilitation of associated roads and bridges, and strengthening of local monitoring and evaluation system for water pollution sources and water quality. All theseactivities have been proposed to address the existing environmental problems in the basin based on the "Integrated Plan for Water Resources and Eco-Environmental Protection in the Basin of Qiandao Lake and its Upstream Xin'an River (2013-2020)" issued by the national government. The anticipated adverse impacts resulting from proposed project will be limited to: (a) small size construction impacts, (b) potential dredging in numbers of secondary or even smaller tributaries of Qiandao Lake/Xin'an River and (c) operation of constructed wetland. Considering the type, location, sensitivity, and scale of the proposed project activities mentioned above, and the nature and magnitude of their potential environmental impacts, these anticipated adverse impacts are not deemed significant or irreversible. Therefore, the project is assigned as a Category B project.

Table 2-12 Correlation Analysis of the Project and the WB Safeguard Policies

Natural Habitats OP/BP 4.04	√ Yes	Under the project, Bank-financed investments will support the ecological protection and conservation of selected rivers, wetlands and forests in the basin, the project activities will have potential negative and positive impacts to those areas, thus the policy is triggered. As per the requirements of OP4.04, the project must be developed in an environmentally sustainable way considering the protection of local species and biodiversity. The project design will therefore include an environmental analysis of any natural habitat issue, including identification of natural habitat sites, their ecological functions, potential project impacts on the sites and mitigation measures to avoid or minimize anticipated impacts when necessary.
Physical Cultural Resources OP 4.11	√ Yes	The RAP survey also found that the subproject of central green corridor will affect 13 rural households' graves, which might be viewed connecting to local tradition. All the compensation and relocation measures for those graves have been formally planned and developed in the RAP based on detailed survey and extensive consultation among the owners. For the 1400 years old year city inundated under the lake, which is an historical relic under the protection of the Zhejiang Province, the EA will include it in the assessment mainly for clarification purpose as the proposed project activities will not have any impacts on the relic site inundated under the lake according to the information available now.
Involuntary Resettlement OP/BP 4.12	√ Yes	The proposed a waste treatment plant in Chun'an County would require the acquisition of about 5 hectares of village land and some village land might be used temporarily by pipeline laying, which will be used for wastewater collection in rural areas in Jiande City. The Bank's Involuntary Resettlement Policy OP 4.12 is therefore triggered, and a resettlement action plan (RAP) will be prepared to identify the relevant issues and develop action plan to mitigate the negative impacts. In addition, project preparation will assess potential involuntary resettlement needs for the natural resources and watershed management activities. As part of the RAP, a RPF is proposed to be prepared for guiding any potential project activities adjustments during project

Table 2-12 Correlation Analysis of the Project and the WB Safeguard Policies

		preperation and implementation.
Safety of Dams OP/BP 4.37	√ Yes	The proposed project areas in Jiande are largely located in the downstream of existing Xin'an Dam. The project triggers Safety of Dams policy because the insufficient dam management and maintenance might threaten the Bank investment activities. According to this policy, due diligence on the safety status, performance history, operation and maintenance of Xin'an Dam need to be conducted to avoid any potential negative impacts from the Dam management.
Indigenous Peoples OP 4.10	× No	There are about 450,000 populations in Chun'an County, including 407 (around 0.1%) populations of Chinese Miao, Hui, Man and other ethnic minorities living scattered in the city downtown area. In Jiande City, there are about 510,000 populations, including 3,500 population of (around 0.68 %) Chinese She ethnic minority living in five villages. A preliminary ethnic minority screening has been conducted including interviews to the departments in charge of ethnic minority affairs and villagers in the proposed project arears. It is concluded that the project areas are predominantly Han Chinese and there is no ethnic minority groups identified in the proposed project areas. Therefore, the Bank Indigenous Peoples Policy OP 4.10 is not triggered.
Pest Management GP 4.09	√ Yes	The proposed agricultural non-point source pollution control and forest restoration and rehabilitation activities involves the use of pesticides, therefore, the OP 4.09 is triggered. As part of the EIA document, a separate PMP will be prepared in accordance with the Bank's safeguard policy on how to promote a safe, effective and environmentally sound pest management approach. Special attention will be paid to different features of the proposed agricultural and afforestation practice during the PMP preparation in order to make it fitting well with the project activities.
Forests OP/GP 4.36	√ Yes	This policy is triggered. The rehabilitation of degraded forests and enrichment planting of conifer forests will have significant positive impacts to the health and quality of the forests. The proposed activities will be undertaken in ecological protection forest sites and the proposed project activities will not affect the rights and welfare of local communities and their level of dependence upon forests. The

Table 2-12 Correlation Analysis of the Project and the WB Safeguard Policies

		impacts of the forest restoration and rehabilitation will be further assessed during the EIA preparation and the results will be included in the EIA. A separate Environmental Protection Guidelines for Plantation (EPGP) are recommended as part of the project EMP in order to further enhance the ecological and environmental benefits of the project, as well as to avoid any potential negative impacts.
Projects in Disputed Areas OP/BP/GP 7.60	× No	This policy is not triggered as the project does not involve any disputed areas.
Projects on International Waterways OP/BP/GP7.50	× No	This policy is not triggered as the project does not involve trans-boundary rivers.

In addition, the applicable Environmental, Health and Safety (EHS) Guidelines of the World Bank Group are also important technical references to provide general and industry-specific examples of Good International Industry Practice (GIIP) during the EA process.

3. Environment and Social Management System

Jiande Municipal Environmental Protection Bureau is responsible for the review and approval of Jiande Subproject while Chun'an County Environmental Protection Bureau is responsible for review and approval of Chun'an County Subproject according to the administrative authority stipulated in the Law of the People's Republic of China on Environmental Protection and the Regulations on Environmental Protection Management of Construction Projects. As the environment management agency of the respective subprojects, Jiande Municipal Environmental Protection Bureau and Chun'an County Environmental Protection Bureau are respectively responsible for proposing environmental protection requirements based on the contents of the EIA Report of the Project, coordinating the environment management work of the various departments and organizing the "three-simultaneousness" acceptance of the environmental protection facilities. The World Bank Loan Project Management Office is responsible for managing the implementation of the entire Project while the Project Owner is responsible for implementing the various specific activities under the general administration framework of the Project. In order to assure smooth implementation of the environment management activities of the Project, a number of full-time or part-time environment management personnel are assigned in the PMO, the Project Owner, the Contractor and the Operator to implement the Environment Management Plan.

3.1 Environment Management Agency

As the environment management activities of the Project in the construction stage are significantly different from those in the operation stage and such activities are either short-term or long-term in terms of their deadlines, the Contractor and the Operator should set up separate organizations to take the responsibility for different stages. As the construction stage ends, the management organization of the construction stage will be cancelled while that of the operation stage will start to operate, with a certain overlapping period allowed based on the progress of the specific management activities. The environment management agencies in the construction stage and the operation stage are shown in Figure 3-1 and 3-2.

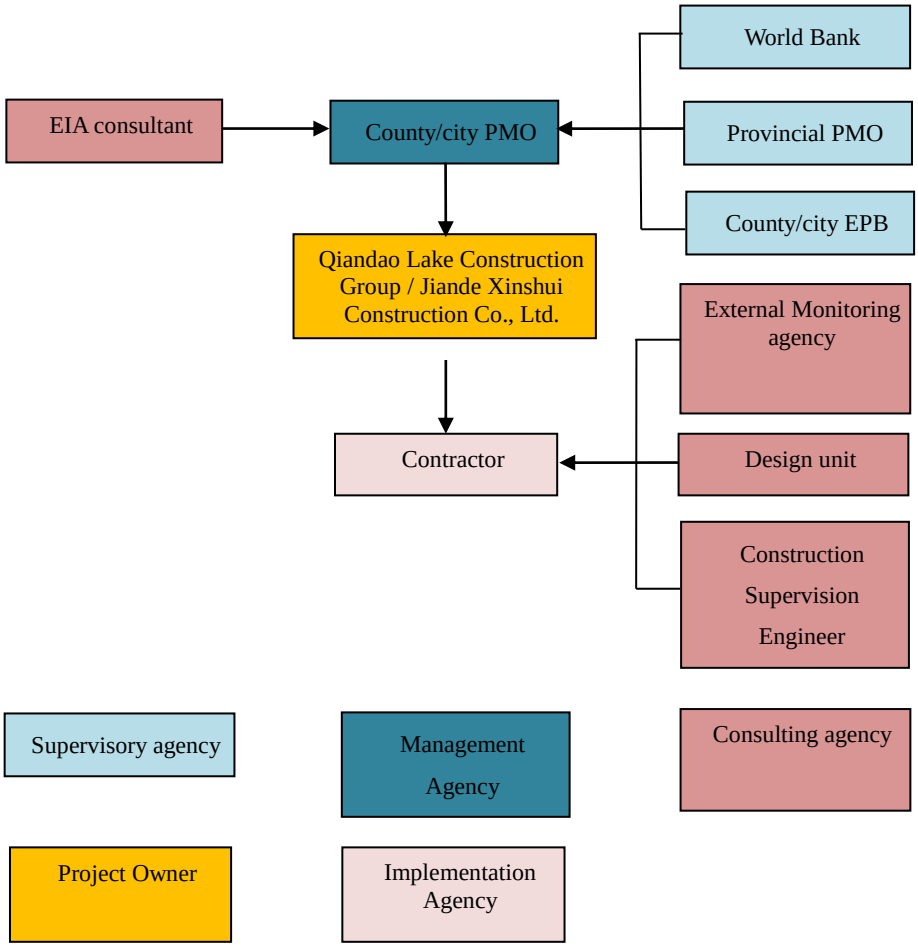

Figure 3-1: Schematic Diagram of the Environment Management Agencies in the Construction Stage of the Project

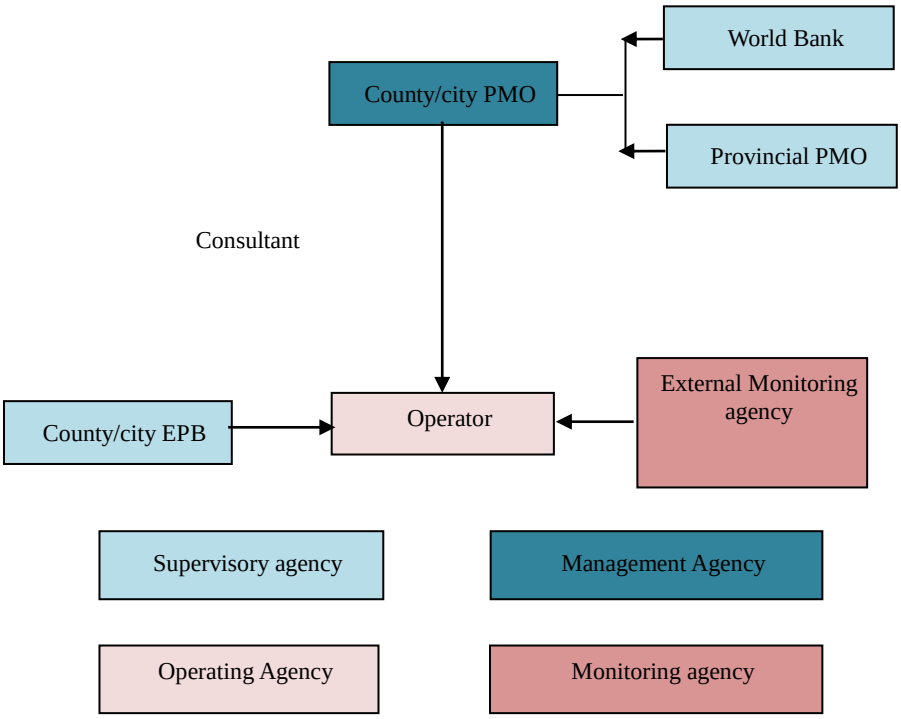

Figure 3-2: Schematic Diagram of Environment Management Agencies in the Operation Stage of the Project

3.2 Responsibilities and Contents of Environment Management

The contents of environment management in the construction stage are remarkably different from those in the operation stage of the Project and the EMP is implemented by different responsible departments. Table 3-1 shows the contents and staffing of each environment management agency for environment management work in different stages.

Table 3-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Environment Management Responsibilities	Staffing
Design and preparation	County / city PMO	Contacting and coordinating with the competent government department of environment management for implementation of the environment management matters;	2

Table 3-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Environment Management Responsibilities	Staffing
	Project Owner	1. Responsible for a series of environmental protection management work in the design and preparation stage of the Project; 2. Securing the fund needed for the environmental protection work; 3. Responsible for coordinating with the competent government department of environment management for implementation of the environment management matters; 4. Recruiting supervision engineer and collecting records.	3
	Designer	1. Incorporating the environmental protection measures into the design program and budget; 2. Incorporating the EMP mitigation measures into the technical specifications of the bidding documents.	3
	EIA consultant	1. Providing technical support to the environmental protection work included in the project design; 2. Preparing the EIA documents of the Project; 3. Development of EMP.	5
	County / city EPB	1. Responsible for review and approval of EIA Report of the Project; 2. Responsible for the routine environment supervision and management work of the Project.	2
Construction stage	Project Owner	1. Responsible for a series of environmental protection management work in the construction stage of the Project and securing the fund needed for the environmental protection work; 2. Managing and supervising the environmental protection work in the construction stage and investigating into and handling problems of public disturbance or pollution arising in the construction process; 3. Responsible for coordinating with the competent government department of environment protection for implementation of the environment management matters; 4. Following up with the execution status of the EMP and reporting on a periodical basis to the competent government department of the same level, the provincial PMO and the World Bank ; 5. Accepting and handing public complaints.	3
	Contractor	1. Preparing the Site Environment Management Plan based on the EMP to become part of the outcome based technical specifications of the contracts; 2. Implementing the environmental protection responsibilities under the contract (as specified in the Site Environment Management Plan), including the environmental, social and health and safety measures; 3. Accepting guidance and supervision by the environment management personnel of the Project	3

Table 3-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Environment Management Responsibilities	Staffing
		Owner, the construction supervision engineer and the related government departments; 4. Accepting technical supports provided by the environmental protection consulting agency; 5. Implementing safety protection measures, e.g. erecting signs and fences on the boundary of construction sites, setting up channels of public communication and assuring construction safety.	
	Construction Supervision Engineer	1. Supervising the contractor's execution of the contract and the Site Environment Management Plan and carrying out the environment mitigation measures in the construction contract; 2. Carrying out site supervision of the implementation status of the Contractor; 3. Assisting the EA in carrying out the environment management work; 4. Keeping records of and developing and submitting to the Project Owner on a periodical basis EMP execution status reports.	5
	Environmental Monitoring Agency	1. Carrying out the environmental monitoring work of the construction stage and operation stage of the Project based on the authorization of the Project Owner and the environmental monitoring plan included in this EIA report; 2. Conducting the monitoring activity under the authorization of the Project Owner in case of any abnormalities in the construction process.	Depending on the scope of authorized assignment
	County/city EPB	1. Supervising and inspecting the environmental protection measures of the Project Owner and the Contractor; 2. Receiving EMP execution reports submitted by the Project Owner and the PMO and performing the administration functions based on such reports; 3. Arranging emergency response actions in the event of any abnormal environmental conditions in the construction process; 4. Accepting and coordinating the handling process of public complaints.	2
	Technical Assistance / Consultant	1. Providing technical supports to the environmental protection work in the construction stage of the Project according to the authorization of the Project Owner and this EIA Report as well as the environmental protection design outcomes; 2. Providing the contractor with technical guidance on the environmental protection work and properly carrying out the environmental protection training work in the construction stage of the Project.	Unlimited
Operation stage	Project Owner or Operator	1. Responsible for the post-operation management work of environmental protection and implementing the mitigation measures and monitoring of the EMP	3

Table 3-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Environment Management Responsibilities	Staffing
		in the operation stage; 2. Responsible for contacting and coordinating with the competent government department about the implementation of the environment management matters; 3. Making emergency responses to environmental accidents; 4. Providing periodical staff training to enhance their competence and actively organizing activities for exchange of environmental protection technology and experiences to further improve the management work of environmental protection.	
	Environmental Monitoring Agency	1. Carrying out the environmental monitoring work of the operation stage of the Project as authorized by the Project Owner and required in the environmental monitoring plan; 2. Carrying out the routine monitoring activities related to the Project on a periodical basis.	Depending on the scope of authorized assignment
	County/city EPB	1. Responsible for the final acceptance of the environmental protection work of the Project; 2. Managing and supervising the status of compliance with the environmental protection standards in the operation stage; 3. Carrying out routine supervision and inspection of the operation status of the built environmental protection facilities.	2
	Public or organizations	Public supervision	Not limited

3.3 Environmental protection supervision plan

Based on the characteristics of the Project, the implementation status of the environmental protection work of the Project is not only subject to the supervision of local EPB, but also the relevant department of the World Bank. Construction supervision engineers should be employed to assist the EA in site supervision and inspection in the construction stage of the Project and an environmental protection division should be set up to supervise the Project in the operation stage.

See Table 3-2 for the environmental protection supervision plan of the Project.

Table 3-2 Environmental Protection Supervision Plan of the Project

Stage	Agency	Content of Supervision	Purpose of Supervision
FS stage	County/city EPB, WB	1. Reviewing EIA Outlines; 2. Reviewing EIA Report; 3. Reviewing EAP	1. To make sure the EIA Report has complete content, well-selected topics and clear focus; 2. To make sure that any

Table 3-2 Environmental Protection Supervision Plan of the Project

Stage	Agency	Content of Supervision	Purpose of Supervision
			significant and potential issues likely to arise in the Project are reflected; 3. To make sure that a specific and feasible implementation plan is available for the mitigation measures of the environmental impacts.
Design and construction stage	County/city Government County/city EPB County/city WRB County/city Forestry Bureau County/city Agriculture Bureau County/city PMO	1. Reviewing the preliminary environmental protection design and EMP; 2. Inspecting the restoration of temporarily occupied land, and vegetation and environment affected by the construction works; 3. Inspecting measures for control of dust and noise pollution and deciding construction time; 4. Inspecting emission of air pollutants; 5. Inspecting discharge and treatment of domestic sewage and waste engine oil on the construction sites; 6. Inspecting restoration and treatment of waste disposal sites; 7. Inspecting and determining whether there any underground cultural relics.	1. To strictly enforce the “three-simultaneousness” policy of the Project; 2. To assure that all the construction sites satisfy the environmental protection requirements; 3. To reduce the impacts on the surrounding environment in the construction stage and enforce the relevant laws and regulations and standards of environmental protection; 4. To make sure that the water quality of the rivers and Qiandao Lake are not polluted; 5. To make sure that the landscape and land resources are not seriously damaged to avoid soil erosion; 6. To make sure that the wastes and debris are properly disposed; 7. To protect the cultural resources from damages.
Operation stage	County/city EPB	1. Inspecting the implementation of EAP in the operation stage; 2. Inspecting the implementation of the monitoring plan; 3. Inspecting sensitive sites where further environmental protection measures are needed (and where unanticipated environmental problems may arise); 4. Inspecting whether the	1. To implement EAP; 2. To implement monitoring plan; 3. To protect environment in the true sense; 4. To strengthen environment management and actually safeguard personal health; 5. To assure that the pollutant emission satisfies the emission standards.

Table 3-2 Environmental Protection Supervision Plan of the Project

Stage	Agency	Content of Supervision	Purpose of Supervision
		environment quality at the environmentally-sensitive sites satisfies the requirements of the corresponding quality standard; 5. Strengthening supervision to prevent unanticipated incidents and developing emergency response plans so that the environmental risks can be eliminated in time in the event of any accidents.	

4. Environmental and social impacts and their mitigation measures

In accordance with the relevant laws and codes of China and Zhejiang Province and in association with the World Bank General Environment, Health and Safety (EHS) Guidelines, EHS Guidelines for Water Supply and Drainage, general and special countermeasures and mitigation measures are proposed for the design stage, the construction stage and the operation stage of different types of subprojects. For the general countermeasures and mitigation measures, four ECOPs and 2 MPs are developed as annexes to the ESMP, namely Annex 1: ECOP for Small Civil Works Construction, Annex 2: ECOP for River Rehabilitation, Annex 3: ECOP for Afforestation and Annex 4: Agricultural Pest Management Plan and Annex 5: Forestry Pest Management Plan and Annex 6: ECOP for Road Construction. Table 4-1 shows the ECOPs and MPs applicable to the respective subprojects while Tables 4-2 present a summary of the environmental and social impacts as well as the mitigation measures(This table summarises the environmental impact mitigation measures proposed in Chapter 5, 6 and 7 of the EIA regarding the social, resettlement and design aspects)..

Table 4-1: ECOPs and MPs applicable to each subproject

Name of subproject	Applicable ECOP
Chun'an County Small Watershed Integrated Improvement	ESMP Annex 2: ECOP for River Rehabilitation
Chun'an County Rural Drinking Water Safety Improvement	ESMP Annex 1: ECOP for Small Civil Works
Chun'an County Dike Reinforcement and River Rehabilitation	ESMP Annex 2: ECOP for River Rehabilitation
Chun'an County Agriculture NPS Pollution Control	ESMP Annex 1: ECOP for Small Civil Works, ESMP Annex 4: Agriculture Pest Management Plan
Chun'an County Forest Eco-system Restoration	ESMP Annex 3: ECOP for Afforestation; ESMP Annex 5: Forestry Pest Management Plan
Jiande City Water Conservancy Facility Rehabilitation	ESMP Annex 2: ECOP for River Rehabilitation
Jiande City Landscaping Afforestation and Forest Form Improvement	ESMP Annex 3: ECOP for Afforestation; ESMP Annex 5: Forestry Pest Management Plan
Jiande City Municipal Engineering	ESMP Annex 6: ECOP for Road Construction; ESMP Annex 1: ECOP for Small Civil Works

Jiande City Agricultural NPS Pollution Control	ESMP Annex 1: ECOP for Small Civil Works, ESMP Annex 4: Agriculture Pest Management Plan

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
Design stage	Social environment	/	1. The local natural and social environment should be taken into full account upon WWTP, WTP and pump station siting and pipeline routing to maximize saving of arable land and avoid environmentally-sensitive sites such as centralized residential areas, schools, hospitals and minimize disturbance and relocation of electricity, telecommunication and water conservancy facilities. The pipelines should be routed in such a way that they are kept far away from or avoid natural reserves, cultural relics, water sources and national key projects and infrastructures. 2. Structures should be reasonably located to minimize inconveniences to the local people due to project construction. 3. The construction organization design should be well developed to minimize environmental impacts from the construction activities. 4. Siting of roads, pipelines, WTPs and WWTPs should be carried out in such a way that resettlement or impacts on local villagers are avoided to the best possibility. 5. Inconveniences for local residents from project construction should be fully considered in the design. For example, pedestrian crossing should be designed in areas with high density of population to allow the local residents with excellent traffic condition. Damaged infrastructure, e.g. ditches, resulting from project construction should be repaired to assure their integrity. 6. Construction design should be optimized and construction period minimized to reduce large scale excavation and fill; construction periods should be reasonably arranged to reduce local impacts of the construction works. 7. Upon comparison and selection alternative designs, O&M cost of the Project needs to be fully considered and the design proposal with less O&M cost should be selected when the other conditions are equivalent or not significantly different between the available alternatives. 8. Occupation of planned residential area and high-quality arable land should be avoided or reduced and existing national or local roads should be utilized to provide access to the proposed construction sites.	/	FSR unit; IA	Provincial PMO and 2 county/city subproject offices

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
	Water environment	/	1. The designer should optimize wastewater treatment process, structure parameters and layout plan of the WWTP based on the wastewater properties and preserve certain design tolerance, load flexibility and expansion space to assure stable and compliant discharge of wastewater of the Project. 2. Water sources with rich reserves and excellent water quality should be selected for the proposed WTPs.		/		
	Acoustic environment	/	1. WWTP, WTP, pump station should be sited away from sensitive receptors such as villages, schools and hospitals and a reasonable protection distance designed to minimize noise and odor impacts on residents. 2. equipment with excellent performance and low noise should be selected to minimize noise impacts.		/		
	Air environment	/	1. Cost-effective deodorization process should be selected to minimize exhaust gas emission.		/		
	Ecological environment	/	1. The sites for WWTP, WTP and pump stations should be selected based on the project scope to avoid purposeless occupation of land and control the boundaries of project construction and reduce damages to local farmland. 2. The earthwork quantities should be strictly controlled through earthwork balance; 3. Excavation scope should be strictly controlled during pipeline construction to avoid uncontrolled increase of excavation area and reduce soil erosion. 4. Eco-revetment and cofferdam should be selected for the river and dike construction components.		/		
Construction stage	Social environment	1. LAR impacts; 2. Impacts on telecommunication and electricity infrastructure due to road excavation	LAR mitigation measures	1. A detailed RAP should be developed and special concern over how the women-headed families, MLSS households, five-guarantee households and other vulnerable groups use the resettlement compensation fund to restore	/	Local government	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
		and pipeline relocation. 3. Short-time impacts likely to arise in the construction stage on irrigation canals.		their income. 2. Compensation on collectively-owned land as acquired will be made based on the original usage. Compensation on land acquisition includes land compensation, resettlement subsidy and compensation for ground attachments and young crops. The comprehensive land acquisition compensation standard (i.e. land compensation and resettlement subsidy) of the project county/city will be executed for compensation of acquired arable land. Ground attachments and young crops will be compensated based on actual estimated price. 3. The land acquisition compensation fund (including land compensation and resettlement subsidy) shall be paid in full amount to the APs, who, after getting paid with the compensation fund, may decide at his/her own will to participate in the social security program for land-lost farmers or other social security programs (e.g. rural social endowment insurance). Compensation for ground attachments and young crops belongs to the property owners. 4. Reasonable LAR and compensation implementation plan should be developed based on the Land Administration Law and the Regulations on Land Acquisition and Resettlement Compensation and other relevant laws, regulations and policies. Integrated arrangements should be made and adequate negotiation conducted to achieve full compensation			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				and proper resettlement and prevent any potential hazards. The various compensation funds shall be disbursed in full amount to the affected households or organization and shall not be withheld and misappropriated so as to assure the public with a secure and happy life and the affected institutions and enterprises a stable production and make sure that the living standard of the resettlement persons will not become lower. 5. LAR mitigation measures are shown in Table 7.2-1.			
			Mitigation measures for impacts on local farmland and water conservancy facilities	1. In order to assure free flow of farmland irrigation ditches and prevent soil erosion, relocation of farmland irrigation ditches involved in the construction process of the Project should be arranged in non-irrigation season where possible and timely restoration is required after completion to assure the free flow of river ditches in the irrigation period. 2. If it is necessary to demolish or relocate existing irrigation ditches or water conservancy facilities, the substitute irrigation ditches should be constructed and put into operation before the demolition is allowed to proceed.	/	Contractor	
			40 irrigation channels (Chun'an County Dike and Small Watershed Construction)	(1) Construction should avoid crop irrigation period where possible; (2) Cofferdam should be built and construction should be done by stage and by section for wide river, in order to ensure water level at intake and meet irrigation demand; (3) In case water intake cannot be used	2.9	Contractor	

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				due to impact of construction activities, temporary cofferdam should be set upstream to ensure water intake. Flexible pipes will be used at 40 locations (100 m in length for each location) to convey water downstream to irrigation channels to meet irrigation demand.			
			Mitigation measures for the impacts of Chun'an County Pingshan WTP pipeline extension works on the county highway (X704) and the provincial highway (S06)	1. Pingshan WTP pipeline extension project involves the county road (X704) and the provincial road (S06) which are planned to be retrofitted this year. It is suggested to pre-bury some pipes during road retrofit to avoid frequent excavation. 2. Temporary bypass roads should be constructed before massive excavation of existing roads to assure road traffic during the construction period. Bulletin boards should be erected along the roads and special personnel assigned to guide traffic and assure smooth traffic flow.	/	IA	
			Mitigation measures for impacts on Jiupaojie Scenic Area	1. Along the section of Qiuyuanxi Stream in Chun'an County from the cofferdam to be constructed to the raw water pipeline of Pingmen WTP, there is the Jiupaojie Scenic Area, which requires that the road traffic can be maintained where possible during the construction stage. This requirement can be met if half-width excavation is adopted to keep the other half-width open to traffic and assure the accessibility of the scenic area 2. The construction plan should be scheduled in such a way that the high season is avoided where possible and	/	Contractor	

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				bypass road wide enough to allow passage of large buses should be preserved during the construction process. Where such bypass cannot be assured, timely communication is required with the scenic area authority and plans should be developed for temporary commutation of tourists. In addition, the construction progress of this highway should be accelerated to minimize traffic impacts.			
			Mitigation measures of the traffic impacts on Provincial Highway 05 and 06	The Project will involve 2 crossings with Provincial Highway 05 and 06 and the pipe jacking technology will be used, thus no impacts will be generated on normal traffic. However, traffic warning and guiding signs should be erected at the construction sites.	/	Contractor	
			Fuel gas pipeline	The underground fuel gas pipelines of Hangzhou Fuel Gas Co., Ltd. will be involved in the pipeline extension works of Fenkou and Jiangjia WTPs in Chun'an County. If no adequate preparations are made, adverse impacts will be generated on the safe operation of the fuel gas pipeline. 1. The contractor and the designer need to communicate with the local planning and municipal engineering authorities and other infrastructure administration authorities during the design stage and prior to construction to identify the layout of underground facilities and works in the construction sites and the adjacent areas, disclose to the local public and carry out further survey of the layout of	/	IA，Contractor	

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			underground infrastructures, negotiate and develop a solution, conscientiously design the construction program and finish the reinforcement and rehabilitation of affected underground facilities and works before the construction of the Project and communicate with the local authorities about the construction program. Reinforcement and rehabilitation of such underground facilities should be covered in a special fund planned under the Project. 2. Construction works at sites involving crossing of fuel gas pipelines should be designed and constructed according to the "Law on Protection of Natural Gas Pipelines" and other regulations and specifications. The contractor shall consult the fuel gas companies and develop a pipeline protection program, carry out a survey of the terrain and topography on site and make sure that the water supply pipelines are kept as far away from the fuel gas pipelines as possible. Prior to ground excavation, detailed information on the safety and technological aspects of the fuel gas pipelines shall be delivered. The locations of the underground pipelines shall be identified before any construction works proceed. A safety separation belt shall be provided on sites involving interfering operations to separate such sites from the construction areas and access should be strictly controlled to keep non-operators away from site. Excavation activities in			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				areas with a distance of less than 10m from the pipeline centerline shall be carried out artificially instead of using large plants. Drainage and waterproofing measures should be properly implemented on the construction sites. In the process of excavation, pipe knocking of any nature is prohibited. Prior to duct backfill, used tires can be placed on top of the new pipelines to separate the two crossing pipelines. Duct backfill shall be carried out manually by filling soft soil around the pipelines and artificially compacted. The backfill shall not cause any impacts and compression of the pipelines. Backfill soil shall be artificially pushed into the duct from one side and compacted. Warning signs should be provided on site. Safety training for construction workers should be organized prior to construction and an emergency response plan should be developed for natural gas leakage during construction. 3. In the construction stage, the construction contractor will contact the competent authorities of municipal engineering, housing and urban-rural development and telecommunication to collect information of underground pipeline survey and the pipe type, alignment and buried depth and a pipeline coordination team should be set up. Excavation and construction activities related to pipelines should be approved by the competent authority or the ownership body before such activities are allowed to			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				commence. 4. The construction plan and the emergency response plan should be developed based on the location and buried depth of the pipeline and the underground pipelines should be avoided where possible. 5. Prior to the excavation of a pipeline, the competent authority should be advised of the construction section and construction time so that emergency responses preparations are made.			
			Mitigation measures for traffic impacts on Da-Guan Highway in Chun'an County	Da-Guan Highway, for which an overhaul is planned for the few years to come. Timely communication with the transportation authority is recommended so as to minimize repetitive excavation of pavement while maintaining the construction progress.	/	IA	
			Mitigation measures for traffic impacts involved in rehabilitation of 12 existing bridges	For the reconstruction of the 12 bridges in Jiande City, the existing bridges need to be demolished and local villagers will be affected during the construction period. Therefore, it is recommended that temporary access bridges are erected by the contractor for villagers in the construction period.	12.0	Contractor	
			Mitigation measures for traffic impacts in Lovers' Valley Scenic Area	It is required that the construction contractor will make reasonable arrangement of construction time to avoid construction in the peak hours of the scenic area and temporary access roads are constructed to assure smooth accessibility of the Scenic Area.	/	Contractor	

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
			Common mitigation measures for impacts on existing transportation infrastructure	1. The contractor should take all appropriate measures to protect any public facilities affected and being affected by the proposed projects in the construction stage. 2. Where there are existing roads, telecommunication, electricity and pipeline infrastructures in the construction scope of the project, assistance should be provided to the concerned authority to get ready for resettlement or reconstruction and prior negotiations with the concerned authorities and prior notice to affected residents should be carried out so that preparations are made to avoid various adverse impacts. 3. Transportation of raw and auxiliary materials or large machinery during the construction period may damage local roads. The damaged roads should be repaired in time during and after the construction or compensation paid to local road management authority for repair. 4. The IA should adequately consult the local transportation and public security authorities to strengthen traffic and transportation management and minimize impacts on traffic by pipeline construction. In addition, the IA should be required to develop a proper transportation plan so that the peak hours of local road traffic are avoided for transportation of road construction materials to avoid traffic congestion and reduce traffic accidents. 5. In the event of any excavation operations close to the public utilities, the			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				contractor should give a notice to the concerned authority and invite representatives of such authorities to be present on site. The contractor should submit the aforesaid notice and a duplicate of the letter of invitation to the supervision engineer for reference. 6. Temporary bypass roads should be constructed before massive excavation of existing roads to assure road traffic during the construction period. Bulletin boards should be erected along the roads and special personnel assigned to guide traffic and assure smooth traffic flow. 7. For construction activities that will affect public traffic, construction program should be provided to public traffic authority in advance for arrangements for adjusting public traffic route, and construction cannot commence until permission is obtained. 8. Signs should be set on construction site before construction indicating construction description and schedule, requesting public understanding of inconvenience caused by construction activities, and disclosing contact information and complaint hotline. This information could be disclosed in advance through media, micro-blog and wechat, if possible.			
	Requirements on protection and management of cultural relics	1. The project produces no impacts on the underground ancient city of Wenyuan Lion	Mitigation measures for impacts on cultural relics	1. If any cultural relics or historic sites are discovered or suspected during the construction period, the IA shall immediately protect the site and submit a report to the local cultural relics bureau for further action in accordance with the "Law	/	IA, Contractor	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
		City. 2. The project involves the relocation of 13 tombs.		of the People's Republic of China on the Protection of Cultural Relics" (Dec. 29, 2007) and the World Bank's Physical Cultural Resources Policy and make sure the construction works shall not resume until actions are taken by the Cultural Relics Bureau. 2. It is stipulated in Article 11, Chapter 2 of the Cultural Relics Protection Law of the People's Republic of China, no other construction works shall be implemented in the scope of protection of the protected cultural relics unit. If necessary for special reason, a prior consent must be obtained from the people's government and the superior cultural and administration department. Where the other construction works are to be implemented in the scope of a national key cultural relics protection unit, consent must be obtained from the people's government of the respective province, autonomous region and municipalities as well as the national cultural administration authority. 3. Where a cultural relics protection unit must be relocated or demolished for the sake of a construction project and special needs, consent should be obtained from the people's government of the respective level and the cultural administration authority of the higher level based on the level of the concerned cultural relics protection unit. Relocation or demolition of a national key cultural relics protection unit shall be reported by the people's government of the province, autonomous			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				region or municipality directly under the Central Government to the State Council for decision. Cost and labor needed for the relocation and demolition should be incorporated by the IA into the investment plan and labor plan. 4. Revolutionary sites, memorial buildings, ancient tombs, ancient buildings, stone cave temples, stone carvings (including appendages of buildings) that have been approved as cultural relics protection units shall be repaired, maintained and relocated following the principle that no change is made to the original state of the cultural relics. 5. Where a cultural relics is discovered or suspected in the construction process, the IA shall: (1) Construction works at sites where a cultural relics is discovered must be suspended immediately and the site must be protected. (2) The Contractor should submit a timely report to the police and cultural relics authority for verification and further action. (3) The scope of protection should be immediately defined if the discovery is certified by expert as a cultural relics. (4) It is necessary to carry out rescue excavation of the cultural relics if it is indeed necessary to go on with the construction works or there is any risks of natural damages. (5) Rescue and excavation of cultural relics must be carried out by professionals with professional equipment and must not			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				be excavated by the contractor on his own. (6) Justifying whether a new project site should be selected in case it is judged that a major cultural relics is discovered.			
			Mitigation measures for relocation of 13 tombs (Chun'an County Drinking Water Safety Improvement)	1. Full consultation with the tomb owners should be done and agreement should be obtained before relocation. 2. Compensation should be provided to affected households directly by town government and relocation should be done by the affected households. 3. Village leaders need to coordinate with tomb owners to select appropriate places for relocation. 4. Local custom for tomb relocation should be respected. 5. Cash compensation for tomb relocation ceremony should be considered besides in-kind compensation.	/	IA	
	Environmental protection requirements on noise pollution control	1. Noise generated by construction plants in the construction stage will have impacts on residents in local villages.	Noise mitigation measures in the construction stage	1. Environment management on the construction sites should be strengthened and the stipulations in the "Ambient Noise Discharge Standard for Boundaries of Construction Sites" should be strictly respected to assure the compliance of noise emission with the standard. 2. The construction time should be reasonably scheduled and high-noise construction activities should be prohibited at night. A reasonable layout plan should be developed and the high-noise equipment should be surrounded with a shelter zone. Night construction should be reported to EPB	20.0	Contractor	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				for approval before the construction works proceed. 3. Announcements should be posted in the vicinity of key roads, residential areas and WTPs and pump stations that the pipeline runs by and the construction deadline should be indicated to not only reassure the public, but also obtain their understanding and supervise the construction contractor to facilitate on-time completion of the project. 4. Operation of high-noise equipment should avoid the class hours at schools, the noon time for residential areas; for sensitive areas such as hospitals and government office buildings, the operation time of high-noise equipment should be shortened to the minimum; low-noise equipment should be selected in terms of the construction equipment and method. 5. The construction period should be reasonably arranged to shorten the construction cycle as much as possible and reduce impacts on local acoustic environment from construction noises. 6. In order to assure the health of construction workers, the IA should reasonably arrange the work time according to the "Noise health standard for industrial enterprises" to enable the operators to operate in turn the construction plants radiating high and strong noises and reduce their exposure to high noises. It is suggested that personal protective measures, such as earmuffs, helmets, etc., are used by the			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				operators and the related staff. 7. Low-noise construction plants and technologies should be selected where possible and fixed mechanical equipment with strong vibration should be installed with a vibration damping pedestal and maintenance and servicing should be strengthened for the various construction equipment. Stronger efforts should be made in management of noise sources on construction site. Metallic materials should be loaded and unloaded with care.			
	Ambient air mitigation measures	1. Impacts of construction dust, exhaust gas of mechanical plants in the construction stage	Construction dust	1. The construction sites should be fenced up (fully or half fenced up with colored steel sheets). In continuous sunny and windy days during pipeline construction, the temporary stockpiling sites of excavated earth should be sprayed with water or covered up with green coverage nets to prevent dust. 2. The IA should take planned and timely action to the waste soil and cover up the trucks in the transportation process (and make sure that transportation is conducted in an enclosed way) and spray water along transportation route with non-earth pavement. In addition, earthwork excavation and material handling should be avoided where possible in windy weather. Overloading must be banned and actions must be taken to prevent spillage and make sure mud and dirt on truck wheels are cleaned before leaving the site. A mechanism should be set up for cleaning of construction access roads so that any	30.0	Contractor	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				spillage of waste soil is cleaned in a timely manner. 3. Designated personnel should be available to be responsible for the management of construction and operation areas in a scientific way; in the foundation construction period, actions should be taken to accelerate progress and transport soil and earth to the designated site in time to shorten the period of stockpiling hazards. 4. Water spraying during excavation and demolition helps to keep a certain moisture; in order to prevent dust, loose and dry surface soil on the construction site should also be sprayed with water frequently; during backfill, water should be sprayed on dry surface soil to prevent dust. 5. Trucks transporting soil and construction materials should be installed with the specified spillage prevention devices and should not be overloaded to prevent spillage in transportation. The transportation routes and time should be well planned to avoid sensitive areas such as downtown areas, high traffic density areas and residential areas; night transportation may be selected based on the actual situation for road sections with stringent environmental requirements to reduce dust impact on environment. 6. Transportation vehicles should be covered up and washed at the loading and unloading sites before operation to reduce spillage from wheels and chassis.			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				7. Mud and dirt spilled on pavement during transportation should be cleaned in time to reduce dust in operation. 8. Sand, cement and other dust-prone materials stockpiled in open air should be covered with tarpaulins or plastic to prevent fugitive dust. 9. Waste construction materials must not be burned in the construction process. 10. Construction sites of resettlement works should be fully fenced up. 11. Roads and vegetation on sites occupied for the construction works should be restored in time upon completion of the construction works. 12. Construction activities should avoid windy days and construction time should be shortened to increase construction efficiency and reduce duration of surface exposure. 13. Construction sites should be sprayed water periodically by designated personnel at a frequency of 1 to 2 times a day based on weather condition to reduce dust. The water spraying frequency may be increased to an appropriate extent in windy or dry weather.			
			Pollution control measures for tail gas from construction plants and vehicles	Construction plants and transportation vehicles complying with the national health protection standard must be selected to assure that exhaust gas complies with the national standards. In addition, load limit, speed limit and tail gas purification measures should be taken for construction plants and vehicles to reduce the impacts of tail gas on residential areas	/	Contractor	

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				in the vicinity.			
	Water environment mitigation measures	1. Construction wastewater includes domestic sewage from construction workers, wastewater from concrete batching system cleaning, slurry during construction, and wastewater from foundation trenches, which, after treatment to the respective standard, can be discharged or reused, producing insignificant environmental impact. 2. The water intake requirements on water quality and volume can be met by the water sources of each WTP and the impacts on hydrological	Water environment mitigation measures in the construction stage	(1) Wastewater collection and sedimentation facility should be set on concrete batching plant. Horizontal concrete and brick masonry sedimentation tank should be built on site. Wastewater will be collected and treated in sedimentation tank with chemical dosing and effluent will be reused for concrete making, vehicle cleaning and site watering for dust control. (2) Wastewater collection ditches should be built on construction equipment maintenance site to collect oily wastewater from cleaning and maintenance. Oil separation and sedimentation tank should be set on construction site and oil and sediment should be cleaned on a regular basis. The effluent will be reused for vehicle cleaning and site watering for dust control. Oil collected should be hauled to qualified facility for disposal. (3) Sedimentation tanks should be built on construction sites for treatment of foundation trench discharge, the retention time of which should be more than 2 hours. The effluent will be pumped out for construction or road watering. (4) Containment structure should be built around temporary cofferdam to prevent water pollution by suspended solids. (5) Residential buildings should be used	200	Contractor	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
		regime downstream of the water intakes will be insignificant. 3. Affected by water extraction, the hydropower generation of the three hydropower stations will reduce, respectively by 2.04%, 0.73% and 4.42% for Guanchuan, Yanjia and Yejiayuan Reservoir, respectively, and impact is little.		as construction worker camps where possible for utilization of existing municipal facilities for domestic sewage treatment. Where there are no wastewater collection and treatment facilities, domestic sewage collection and treatment facilities should be built by the contractor prior to construction. Septic tank should be built for toilet, and septic tank discharge could be collected by local sanitation utility. When construction site is located in remote area where service of sanitation utility is not available, underground and powered wastewater treatment facility should be provided and domestic sewage should be treated to meet Integrated Wastewater Discharge Standard (GB8978-1996) Class 1 and reused for nearby farmland and forest irrigation. (6) Siting of construction site should fully accommodate need for drainage and should be located as far away from water bodies as possible. Construction site, warehouse, and diesel storage site should not be located within 500 m of the river. Necessary measures should be taken to prevent discharge of pollutants into the river, especially through storm water runoff or surface runoff in rainy season. (7) Drilling debris should be hauled to designated site for disposal, and drilling slurry should be pumped to sedimentation tank for treatment and then transported to designated site for disposal. (8)Construction wastewater should be			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				adequately treated in sedimentation tank and effluent should be reused for road and vehicle tire cleaning. (9) 50 cm high brick masonry retaining wall can be built around temporary construction material storage site to prevent storm water erosion. Construction debris should be stored on designated site, covered and transported for disposal in a timely manner to prevent entering watercourse through surface runoff in raining days. (10) Construction site should be cleaned. Construction equipment should be maintained and repaired in a timely manner to avoid oil leakage and spill. Measures should be taken in the event of oil leakage immediately by collecting oil in special container and appropriate disposal. (11) Management of wastewater treatment facilities should be enhanced by sedimentation tank and drainage channel cleaning on a regular basis and off-site disposal of oil and grease from oil separation tank. Uncontrolled dumping is not allowed. (12) Water-related construction should be done in dry season where possible, and construction stage should be shortened, if possible, to reduce disturbance to water body.			
			Mitigation measures for impacts on power generation	Power generation of 4 hydropower stations of Guanchuan Hydropower Station, Fengshuling Reservoir, Yanjia Reservoir and Yejiayuan Reservoir will	/	IA	Provincial PMO and Chun'an County PMO

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				reduce under the impacts of water diversion. The IA has communicated with the hydropower stations for compensations based on the actual loss.			
	Solid waste mitigation measures	1. Solid wastes involved in the construction stage of the Project mainly comprise of dredging sediments and domestic solid wastes, which, after treatment, will produce insignificant environmental impacts.	Solid waste mitigation measures in the construction stage	1. Domestic solid wastes generated in the construction stage will be collected and transported by environmental sanitation authority to a designated site for disposal. 2. Solid wastes generated from Jiande subproject will be fully reused for site leveling in the industrial parks of Datong Town and Hangtou Town. 3. Solid wastes in a total volume of 649,400m3 generated from Chun'an subproject will be stockpiled at 72 spoil disposal sites and water and soil conservation measures, such as retention, covering and drainage gutters, will be taken as detailed in the respective section.	10.0	Contractor, IA	Provincial PMO and 2 county/city subproject offices, local EPB
			Wastes generated from dredging of Zitongyuan River in Chun'an County	Results of monitoring of river sediments in Chun'an County show that the sediments sampled and monitored at Zitongyuan River satisfy the Class III standard specified in the Soil Environment Quality Standard (GB15618-1995) and are only usable as forest land soil. The sediments will be delivered to Changning Village Construction Waste Landfill Site for disposal。	/		
			Wastes generated from dredging of Zhenyuanxi Stream, Shimulingxi Stream and Wulongxi Stream in Jiande	Results of monitoring of sediment samples show that such sediments satisfy the Class III standard specified in the Soil Environment Quality Standard (GB15618-1995) and are usable as forest land soil. All the sediments from dredging	/		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
			City	under the Project will be delivered to the industrial parks in Datong Town and Hangtou Town in Jiande City for site leveling			
	Water and soil conservation measures	Terrain and topography in the project area are disturbed and surface and vegetation damaged during construction, resulting in loss or degradation of the original water and soil conservation function; on the other hand, the large volume of earthwork excavation and fill can easily lead to soil erosion.	Water and soil conservation measures for Jiande City Water Conservancy Facility Improvement, Forest Fire Emergency Access Road, Mountain-climbing Road	Based on the construction time and sequence, layout and characteristics of soil erosion possibly caused by the construction works, the subproject is divided into 4 soil erosion control zones: Zone I (control zone for flood dike construction), Zone II (control zone for municipal road construction), Zone III (Control zone for earth stockpiling sites) and Zone IV (control zone for temporary construction facilities). The detailed quantities are summarized as follows: 1) Zone I (Control zone for flood dike construction): The area of this control zone is 86.67hm^2, including 2.57hm^2 for dike construction and river rehabilitation works and 84.10hm^2 for the directly affected area. Structural measures: (1) Topping soil: 9,800m^3. Temporary measures: (1) Covering the side slope temporarily with colored plastic cloth and preparing plastic cloth for a total area of 5600m^2. 2) Zone Ⅱ (Control zone for municipal roads) The area of this control zone is 17.80hm^2, including 9.43 hm^2 for construction of new roads and 8.37hm^2 for the directly affected area. Structural measures: (1) Topping soil with a volume of 41,800m^3; (2) C20 concrete	659.45	Contractor. IA	Provincial PMO and 2 county/city subproject offices, local EPB, WRB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				rectangular drainage ditches on one side of the roads as a part of the drainage facilities with a length of 20.90km and a volume of 2,700m^3. Planting measures: (1) Vegetated slope within a distance of 0.5m on both sides of the road with a total area of 2.09hm^2; (2) tending area: 2.09hm^2·a. Temporary measures: (1) covering the side slope temporarily with colored strip plastic cloth with a total area of 4200m^2. 3) Zone III (control zone for earth stockpiling sites) Control area: 11.88hm^2, including 9.99hm^2 for stockpiling sites and 1.90hm^2 for directly affected area. Structural measures: 9.99 hm^2 for site leveling. Temporary measures: C20 concrete rectangular interception ditches with a length of 2.52km and a volume of 300m^3. 4) Zone IV (Control zone for temporary construction facilities) Control area: 3.38hm^2, including 1.16hm^2 for construction sites, 1.32hm^2 for construction access roads and 0.90hm^2 for directly affected area. Structural measures: 2.48 hm^2 for site leveling; 1200m^3 for C20 concrete rectangular drainage ditches with a length of 9.04km. Temporary measures: covering temporarily with colored strip plastic cloth with a total area of 3000m^2.			
			Chun'an County Rural Drinking Water	Water and soil conservation of this subproject has four zones, namely, WTP	521		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
			Safety Improvement Water and soil conservation measures	construction zone, water supply pipeline construction zone, water intake structure construction zone and temporary facility construction zone. For the purpose of soil erosion prevention and control in the project area, the structural measures, the greening measures and the temporary measures are integrated to form a complete and sound system of soil erosion prevention and control measures. 1. Zone I (WTP Construction Zone) Soil erosion prevention area is 4.1876 hm^2 including 3.7246 hm^2 construction area and 0.463 hm^2 land directly affected by construction activities. Structural measures: removal of 2.833 hm^2 surface soil and 5,700 m^3 surface soil backfill. Greening measures: 1.1332 hm^2 plant area greening and tending (one year). Temporary measures: construction of 3,600 m drainage channel and seven sedimentation tanks. 2. Zone II (water supply pipeline construction zone) Soil erosion prevention area is 1206.3172 hm^2 including 953.6722 hm^2 construction area and 252.645 hm^2 land directly affected by construction activities. Structural measures: removal of 498.2704 hm^2 surface soil, 996,500 m^3 soil backfill, 953.6722 hm^2 ground leveling, and 247.9548 hm^2 land reclamation. Greening measures: planting of 228,881 trees, 347.1367 hm^2 of grass sowing and			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				tending (one year). Temporary measures: 20,000 m^2 colored strip plastic cloth. 3. Zone III (water intake structure construction zone) Soil erosion prevention area is 0.12 hm^2 including 0.09 hm^2 construction area and 0.03 hm^2 land directly affected by construction activities. Temporary measures: construction of 300 m drainage channel and four sedimentation tanks. 4. Zone IV (temporary facility construction zone) Soil erosion prevention area is 0.9 hm^2 land occupied by temporary facilities. Structural measures: 0.9 hm^2 ground leveling. Temporary measures: 1,090 m drainage channel, 6,000 m^2 colored strip plastic cloth, and 550 m^3 straw bag stuffed with soil.			
			Water and soil conservation measures Chun'an County Dike Reinforcement and River Rehabilitation	This subproject has two zones for water and soil conservation based on construction scheduling, construction distribution and nature of potential soil erosion, and they are Zone I (Main Works Zone) and Zone II (temporary facility zone). Quantities of particular mitigation measures are summarized as below. (1) Zone I (Main Works Zone) Soil erosion prevention area is 137.1 hm^2 including 100.3 hm^2 embankment improvement and river rehabilitation area and 36.8 hm^2 land directly affected by	577.9		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				construction activities. Structural measures: removal of 24,600 m^3 surface soil and 1,000 m^3 surface soil backfill for greening. Greening measures: 0.1945 hm^2 grass planting on embankment and tending. Temporary measures: construction of 66.86 km drainage channel and 76 sedimentation tanks (2) Zone II (Temporary Facility Zone) Soil erosion prevention area is 312.3 hm^2 including 15.2 hm^2 spoil disposal site, 164.76hm^2 construction site, 33.2hm^2 construction access road, 33.4hm^2 temporary material storage site, 5.54hm^2 surface soil storage site, and 60.2 hm^2 land directly affected by construction activities. Structural measures: removal of 362,000 m^3 surface soil, 38.56 hm^2 soil backfill, 252.1 hm^2 land reclamation, and 252.1 hm^2 ground leveling. Temporary measures: 3,000 m^3 rock masonry retaining wall, 95.746 km drainage channel, 8,556 m^3 soil bag, and grass planting of 55,981 m^2.			
			Water and soil conservation measures Chun'an County Small Watershed Integrated Improvement	This subproject has three zones for water and soil conservation and they are Zone I (main works zone), Zone II (spoil disposal site), and Zone III (temporary facility zone). Quantities of particular mitigation measures are summarized as below. 1. Zone I (Main works zone): Soil erosion prevention area is 144.14 hm^2 including land occupation by flood control embankment, bank protection, river	1257		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				rehabilitation, weir/dike and landscaping, and land directly affected by construction activities. Structural measures: removal of 67,600 m^3 surface soil and 67,600 m^3 surface soil backfill for greening. Greening measures: 23.01 hm^2 greening and tending. Temporary measures: construction of 66.61 km temporary drainage channel outside embankment and 220 temporary sedimentation tanks 2. Zone II (spoil disposal site): Soil erosion prevention area is 39.13 hm^2 including land area of disposal site and affected land area within 10 m of upper slope and 20 m within down slope. Structural measures: removal of 36,700 m^3 surface soil, 16 km drainage channel, 10 sedimentation tanks, and12,080 m stone mortar masonry retaining wall. Greening measures: 25.02 hm^2 grass planting on top of the disposal site. Zone III (temporary facility zone): Soil erosion prevention area is 71.42 hm^2 including construction access road, construction site, temporary earth storage site and affected area. Structural measures: removal of 50,500 m^3 surface soil, 20.2 hm^2 ground leveling, 87,200 m^3 earth backfill, and 32.58 hm^2 land reclamation. Temporary measures: 4,120 m temporary drainage channel and 50 sedimentation tanks for construction site; 20,020 m temporary drainage channel and 57			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			sedimentation tanks for construction access road; 10,560 m^3 soil bag, 10,560 m temporary drainage channel, and 9.07 hm^2 colored strip plastic cloth for temporary earth storage site; 17,750 m^3 soil bag for containment of surface soil storage site and 22.07 hm^2 grass planting.			
	Other requirements	Tendering and bidding	1. The objectives of environmental protection for each contract section and the responsibilities and obligations of the contractors for realizing such objectives in the project area shall be explicitly defined in the tendering documents. The various environmental protection measures and recommendations included in the EIA Report reviewed and approved by the environmental protection authority shall be included in the contract clauses. 2. The bid documents shall prescribe the contractor's obligations in environmental protection and the subproject contractors shall make commitments on their obligations in implementing environmental protection over the objects of environmental protection involved in the project area and all the construction organization design and plans developed by the contractors shall include contents in implementation and enforcement of the environmental protection measures.	/	Contractor. IA	Provincial PMO and 2 county/city subproject offices
		Contractor requirements	1. Competent contractor should be selected to assure effective execution of the EMP. 2. The contractor and the construction supervision engineer are required to receive training on environmental protection and environment management prior to the commencement of the construction works; 3. Environment impact mitigation measures for the construction stage should be included in the bid documents of the contractor and finally in the construction contract as contractual requirements for the contractors under the Project. 4. The contractors are required to monitor their environmental activities and submit on a weekly basis environmental performance diaries. The PMOs, IAs and construction supervision teams will supervise and review such diaries.	/	Contractor. IA	Provincial PMO and 2 county/city subproject offices

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			5. The contractors should provide 1 full-time environment officer, who will receive planned training to be competent in their work. 6. In the construction process, the contractors should communicate and negotiate with local public in the project area and set up bulletin boards for each construction site to inform the public of the construction activity and construction time and the contact person and telephone number for the sake of public complaints and suggestions.			
		Environmental protection requirements on preparation of construction sites	1. It is prohibited to locate any temporary sites in nature reserves, water source protection zones and river dike protection zones; 2. Temporary sites are usually not permitted to be located with a distance of less than 100m from the river bank. 3. Temporary sites should be located, where possible, on sparsely vegetated barren land or unoccupied land in villages; 4. Temporary land use should be strictly controlled to minimize farmland occupation. Temporary sites may also be located within the right-of-way of the project to minimize temporary land occupation. 5. Construction sites and cement concrete mixing plants should be located as far away from residential areas as possible and more than 300m away from the environmentally sensitive sites at the leeward of the annual dominant wind direction. 6. Site survey should be conducted before mobilization and the construction site should reasonably arranged based on the local environmental condition.	/	Contractor	Provincial PMO and 2 county/city subproject offices, local EPB
		Environmental Code of Practice for construction camps	1. Local houses should be rented where possible and domestic garbage collection sites or garbage bins should be provided. Electricity or other clean energies should be used to meet the needs of domestic or heating energy. 2. The construction workers should respect the local customs and habits and carry out the construction activities in a civilized way and stay in good terms with local residents. 3. Dry toilets and production wastewater sedimentation tanks should be provided on the construction camps. The production wastewater shall be sedimented and then reused for production	/	Contractor	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			instead of discharge and the domestic sewage (from toilet) will be treated in dry toilet and transported by local farmers for farmland irrigation. The dry toilets will be covered up after the construction is over. 4. Construction camps should be sited on poor quality land and occupation of arable land is prohibited; where occupation of arable land is inevitable, construction camps must not be sited on basic farmland; arable top soil stripped before construction should be stockpiled on a flat area and temporarily fenced up with a bagged earth cofferdam. Temporary drainage gutters and sedimentation measures should be provided and the stockpiles should be covered with dust net. After the construction is over, the stripped top soil should be used as top soil for land reclamation of the construction camps or as planting soil for landscaping purposes.			
		General requirements	Environmental impact mitigation measures in the construction stage of small civil works shall be implemented according to EMP Annex 1: ECOP for Small Civil Works; Environmental impact mitigation measures in the construction stage of river rehabilitation works shall be implemented according to EMP Annex 2: ECOP for River Rehabilitation; Environmental impact mitigation measures in the construction stage of afforestation shall be implemented according to EMP Annex 3: ECOP for Afforestation; Environmental impact mitigation measures in the construction stage of road construction works shall be implemented according to EMP Annex 6: ECOP for Road Construction.	/	Contractor	Provincial PMO and 2 county/city subproject offices, local EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
Operation stage	Noise pollution control measures	Shouchang WWTP equipment noise produces little impacts on the nearby villages of Hecun and Shanfeng; noise level on the WWTP boundaries and for local residents meets the standard.	(1) Selection of low-noise and efficient equipment. (2) Damping and insulation measures should be taken to mitigate impact of high-noise equipment like water pump in order to meet Industrial Facility Noise Health Standard. (3) Regular inspection and maintenance of various machines and noise reduction equipment should be improved and equipment in failure should be replaced in a timely manner to avoid noise from improper operation. (4) Water pump should be equipped with anti-vibration pad and sound insulating door and window should be installed for pump chamber. High-noise equipment like air blower should be installed within building, if possible, for better noise insulation. (5) Equipment foundation should be equipped with anti-vibration pad to reduce vibration noise.	5	Shouchang WWTP	Provincial PMO and Jiande City PMO, Jiande City EPB
		WTP and pump station equipment noise produces insignificant impacts and prediction shows that noise level on the WTP and pump station boundaries and for local residents meets the standard (8 new WTPs and 26 pump stations).	(1) Selection of low-noise and efficient equipment. (2) Damping and insulation measures should be taken to mitigate impact of high-noise equipment like water pump in order to meet Industrial Facility Noise Health Standard. (3) Regular inspection and maintenance of various machines and noise reduction equipment should be improved and equipment in failure should be replaced in a timely manner to avoid noise from improper operation. (4) Water pump should be equipped with anti-vibration pad and sound insulating door and window should be installed for pump chamber. (5) Equipment foundation should be equipped with anti-vibration pad to reduce vibration noise. (6) Proper maintenance of water pump, regular inspection of concentricity of motor and pump axle, and good lubrication of bearings to reduce abrasion of pump components and parts.	29	WTP O&M Unit	Provincial PMO and Chun'an County PMO, Chun'an County EPB
	Ambient air mitigation measures	Odor from the WWTP meets the standard limits for	(1) Shouchang WWTP needs to have a health protection distance of 100m, within which there is no residential place. (2) WWTP expansion design includes enclosure of inverted	200	Shouchang WWTP	Provincial PMO and Jiande City

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
		WWTP boundaries.	A/A/O tank with access hole for equipment maintenance and manhole, and odor pollutants are collected through pipelines for treatment in odor removal system. Sludge thickening tank is covered and odor pollutants are collected and treated in the same odor removal system. Biological odor removing method is adopted for this Project.			PMO, Jiande City EPB
	Accidental discharge of Shouchang WWTP	In the event of emergency discharge by Shouchang WWTP, a 13.3km long CODcr pollution belt and a 14.9km long NH3-N pollution belt will be generated, causing certain impacts to water quality of Shouchang River and even non-compliance to a certain scope in the downstream section.	(3) Emergency responses to unstable water amount caused by various factors shall be fully considered in the design to alleviate the unfavorable situations. (4) Establishing a WWTP operation and management responsibility system; (5) Organizing trainings for the management and technical staff and establishing technical appraisal records so that those failing the technical appraisal are not allowed to be on duty; Employing experienced professional and technical staff to be responsible for the technical management in the WWTP; Organizing domestic and abroad trainings for the technical staff; (6) Strengthening inspection of pipelines and detecting and resolving problems in a timely manner. (7) For the vulnerable equipment, multiple standby equipment and adequate spare parts should be assured on site. All key mechanical and electrical equipment should be configured in such a way that one standby is available. (8) Use high-quality equipment. All machinery, electrical appliances, instruments and other equipment selected should have good quality, low failure rate, good durability and be easy to maintain and repair. (9) During operation, the operators shall strictly follow the rules and regulations of facility operation and conduct regular inspection and timely maintenance to reduce equipment failure rate. (10) The electrical equipment should be operated in compliance with the grounding protection regulation and be equipped with automatic tripping circuit. The main equipment shall be operated under the surveillance of a computer data monitoring system and be capable of giving alarms and recording the location, time and features of accident so that the workers can organize maintenance	/	Shouchang WWTP	Provincial PMO and Jiande City PMO, Jiande City EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			promptly. All electrical equipment shall be installed with a protection system according to the relevant safety requirements. (11) Dual-circuit power supply shall be used to assure normal operation of the power supply facilities and lines.			
	Health and environment	Shouchang WWTP employees are highly exposed to sewage or sludge containing a variety of pathogens and parasites eggs in their operating environment. Mist and moisture on the wastewater treatment facilities can spread bacteria and viruses and the WWTP workers are exposed to micro-organisms in sewage and sludge and may be infected.	1. Appropriate protective clothing, gloves, respirators should be provided for the workers; antiskid shoes should be provided for transportation workers and hard-sole safety boots should be provided for all workers to prevent feet injuries. Workers around large noise equipment must be provided with noise protection devices. Workers operating at heavy lifting equipment, fork lifts, cranes and loading and unloading sites should be provided with safety helmets. Guardrails should be installed around all processing tankers and water pools. Workers operating within the guardrails are required to use lifelines and personal floating devices and it should be assured that relevant life-saving devices are available in the event of any accidents. 2. Design and material specifications allowing reduction of exposure to hazards should be designed and developed (e.g. ventilation, air-conditioning, enclosed conveyor belt, low-load and classified height, antiskid floor, staircase and corridor safety guardrails, splash protection and leakage prevention, noise control, dust prevention, gas alarm system, fire alarm and control system and emergency evacuation facilities, etc.). 3. Shower and dressing zone should be provided for workers' convenience and working clothing laundry service should be provided. Personnel working at the WWTP should be encouraged to wash hands frequently. 4. Plans for access to enclosed spaces complying with the national requirements and internationally accredited standards should be developed for any construction works implemented in the enclosed treatment areas. Ventilation before access is required and personal gas detectors should be carried. Valves leading to the processing tank should locked to prevent unexpected spillage in the process of maintenance. 5. Eating, smoking and drinking outside the designated areas are	/	Shouchang WWTP	Provincial PMO and Jiande City PMO, Jiande City EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			banned. 6. Workers should be isolated from bacterial spread channels by means of mechanical flip (e.g. using tractors or front-end loaders having a driver cabinet equipped with enclosed air-conditioning or ventilating system) or artificial flip, in which case ventilation system is preferred.			
		Exposure to sodium hypochlorite and sludge in WTP may cause physical harm.	1. Appropriate protective clothing, gloves, respirators should be provided for the workers; antiskid shoes should be provided for transportation workers and hard-sole safety boots should be provided for all workers to prevent feet injuries. Workers around large noise equipment must be provided with noise protection devices. Workers operating at heavy lifting equipment, fork lifts, cranes and loading and unloading sites should be provided with safety helmets. Guardrails should be installed around all processing tankers and water pools. Workers operating within the guardrails are required to use lifelines and personal floating devices and it should be assured that relevant life-saving devices are available in the event of any accidents. 2. Sodium hypochlorite should be stored in a cool, dry and dark condition for no longer than one month in containers made of anti-corrosion materials. 3. Plans for access to enclosed spaces complying with the national requirements and internationally accredited standards should be developed for any construction works implemented in the enclosed treatment areas. Ventilation before access is required and personal gas detectors should be carried. Valves leading to the processing tank should locked to prevent unexpected spillage in the process of maintenance. 4. Training on safety treatment specification and emergency response procedures should be provided for operators of the chlorine activities. Suitable personal protection devices should be provided and training should be organized on correct use and maintenance of equipment.	/	WTP O&M unit	Provincial PMO and Chun'an County PMO, Chun'an County EPB
	Measures for mitigating the environmental impacts of liquid fertilizer distribution and manure		(1) An internal manure and biogas slurry record system should be set up by each livestock and poultry breeding enterprise (including individual farmers, breeding farms or organic fertilizer processing	/	Liquid fertilizer distribution	Provincial PMO & County PMO,

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
	transportation		enterprises) to record the volume of production, treatment and disposal of manure and biogas slurry. (2) The manure transportation operators must set up a record management system for the transportation process and implement the transfer manifest system. (3) A collection and transportation schedule should be developed in advance to assure that the manure collection and transportation work is carried out in an orderly and efficient manner. A special transportation route must be designated for each farm in such a way that the centralized residential areas and water source protection areas are avoided to the best possibility. The operators must follow and shall not alter the designated routes without authorization. (4) Enclosed tanker trucks installed with GPS should be used to achieve online monitoring. (5) Trucks should be inspected before departure and the pumping pipes and buckets must be cleaned after manure pumping operation is over. Actions should be taken to prevent possible leakage and spillage in the transportation process. (6) The transportation process should be observed from time to time so that any spillage can be cleaned in time.			and manure transportation unit	local EPB
	Operation and management requirements of Jiande City Hangtou Wetland		1. When the wetland is completed and put into operation, Hangtou Town Government will be responsible for the operation and management of the wetland and 2 special personnel will be assigned to be responsible for daily wetland management. 2. The wetland plants will be harvested on a regular basis each year and sediments will be dredged periodically to avoid odor generated from rotten plants. 3.Effluent quality and plant growth in the wetland will be monitored on a regular basis.		/	Jiande City Hangtou Town Government	Jiande City EPB
	Water environment mitigation measures	1. WTP production and domestic wastewater is treated to the standard,	Measures for treatment of production wastewater and domestic sewage of 8 new WTPs	1. WTP should be installed with underground powered domestic sewage treatment facility. Production and domestic sewage should be treated to meet Urban Wastewater Reuse Standard for Miscellaneous Municipal Purposes (GB/T	80	WTP O&M unit	Provincial PMO and Chun'an County PMO, Chun'an County EPB

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
		producing insignificant environmental impact.		18920-2002) and reused for greening. 2. WTP production wastewater from flocculation sedimentation tank, filtration tank and thickening tank will be treated in sedimentation tank. Supernatant is reused for water production			
			Water source protection measures for the intakes of 8 new WTPs to be constructed	1. WTP Water Source Protection Zoning Drinking water protection zone has been designated for water source of existing WTPs with pipeline extension and Weiping WTP, but this has not been done for other WTPs. Drinking water protection zone should be designated in accordance with Technical Guidelines for Designating Drinking Water Source Protection Zone (HJ/T 338-2007) and based on actual condition. Eye-catching signs should be posted and requirements stipulated by applicable laws and regulations should be enforced to further strengthen control of domestic, agricultural and tourism pollution sources in surrounding area. In accordance with Technical Guidelines for Designating Drinking Water Source Protection Zone (HJ/T 338-2007), this EIA proposes the following for designating water source protection zone for the proposed WTPs: ① Yanjia Reservoir (Wangfu WTP water source) Yanjia Reservoir will be water source of Wangfu WTP, which is mountain area type medium-sized reservoir with total capacity of 21.40 million m^3. Class 1 protection zone: water area within	/	Chun'an County Government, Chun'an County EPB and project township/town	Provincial PMO and Chun'an County PMO

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			300m from the water intake and terrestrial area within 200m from waterline next to the water intake (or watershed, whichever is the nearer). Class 2 protection zone: water area outside Class 1 protection area, terrestrial area within crest line around the reservoir (outside Class 1 protection zone) and catchment area 3,000m upstream from river estuary. Water quality target is Category II. ② Yejiayuan Reservoir (Yejia WTP water source) Yejiayuan Reservoir will be water source of Yejia WTP, which is mountain area type small-sized reservoir with total capacity of 1.085 million m^3. Class 1 protection zone: water area below normal waterline and terrestrial area within 200m from waterline next to the water intake (or watershed, whichever is the nearer). Class 2 protection zone: water area outside Class 1 protection area, terrestrial area upstream from the reservoir (outside Class 1 protection zone). Water quality target is Category II. ③ Qiandaohu Reservoir (Zitong No.2 WTP water source) Zitong No.2 WTP abstracts water from Qiandaohu Reservoir, which is mountain area type large-sized reservoir. Class 1 protection zone: water area within 500m from the water intake and terrestrial area within 200m from waterline next to the water intake (or watershed, whichever			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			is the nearer). Class 2 protection zone: water area within 2000m outside Class 1 protection area, terrestrial area within 3000m outside Class 1 protection zone (or watershed, whichever is the nearer). Water quality target is Category II. ④ Zhutiankeng Reservoir (Baima WTP water source) Zhutiankeng Reservoir will be water source of Baima WTP, which is mountain area type small-sized reservoir. Class 1 protection zone: water area below normal waterline and terrestrial area within 200m from waterline next to the water intake (or watershed, whichever is the nearer). Class 2 protection zone: water area outside Class 1 protection area, terrestrial area upstream from the reservoir (outside Class 1 protection zone). Water quality target is Category II. ⑤ Wuqiangxi Stream (Xiashan WTP water source) Water source of Xiashan WTP is river section upstream Wuqiangxi Stream. New dike and water intakes will be built on two tributaries upstream from Wuqiangxi Stream. Dike 1 is located at Daxikou on east tributary of Wuqiangxi Stream, and dike 2 is located near Banshan Village along west tributary of Wuqiangxi Stream. Total catchment area is 57.7 km^2. Class 1 protection zone: water area below water level under 1-in-5 years flood from 1,000m upstream from water intake dike			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			to 100m downstream from water intake dike, and terrestrial area within 50 m of both sides outside Class 1 protection zone water area. Class 2 protection zone: water area below water level under 1-in-10 years flood from 2,000 m upstream from upper boundary of Class 1 protection zone and 200m downstream from lower boundary, and terrestrial area upstream from the water intake dike. Water quality target is Category II. ⑥ Qiuyuanxi Stream (Pingmen WTP water source) New dike for water intake of Pingmen WTP will be built Qiuyuanxi Stream upstream from Qiuyuan Village with catchment area being 30.8km^2 in total. Class 1 protection zone: water area below water level under 1-in-5 years flood from 1,000m upstream from water intake dike to 100m downstream from water intake dike, and terrestrial area within 50 m of both sides outside Class 1 protection zone water area. Class 2 protection zone: water area below water level under 1-in-10 years flood from 2,000 m upstream from upper boundary of Class 1 protection zone and 200m downstream from lower boundary, and terrestrial catchment area upstream from the water intake dike. Water quality target is Category II. ⑦ Tongshanyuan River (Fengshuling WTP water source) The planned water source for new			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			Fengshuling WTP is Tongshanxi Stream downstream from Tongshan Reservoir. Two dikes for water intake will be built upstream and downstream from Tongshan Class 1 Hydropower Station. Catchment area totals 45.1km^2. Class 1 protection zone: water area below water level under 1-in-5 years flood from 1,000m upstream from water intake dike to 100m downstream from water intake dike, and terrestrial area within 50 m of both sides outside Class 1 protection zone water area. Class 2 protection zone: water area below water level under 1-in-10 years flood from 2,000 m upstream from upper boundary of Class 1 protection zone and 200m downstream from lower boundary, and terrestrial catchment area from the water intake dike to Tongshan Reservoir. Water quality target is Category II. ⑧ Zhutiankeng Stream (Baima WTP water source) Water source of Baima WTP is Zhutiankeng Reservoir upstream from Zhutiankeng Stream and Yanglanli dike. Water source protection zoning has been done for Zhutiankeng Reservoir, and water source protection zoning for Zhutiankeng Stream is as below: Class 1 protection zone: water area below water level under 1-in-5 years flood from 1,000m upstream from water intake dike to 100m downstream from water intake dike, and terrestrial area within 50 m of both sides outside Class 1 protection zone			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			water area. Class 2 protection zone: water area below water level under 1-in-10 years flood from 2,000 m upstream from upper boundary of Class 1 protection zone and 200m downstream from lower boundary, and terrestrial catchment area upstream from the water intake dike. 2. Measures for Drinking Water Source Protection (The local government and EPB will be responsible for implementation of such measures) ①As specified in PRC Water Pollution Prevention and Control Law, Regulation on Drinking Water Source Protection Zone Pollution Control and Zhejiang Province Drinking Water Source Protection Regulation, pollution control should be done in designated water source protection zone. Enclosed management approach should be adopted for protection of Class 1 protection zone,, if possible,. ②Automatic monitoring station should be set for water intake to monitor COD_{Mn}, NH_3-N and TP. Water intake water quality monitoring plan should be enforced in accordance with Implementation Program for Centralized Drinking Water Source Water Quality Monitoring and Notice of Further Improving Water Functional Zone and Drinking Water Source Water Quality Monitoring (Zhejiang Water Affairs [2016] Document No.6). 3. Actions to be taken include water source integrated water and soil conservation, pollution source			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			management, water body eco-restoration, rural environment rehabilitation, water quality monitoring system construction, etc.			
	Solid waste mitigation measures	1. Domestic solid wastes and sludge from WWTP and WTP will be collected and transported by environmental sanitation authority, producing insignificant environmental impacts. 2. Pesticide bottles recovered from the agriculture NPS pollution control subproject will be collected at designated site and delivered for centralized disposal.	1. WTP sludge is classified as ordinary inorganic solid waste and will be collected by municipal sanitation utility for disposal. 2. Sludge of Shouchang WWTP will be hauled to Jiande City solid waste landfill for disposal. 3. A proper solid waste management account book should be prepared to standardize the records of various solid wastes. 4. The waste pesticide bottles in the project area are collected and transported by Hangzhou Lijia Environmental Service Co., Ltd. to a designated site for disposal.	10	IA, Operator	Provincial PMO and 2 county/city subproject offices, local EPB
Total:				3614.2		

LAR Impacts and Compensation Measures

Area	Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
Chun'an	Permanent	Permanent	All affected HH will receive	LAR compensation shall be made based on the local	Chun'an

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
County	land acquisition	acquisition of 39.4mu rural collectively-owned land, including 0.9mu arable land, 19.57mu forest land, 18.05mu garden land and 0.87mu land of other types and affecting 272 persons from 71 households.	cash compensation. Compensation for collective land will be shared equally by the production group. The tenant will be compensated at equivalent value as the land attachments.	comprehensive price in accordance with the Notice on "Outcomes of Updating of the Benchmark Land Prices in Chun'an County" (ChunGovCircular No. [2016]10) and the Notice on Renewal of the Local Comprehensive Price for Acquisition of Collectively-owned Land in Chun'an County". Comprehensive compensation for arable land and construction land: CNY 40000/mu for Pingmen Township, Zhongzhou Town and Wangfu Township; CNY 44000/mu for the other towns and townships; no comprehensive cost is used for forest land and unused land, which are compensated at a price of CNY 19000/mu. The comprehensive compensation shall be paid to the rural collective economic organizations and the farmers to be resettled due to land acquisition and used for production activities and livelihood restoration of farmers; compensation on ground attachments shall be paid; opportunities of training and employment shall be provided; actions shall be taken to make sure that the income of the affected persons is not reduced; pension shall be provided to land-loss farmers if the required conditions are met.		County Qiandao Lake Construction Group Co., Ltd., Chun'an County Land and Resources Bureau, town and township governments and land and resources bureau
	Temporary land occupation	Temporary occupation of 1371.69mu collectively-owned land and affecting 6413 persons from 1514 households.	All affected HH will receive cash compensation. Compensation for collective land will be shared equally by the production group. The tenant will be compensated at equivalent value as the land attachments.	Young crop compensation: CNY 1000/mu for arable land in general; upon the completion of the construction works, the project unit should be responsible for restoring the occupied land to the original standard and original scale. The comprehensive compensation shall be paid to the rural collective economic organizations and the farmers to be resettled due to land acquisition and used for production activities and livelihood restoration of farmers.		Chun'an County Qiandao Lake Construction Group Co., Ltd., Chun'an County Land and Resources Bureau, town and township governments and land and resources bureau, IAs
	Special	13 tombs,	All APs or owners shall be	The APs will get compensated at a rate of CNY 10 for per tea tree,			Chun'an

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
	facilities and ground attachments	29.81mu tea trees; 252 Carya cathayensis and 1982 osmanthus fragrans.	equally compensated.	CNY 6.5 to 338 for per Carya cathayensis and CNY 18 to 1800 per osmanthus fragrans and CNY 1800 per tomb. The special facilities shall be fully compensated at the replacement price. The affected infrastructure and ground attachments shall be compensated by the project unit to the ownership unit at the replacement price and reconstructed by the ownership unit or the project unit against the original standard and the original scale.			County Qiandao Lake Construction Group Co., Ltd., Chun'an County Land and Resources Bureau, town and township governments and land and resources bureau
	Vulnerable groups	The Project involves no vulnerable groups.					
	Women	Affected women	Affected women	(1) Create employment and livelihood opportunities for women. (2) Ensure women participation. (3) The local government and resettlement office shall ensure the female has the same rights as male in terms of land property. (4) Gender discrimination shall be eliminated to encourage women to create their own business. (5) The affected women have access to information related to land acquisition and assured participation in the land acquisition and public participation process; the compensation agreement must be signed by both the husband and wife; (6) Technical training should be provided to the affected women employees with priority; (7) In the process of project implementation, jobs in the catering and temporary jobs should be provided to affected women with priority to assure their income restoration.			Chun'an County Qiandao Lake Construction Group Co., Ltd., Chun'an County Land and Resources Bureau, town and township governments and land and resources bureau
Jiande	Permanent	Permanent	All affected HH will receive	Compensation standard: CNY 24,000/mu for forest land;			Jiande City

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
City	land acquisition	acquisition of 199mu collectively-owned forest land and affecting 196 persons from 63 households.	cash compensation. Compensation for collective land will be shared equally by the production group. The tenant will be compensated at equivalent value as the land attachments.	The comprehensive compensation shall be paid to the rural collective economic organizations and the farmers to be resettled due to land acquisition and used for production activities and livelihood restoration of farmers; compensation on ground attachments shall be paid; opportunities of training and employment shall be provided; actions shall be taken to make sure that the income of the affected persons is not reduced; pension shall be provided to land-loss farmers if the required conditions are met.			Xinshui Construction Co., Ltd., Jiande City Land and Resources Bureau, town and township governments and land and resources bureau
	Temporary land occupation	Temporary occupation of 1626.15 mu land, including 5mu state-owned land and 1621.15mu collectively-owned land and affecting 5553 persons from 1799 households.	All affected HH will receive cash compensation. Compensation for collective land will be shared equally by the production group. The tenant will be compensated at equivalent value as the land attachments.	Temporary occupation of state-owned land under the Project shall be free of land occupation compensation while the demolished ground attachments shall be compensated at the replacement price or restored by the project unit against the original standard and the original scale. Young crop compensation: CNY 1000/mu for arable land in general; upon the completion of the construction works, the project unit should be responsible for restoring the occupied land to the original standard and original scale. Temporary use of state-owned land shall be approved by the land administration authority of the respective city/county. If the temporary use of land is located in the planned urban area, a consent shall be obtained from the concerned urban planning administration authority. The land user shall enter into a contract of temporary land use with the concerned land administration authority based on the land ownership and pay the compensation for temporary land use as agreed in the contract and shall not build any permanent buildings. Upon the expiry of the temporary land use contract, the temporary land use organizations and individuals shall be responsible for restoring the land to its original state and, where such restoration is unlikely and losses are resulted, the temporary land use organizations and individuals shall take the corresponding responsibilities of economic compensation. The project construction units shall pay compensation to the land			Jiande City Xinshui Construction Co., Ltd., Jiande City Land and Resources Bureau, town and township governments and land and resources bureau

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures		EP investment (CNY'0000)	IA	Supervisory Agency
				user based on the temporary land occupation compensation policy developed by the local government and pay reclamation fee to the land owners to enable restoration of cultivation; the young crop compensation shall be paid to the land contractors.			
	Special facilities and ground attachments	Water ditches, drainage pipes, wells, scattered fruit trees, etc.; The Project involves no special facilities.	All APs or owners shall be equally compensated.	The APs will get compensated at a rate of CNY 36/m^2 for water ditches, CNY 200/m for drainage pipes and CNY 5 per well and CNY 200 per fruit tree. The affected infrastructure and ground attachments shall be compensated by the project unit to the ownership unit at the replacement price and reconstructed by the ownership unit or the project unit against the original standard and the original scale.			Jiande City Xinshui Construction Co., Ltd., Jiande City Land and Resources Bureau, town and township governments and land and resources bureau
	Vulnerable group	The Project involves no vulnerable groups.					
	Women	97 persons	Affected women	(1) Create employment and livelihood opportunities for women. (2) Ensure women participation. (3) The local government and resettlement office shall ensure the female has the same rights as male in terms of land property. (4) Gender discrimination shall be eliminated to encourage women to create their own business. (5) The affected women have access to information related to land acquisition and assured participation in the land acquisition and public participation process; the compensation agreement must be signed by both the husband and wife; (6) Technical training should be provided to the affected women employees with priority; (7) In the process of project implementation, jobs in the catering and temporary jobs should be provided to affected women with priority to assure their income restoration.			Jiande City Xinshui Construction Co., Ltd., Jiande City Land and Resources Bureau, town and township governments and land and resources bureau

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency

Dam Action Plan and Correction Measures

S/N	Name of Reservoirs	Follow-ups Actions	Correction Measures
1	Jiande City Xin'an Jiang Reservoir Dam	Xin'an Jiang Reservoir has been operated for more than 60 years. There is a strict and effective regulatory system of dam safety. At present, the fourth round of dam safety assessment has been completed, and the dam is assessed to be a normal dam (equivalent to Class I Dam of the standards of Ministry of Water Resources (MWR)). The dam is well managed and maintained. The observation data are analyzed and reported to the Hangzhou Center every year. No significant abnormalities were found during site inspection. The dam can be operated according to design. No follow-up action is needed.	N/A
2	Chun'an County Mugua Reservoir Dam	Mugua Reservoir was recently constructed with proper design standard and construction quality. According to the approval and completion acceptance of the reservoir, the dam design meets the requirement of codes and standards, and the construction quality meets the design specifications. The dam has been operated for 6 years after impoundment. No significant abnormalities were found during site inspection. The management system is implemented well and the reservoir can be operated as designed. However, some issues need to be addressed, including: the crest of the dam was eroded by frost weathering; there is no water level ruler in the reservoir; there are two through cracks at the hoist room of the dam arc gate; the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.	(1) Repair the crest of the dam which has been eroded by frost weathering. (2) Install more water level rulers in the reservoir (3) Strengthen the observations of cracks at the hoist room (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 100,000
3	Chun'an County Xinfu Reservoir Dam	The design of Xifu Reservoir rehabilitation and reinforcement met the requirements of relevant codes and standards. The construction is now in progress. The completed components look good. The management system is implemented well. No significant abnormalities were found during site inspection. After the completion of rehabilitation and reinforcement project, the reservoir can be operated as per design. However, some issues need to be addressed, including: there is no seepage monitoring facilities; the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.	(1) Build a new weir to monitor the seepage flow of the dam (2) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 500,000

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
4	Chun'an County Qianyuan Reservoir Dam		The design of Qianyuan Reservoir rehabilitation and reinforcement met the requirements of relevant codes and standards. The construction quality met the operational requirement. The reservoir has been operated for 6 years after the completion of rehabilitation and reinforcement project. No significant abnormalities were found during site inspection. The management system is implemented well. The reservoir can be operated as per design. However, some issues need to be addressed, including: too many weeds growing at the drainage prism and seepage under the prism cannot be observed; there is no seepage drain and flow measuring weir at the foot of the downstream dam; the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.	(1) Remove the weeds on the drainage prism as soon as possible, build new seepage drain and weir (2) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 50,000		
5	Chun'an County Quankeng Reservoir Dam		Quankeng Reservoir was recently constructed and has been operated for 5 years. It was found during site inspection that the reservoir is not well managed and maintained. Although it still can be operated normally, the maintenance must be enhanced as soon as possible. Some issues need to be addressed, including: there is no bridge at the non-overflow sections of the dam, which is not convenient for urgent repair work; the galvanized railings and drain pipes at the right non-overflow dam section were rusted; hoists and gates are lack of maintenance; no water level ruler in the reservoir; there is seepage at the foot of the dam and there is localized erosion of concrete structures; there are landsides at both sides of the embankment, affecting flood discharge and traffic; the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.	(1) Conduct dam safety assessment as soon as possible (2) Build a bridge at the overflow dam section (3) Install additional water level ruler and seepage monitoring facilities, replace hoist, strengthen maintenance of gate, railings and discharge steel pipe. (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 300,000		
6	Chun'an County Liaokeng Reservoir Dam		Liaokeng Reservoir was recently constructed and has been operated for 5 years. It was found during site inspection that the reservoir is not well managed and maintained. Although it still can be operated normally, the maintenance must be enhanced as soon as possible. Some issues need to be addressed, including: there is no monitoring facilities including water level ruler; there is signs of seepage at the foot of the downstream dam, but the seepage flow cannot be observed; there is crack on hoist equipment; the galvanized railings and drain pipes are rusted due to lack of maintenance; the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.	(1) Conduct dam safety assessment as soon as possible (2) Install additional water level ruler and seepage monitoring facilities, replace hoist, strengthen maintenance of gate, railings and discharge steel pipe. (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 150,000		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
7	Chun'an County Fengshuling Reservoir Dam		Fengshuiling Reservoir conducted two rounds of dam safety assessment – in 2006 and 2015, which indicates the reservoir is well managed. Both assessments concluded that the dam was a Class II dam, indicating that the dam is well constructed and there are no major problems in flood control, seepage and structural stability. The major task is to improve the daily maintenance. The reservoir has been operated for 10 years after the completion of rehabilitation and reinforcement project. Recent observations show that the deformation and seepage of the dam are normal. No significant abnormalities were found during site inspection. The reservoir can be operated as per design. Some issues need to be addressed, including: there is not enough capacity for dam safety monitoring data analysis; emergency response plan need to be further improved. Follow-up actions are required.	(1) Strengthen the capacity building of the reservoir management staff on dam safety monitoring data analysis. (2) Verify the elevation of uplift pressure piezometer tube, and analyze the causes of high uplift pressure at some points. (3) Strengthen the reservoir emergency response plan and conduct training. Time of completion: 30 Nov 2018 Cost estimation: CNY 50,000		
8	Chun'an County Tongshan Reservoir Dam		Tongshan Reservoir was assessed as Class II dam in the dam safety assessment of 2016. The issues identified in the assessment were all localized problems and most of them have been addressed. The reservoir has been operated as per design for nearly 20 year. Recent observations show that the deformation and seepage of the dam are normal. No significant abnormalities were found during site inspection. The reservoir can be operated as per design. Some issues need to be addressed, including: there is not enough capacity for dam safety monitoring data analysis; emergency response plan need to be further improved. Follow-up actions are required.	(1) Strengthen the capacity building of the reservoir management staff on dam safety monitoring data analysis. (2) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 30,000		
9	Chun'an County Xiayuan Reservoir Dam		Xiayuan Reservoir was assessed to be Class II dam in dam safety assessment. The design of rehabilitation and reinforcement met the requirements of relevant codes and standards. The construction quality met the design specifications. The reservoir has been operated for 10 years after the completion of rehabilitation and reinforcement project. The deformation and seepage of the dam are normal. It can be operated as per design. Some issues need to be addressed, including: the downstream water course in polluted by the herbicide used at downstream embankment; There is too many weeds between the first and secondary bench, which might be a sign of seepage; measurement of the monitoring weir is not accurate; there is not enough capacity for dam safety monitoring data analysis; emergency response plan need to be further improved. Follow-up actions are required.	(1) To prevent water pollution, herbicide should be avoided. It's better to use mower to remove weeds. (2) To check seepage at the place between the first and secondary bench where there are a lot of weeds growing. (3) Clear the shrubs between the seepage drain and right side of the drainage prism to improve the accuracy of the weir. (4) Analyze the reason why the levels of some piezometer tubes are as high as the reservoir water level, and to participate in data analysis training when possible.		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
				(5) Prepare a practical emergency response plan and conduct training. Time of completion: 30 Nov 2018 Cost estimation: CNY 200,000		
10		Chun'an County Linjiawu Reservoir Dam	Linjiawu Reservoir has been operated for nearly 10 years since 2007. It was assessed to be Class II dam in dam safety assessment, indicating there in no major safety hazards of the reservoir. The deformation and seepage of the dam are normal. It can be operated as per design. Some issues need to be addressed, including: there is no seepage monitoring facilities at the foot of the dam; dam maintenance should be strengthened. Follow-up actions are required.	(1) Strengthen daily maintenance, and gradually implement recommendations provided in dam safety assessment report. (2) Remove the weeds on the drainage prism and conduct seepage monitoring. Time of completion: 30 Nov 2018 Cost estimation: CNY 200,000		
11		Chun'an County Hecun Reservoir Dam	Hecun Reservoir Dam was assessed to be Class III dam in dam safety assessment. The design of rehabilitation and reinforcement met the requirements of relevant codes and standards. Although there is no construction completion acceptance report submitted for review, the reservoir has been operated for nearly 10 years, which indicating the construction quality met the operational requirement. It was found during the site investigation that the reservoir was well maintained and managed with adequate personnel. The deformation and seepage of the dam are normal. It can be operated as per design. Some issues need to be addressed, including: there are too many weeds on the embankment; whether the existing piezometer tube is workable need to be confirmed; there is seepage monitoring facilities at the foot of the dam; emergency response plan need to be further improved. Follow-up actions are required.	(1) Mow the downstream embankment timely and remove upstream weeds. (2) When possible, check whether the existing piezometer tubes are still functioning. If yes, they can be used to observe seepage pressure. (3) Build a new weir to observe the seepage flow of the dam (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2018 Cost estimation: CNY 100,000		
12		Chun'an County Chaoyang Reservoir Dam	Zhaoyang Reservoir Dam was assessed as Class III dam after several rounds of investigation of the relevant authorities and design institutes. The design of rehabilitation and reinforcement met the requirements of relevant codes and standards. Although there is no construction completion acceptance report submitted for review, the reservoir has been operated for nearly 10 years, which indicating the construction quality met the operational requirement. The reservoir is well maintained and managed with standardized protocols and procedures which were established in 2017. The deformation and seepage of the dam are normal. It can be operated as per design. It is recommended to strengthen daily maintenance and management and address the comments raised in the technical assessment report of the municipal water resource bureau in 2016. No follow-up action is	N/A		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			needed.			
13		Damaoling Reservoir Dam	The rehabilitation and reinforcement project of Damaoling Reservoir started from 2010. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The construction quality met the design specifications. The reservoir has been operated for 7 years after completion of the rehabilitation and reinforcement project. It can be operated as per design. Fuwen Township government formulated Emergency Responses Plan of Damaoling Reservoir in 2017, which met the requirement of the guidelines, but the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.	(1) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 50,000		
14		Jiangjia Town Datongkeng Reservoir Dam	The rehabilitation and reinforcement project of Datongkeng Reservoir started from 2004. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The construction quality met the design specifications. The reservoir has been operated for 13 years after completion of the rehabilitation and reinforcement project. The reservoir is maintained in good condition and operated well. There is no abnormal deformation and seepage of the dam even the reservoir is currently operated with a relatively high water level. There is a complete management system. Inspections are carried out on a regular basis. Weeds are mowed timely. Some issues need to be addressed, including: (i) hoist gate has been damaged; (ii) there are too many weeds at the downstream of the drainage prism. Seepage cannot be observed and monitored; (iii) the reservoir has been operated for 40 years but no dam safety assessment has been done. Follow-up actions are required.	(1) Conduct next dam safety assessment as soon as possible (Technical assessment). (2) Repair the screw hoist, remove the weeds at the downstream of the drainage prism and monitor the seepage. (3) Find out the reason of rusty color water follow at the reservoir outlet culvert. (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 1,000,000		
15		Juyuan Reservoir Dam	The rehabilitation and reinforcement project of Juyuan Reservoir started from 2011. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 6 years after completion of the rehabilitation and reinforcement project. It can be operated as per design. Some issues need to be addressed, including: (i) the water level ruler is corrode and cannot read; (ii) there are too many weeds on the embankment, therefore the seepage cannot be observed and monitored; (iii) Jiangjia Town government formulated Emergency Responses Plan of Juyuan Reservoir in 2017, which	(1) Change water level rulers in the reservoir (2) Remove the weeds in the seepage drain, add measuring weir to monitor seepage. (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 100,000		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			met the requirement of the guidelines, but the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.			
16	Yanjia Reservoir Dam		(1) The reservoir dam passed the safety appraisal for impounding in Dec 2005 by Nanjing Institute of Hydraulic Research. It completed impoundment acceptance in 2006. After the reservoir is put into operation, so far no dam safety assessment has been done. According to the regulation, dam safety assessment should be conducted 5 years after new reservoir is put into operation. Yanjia Reservoir has been operated for 12 years, therefore dam safety assessment should be conducted as soon as possible. (2) The steel wire of the debris barrier hoist at the water inlet of the generator is broken. (3) No pressure gauge installed to monitor uplift pressure. (4) Hangzhou Qiandao Lake Hengxin Hydropower Development Co, Ltd formulated "Emergency Responses Plan of Chun'an County Yanjia Reservoir" in Jan 2017, which met the requirement of the guidelines, but the effectiveness, predictability and maneuverability of the emergency response plan need to be further improved. Follow-up actions are required.		(1) Replace the steel wire of the debris barrier hoist at the water inlet of the generator (2) Install pressure gauge to monitor uplift pressure. (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 800,000	
17	Yanchang Hydropower Station Reservoir Dam		(1) Yanchang Reservoir has been operated for 11 years, dam safety assessment should be conducted as soon as possible. (2) The screw of the hoist offset to the right. It needs to be repaired and maintained. (3) The corner of the flip is torn, and water seal is aging, follow-up actions are needed.		(1) Conduct dam safety assessment as soon as possible (2) Strengthen maintenance of the hoist. (3) Repair the torn flip, replace the seal if necessary. (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 500,000	
18	Longtou Reservoir Dam		The dam safety assessment of Longtou Reservoir was conduct in Jan 2017. The dam was assessed to be Class I dam and can be operated as per design, which again proved the dam is well designed and constructed. The daily maintenance is sufficient to meet operational requirement. Hangzhou Qiandao Lake Hengxin Hydropower Development Co, Ltd formulated "Emergency Responses Plan of Chun'an County Longtou Reservoir" in Jan 2017, which met the requirement of the guidelines, but the effectiveness, predictability and maneuverability of the emergency response plan need to		Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 50,000	

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			be further improved.			
19	Chun'an County Hongqi Reservoir Dam		The rehabilitation and reinforcement project of Hongqi Reservoir started from 2017. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The project is still ongoing. No issues relating construction quality or management have been identified so far. No follow-up action is needed.	N/A		
20	Chun'an County Liantangwu Reservoir Dam		The rehabilitation and reinforcement project of Liantangwu Reservoir started from 2014. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 3 years after the completion of the rehabilitation and reinforcement project. It can be operated as per design. However, the width of the dam crest is only about 3m, which cannot meet the requirement of relevant codes and standards. Follow-up actions are needed.	(1) Thicken the downstream dam slope and widen the dam crest to 4m. (2) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 100,000		
21	Chun'an County Jijiawu Reservoir Dam		The rehabilitation and reinforcement project of Jijiawu Reservoir started from 2016. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 1 year after the completion of the rehabilitation and reinforcement project. It can be operated as per design. However, the width of the dam crest is only about 3m, which cannot meet the requirement of relevant codes and standards. Follow-up actions are needed.	(1) Thicken the downstream dam slope and widen the dam crest to 4m. (2) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 100,000		
22	Chun'an County Huangmengkeng Reservoir Dam		The rehabilitation and reinforcement project of Huangmengkeng Reservoir started from 2007. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 10 years after the completion of the rehabilitation and reinforcement project. It can be operated as per design. However, some issues still need to be addressed: there is no water level ruler; the stairs of downstream dam slope and the drain at dam shoulder are eroded severely by weathering; no seepage drain at the downstream dam foot; too many weeds at the downstream dam foot and seepage cannot be observed and monitored; the emergency response plan need to be further improved. Follow-up actions are needed.	(1) Construct seepage drain at the foot of downstream dam to monitor seepage. (2) Install water level ruler (3) Repair the stairs of downstream dam slope and the drain at dam shoulder. (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 150,000		
23	Chun'an County Shiyanmen Reservoir Dam		The rehabilitation and reinforcement project of Shiyanmen Reservoir started from 2006. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been	(1) Construct seepage drain at the foot of downstream dam to monitor seepage. (2) Install water level ruler		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			operated for 11 years after the completion of the rehabilitation and reinforcement project. It can be operated as per design. However, some issues still need to be addressed: there is no water level ruler; the top of the dam is used as a road for traffic for long term, the heavy loading has caused the depression in the middle of the dam crest; no seepage drain at the drainage prism and there are too many weeds there; the overflow from the stilling basin of the culvert outlet also falls to the drainage prism, which makes it hard to monitor the seepage; the emergency response plan need to be further improved. Follow-up actions are needed.	(3) Restrict heavy truck at dam crest. (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 100,000		
24	Chun'an County Jingkengyuan Reservoir Dam		Jingkengyuan Reservoir was identified as Class III dam in 2015. The design of the rehabilitation and reinforcement project, which will commence in Oct 2017, met the requirements of relevant codes and standards. After the project, the presentation of the reservoir will be significantly improved. Many issues were identified during site investigation, which will need to be addressed after the project completion. The daily maintenance and the implementation of management system need to be further strengthened. Follow-up actions are needed.	(1) Strengthen the daily inspection and maintenance before the project. (2) Strictly control the construction quality of the rehabilitation and reinforcement project (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 50,000		
25	Chun'an County Jiulong Reservoir Dam		The rehabilitation and reinforcement project of Jiulong Reservoir started from 2013. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 4 years after the completion of the rehabilitation and reinforcement project. No obvious abnormalities were identified during site investigation. The management system is implemented well. The reservoir can be operated as per design. However, some issues still need to be addressed: the precast concrete cover of the seepage drain is too heavy to lift; the emergency response plan need to be further improved. Follow-up actions are needed.	(1) Replace the seepage drain cover with light material or remove the cover. (2) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 30,000		
26	Chun'an County Hengkengwu Reservoir Dam		The rehabilitation and reinforcement project of Hengkengwu Reservoir started from 2014. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 3 years after the completion of the rehabilitation and reinforcement project. No obvious abnormalities were identified during site investigation. The management system is implemented well. The reservoir can be operated as per design. However, some issues still need to be addressed: the width of the dam crest is only about 3.5m, which cannot	(1) Strengthen the inspection for the depression of the dam crest, report to relevant authorities whenever there are any abnormalities. (2) Widen the dam crest to at least 4m. (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			meet the requirement of relevant codes and standards; the dam crest has a slight depression, the depression at the upstream side is depressed more severely; the emergency response plan need to be further improved. Follow-up actions are needed.	Cost estimation: CNY 300,000		
	27	Chun'an County Jintong Reservoir Dam	Chun'an County Water Resources and Hydropower Bureau organized the project completion acceptance of Jintong Reservoir Security Construction Project in Aug 2010. The dam can be operated safely. However, some issues still need to be addressed: there are too many weeds at the seepage drain which affects the seepage observation and monitoring; hoist gate cannot be fully closed, there is a gap between the hoist gate and discharge culvert, the leakage is severe; there is localized seepage at the overflow spillway and there are also weeds in the spillway. Follow-up actions are needed.	(1) Remove the weeds as soon as possible and observe the seepage. (2) Fix the problem of the hoist gate and seepage of the spillway. (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 600,000		
	28	Chun'an County Qingwu Reservoir Dam	Chun'an County Water Resources and Hydropower Bureau organized the project completion acceptance inspection of Qingwu Reservoir rehabilitation and reinforcement project in Aug 2012. The inspection confirmed that the dampening of the dam slop, installation of inverted siphon pipe, reconstruction of the spillway, well casing backfill and dam emergency rescue road construction have been completed. The dam can be operated safely. However, some issues still need to be addressed: the prefabricated concrete blocks in the fluctuation area of water table are severely eroded; manual diesel engine of the siphon facilities is damaged; there are two obvious cracks in the inlet section of the spillway; there is some localized weathering of the spillway retaining wall. Follow-up actions are needed.	(1) Repair the precast concrete blocks at the upstream slope, inlet section of the spillway and the spillway retaining wall. (2) Replace the manual diesel engine. (3) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 500,000		
	29	Wenchang Town Chun'an County Xihe Reservoir Dam	The rehabilitation and reinforcement project of Xihe Reservoir was completed in 2004. The dam can be operated safely. However, some issues still need to be addressed: There is no stairs at either downstream or upstream of the dam, which is not convenient for daily maintenance; outlet of the stilling tank is relatively small and low, which may get blocked frequently; there is no seepage drain at the downstream of the dam foot; emergency response plan is not comprehensive. Follow-up actions are needed.	(1) Construct stairs for both upstream and downstream side of the dam. (2) Improve the stilling tank. (3) Construct a seepage drain that at the downstream side of the dam drainage prism for seepage observation. (4) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 80,000		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
30	Chun'an County Gongkeng Reservoir Dam		The rehabilitation and reinforcement project of Gongkeng Reservoir started from 2013. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 14 years after the completion of the rehabilitation and reinforcement project. The reservoir can be operated as per design. However, some issues still need to be addressed: water level ruler is worn-out; there is no deformation and settlement observation facilities; no access road to the dam; the hoist room is old and shabby; there are no stairs at dam slopes; there is no administration building. Follow-up actions are needed.	(1) Change water level ruler; (2) Set up dam safety automation monitoring system; (3) Construct dam access road; (4) Reconstruct hoist room; (5) Construct stairs on the dam slopes; (6) Build administration building Time of completion: 30 Nov 2019 Cost estimation: CNY 900,000		
31	Chun'an County Yunxi Reservoir Dam		The design of Yunxi Reservoir Project (2015) met the requirements of relevant codes and standards. The construction quality met the requirements of design specifications. The reservoir has been operated for 9 years after project completion in 2008. The reservoir can be operated as per design. However, some issues still need to be addressed: water level ruler is worn-out; there is no administration building; there are too many weeds at the downstream side of the dam. Follow-up actions are needed.	(1) Install water level ruler. (2) Build reservoir administration building. (3) Remove the weeds on the slopes of the dam Time of completion: 30 Nov 2019 Cost estimation: CNY 500,000		
32	Chun'an County Langchuan Township Xindian Reservoir		The rehabilitation and reinforcement project of Xindian Reservoir started from 2013. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 4 years after the completion of the rehabilitation and reinforcement project. The reservoir can be operated as per design. However, the maintenance of spillway outlet and culvert outlet need to be strengthened (weeds should be removed).	(1) Strengthen daily maintenance and remove the weeds in the spillway. Time of completion: 30 Nov 2019 Cost estimation: CNY 20,000		
33	Chun'an County Langchuan Township Ruitang Reservoir		The rehabilitation and reinforcement project of Ruitang Reservoir started from 2006. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 11 years after the completion of the rehabilitation and reinforcement project. The reservoir can be operated as per design. However, some issues still need to be addressed: there is no stilling tank at the culvert outlet; there is no railing at both sides of the spillway entrance; there is no safety warning sign near the reservoir; the dam crest is not even. Follow-up actions are needed.	(1) Rehabilitate the stilling tank at the culvert outlet. (2) Install handrails at both side of the spillway entrance. (3) Place safety warning signs near the reservoir. (4) Pave the dam crest with permeable bricks Time of completion: 30 Nov 2019 Cost estimation: CNY 200,000		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
34	Chun'an County Langchuan Township Hengzhaiwu Reservoir	The rehabilitation and reinforcement project of Hengzhaiwu Reservoir started from 2006. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The reservoir has been operated for 11 years after the completion of the rehabilitation and reinforcement project. The reservoir can be operated as per design. However, some issues still need to be addressed: there are many weeds at the downstream side of the drainage prism and at the spillway outlet, there is no railing at both sides of the spillway entrance; there is no safety warning sign near the reservoir; the dam crest is not even. Follow-up actions are needed.	(1) Remove the weeks and silt. (2) Install handrails at both side of the spillway entrance. (3) Place safety warning signs near the reservoir. (4) Pave the dam crest with permeable bricks Time of completion: 30 Nov 2018 Cost estimation: CNY 200,000			
35	Chun'an County Langchuan Township Xiahengzhai Reservoir	Some issues need to be addressed: (1) there is no pavement on the dam crest road and there is no wave wall. The crest of the dam is inclined downward as a whole, the elevation difference between the two ends of the dam is about 30cm: (2) the existing dam cannot meet flood control standards; (3) The slope of the water face of the dam is steep and has a certain degree of depression. There are no slope protection measures of the upstream side of the dam. There are weeds above normal water level. There are no stairs on the dam slopes. The back face of the dam is protected with turf. However, there are obvious bumps and depressions. There is no obvious abnormal deformation or seepage on the dam surface. There is no drainage ditch on the both left and right hand of the dam where the dam is connected to the hillside. There is no stairs at the downstream dam surface, which is not convenient for daily inspection; (4) spillway entrance are constructed with dry masonry and there is potential risk of seepage. The hill slope at the right of the dam is basically stable, but the rock is fragmented. The concrete structure of weir is cracking and sagging. The spillway is in relative good condition. The bottom spillway slab and the side walls are made of concrete, but the aging of the concrete structure is also serious. (5) The pipe structure of the concrete drain pipe is poor. Although the hoists can still be used but they are all exceed their service life. (6) There is no dam safety monitoring facilities; (7) there is no inspection stairs or safety warning signs or administrative buildings.	(1) Conduct comprehensive rehabilitation and reinforcement of the dam. Rehabilitate both upstream and downstream slope with proper embankment. Backfill sleeve wells with clay. Implement curtain grouting seepage control at dam foundation. (2) Demolish the old spillway and construct a new spillway; (3) Block the water culvert and build new water culvert using tunneling method, and replace the full set of hoist equipment; (4) Build administration building (5) Install reservoir safety monitoring facilities; (6) Raise the dam crest or widen the spillway to meet flood control standards. Time of completion: 30 Nov 2019 Cost estimation: CNY 3,000,000			
36	Chun'an County Chengfengyuan Reservoir Dam	The reservoir has been operated for 12 years after the completion of the rehabilitation and reinforcement project in 2005. The reservoir can be operated as per design. However, some issues still need to be addressed: there is settlement at the dam crest; the access road is too narrow and	(1) Repair the settlement at the dam crest. (2) Improve the seepage drain at the bottom of drainage prism and observe seepage;			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			steep; the screw of hoist is bending; there is no administration building.	(3) Widening the upper dam road to 5m and install handrails on both sides to eliminate safety hazards; (4) Change hoist screw; (5) Build reservoir administration building; (6) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 450,000		
37	Chun'an County Longyao Reservoir Dam		The design of the rehabilitation and reinforcement project in 2016 met the requirements of relevant codes and standards. The construction is still in progress. The presentation of the completed project is good. The management system is implemented well with adequate staff. After the completion of the rehabilitation and reinforcement project, Longyao Reservoir can be operated as per design.	(1) It is recommended to conduct project complete acceptance inspection as soon as possible after the project completion to confirm bill of quantities of the project. Time of completion: 30 Nov 2019 Cost estimation: 0		
38	Chun'an County Tangwu Reservoir Dam		Chun'an County Water Resources and Power Bureau organized the project completion acceptance inspection of Tangwu Reservoir in 2014. Generally the reservoir is well operated. However, some issues still need to be addressed: access road of the dam is in poor condition; there is risk of landslide at the hill slope close to the hoist room; the old water diversion pipe still left at the right side of the dam.	(1) Pave the dam access road. (2) Carry out slope protection of the hill slope close to the hoist room. (3) Remove the old water diversion pipe. (4) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 400,000		
39	Chun'an County Hudetang Reservoir Dam		The reservoir has been operated for 9 years after the completion of the rehabilitation and reinforcement project in 2008. The reservoir can be operated as per design. However, some issues still need to be addressed: the width of the dam is less than 3m which cannot meet the requirements of standards; the dam access road is covered with weeds; there no water level ruler at upstream side of reservoir; there is no stairs at the downstream side of the reservoir, there is a wall constructed in the spillway.	(1) Immediately remove the wall constructed in the spillway. (2) Implement the management system and remove the weeds as soon as possible. (3) Thicken the downstream dam slope and widen the dam crest to 4m. (4) Remove the weeds on the dam access road and pave the road. (5) Install water level ruler. (6) Construct stairs at the downstream side of the dam. (7) Prepare a practical emergency response plan and conduct training		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
				Time of completion: 30 Nov 2019 Cost estimation: CNY 400,000		
40	Chun'an County Wenchao Reservoir Dam	The reservoir has been operated for 7 years after the completion of the rehabilitation and reinforcement project in 2010. The reservoir can be operated as per design. However, some issues still need to be addressed: the width of the dam is less than 3m which cannot meet the requirements of standards; the dam access road is not paved; there is no water level ruler; there are weeds at the upstream side of the dam.	(1) Thicken the downstream dam slope and widen the dam crest to 4m. (2) Pave the dam access road. (3) Install water level ruler. (4) Remove the weeds at the upstream side of the dam and weeds in the seepage drain. (5) Prepare a practical emergency response plan and conduct training Time of completion: 30 Nov 2019 Cost estimation: CNY 350,000			
41	Chun'an County Yejiayuan Reservoir Dam	The reservoir has been operated for 27 years after the completion of the rehabilitation and reinforcement project in 1990. However, some issues still need to be addressed: There are weeds at both dam shoulders and at the back slope of the dam; there is no bridge at the overflow section of the dam; there is no administration building, emergency response plan needs to be further improved.	(1) Build bridge at the overflow section of the dam. (2) Build administration building. (3) Remove the weeds at the dam shoulders and at the back slope of the dam as soon as possible. (4) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 1,000,000			
42	Chun'an County Hefu Reservoir Dam	Chun'an County Water Resource Bureau organized project completion acceptance inspection of the rehabilitation and reinforcement of the reservoir in 2013. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The construction quality met the requirements of design specifications. The reservoir has been operated for 6 year after the completion of the project. It can be operated as per design. However, some issues still need to be addressed: emergency response plan needs to be further improved; there is no administration building. Follow-up actions are needed.	(1) Build a reservoir administration building. (2) Improve emergency response plan for flood control. Time of completion: 30 Nov 2019 Cost estimation: CNY 500,000			
43	Chun'an County Shaozhai Reservoir Dam	The reservoir has been operated for 12 years after the completion of the rehabilitation and reinforcement project in 2005. However, some issues still need to be addressed: there is no seepage drain behind the drainage prism;	(1) Construct seepage drain behind the drainage prism for seepage observation. (2) Construct the dam access road as			

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			there is sign of seepage of the dam; the dam access road is too narrow and some road sections are collapsed; there is no administration building, emergency response plan needs to be further improved.	soon as possible. (3) Curtain grout to the dam. (4) Build a reservoir administration building. (5) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 1,300,000		
44	Chun'an County Shaokengwu Reservoir Dam		The reservoir has been operated for 17 years after the completion of the rehabilitation and reinforcement project in 2000. However, some issues still need to be addressed: the flood control system of the dam cannot meet the requirements of relevant standards; there are no slope protection measures of the dam; the permeability coefficient of the seepage control of the dam is relatively high; the saturation line of the dam body is relatively high; there is seepage points at the left dam foot and on the left dam slope; there is a layer of medium-permeability briquette-silty clay in the dam foundation of the river bed section; there is no cut-off trench at the dam shoulders; strong weathered bedrock are present at the left and right shoulders of the dam which are of medium-permeability; there are seepage and by-pass seepage at dam foundation, therefore the dam seepage control system does not meet the current requirement of seepage control; the concrete of bottom and the side wall of the spillway is aged seriously; there is no lining of the slab of the spillway, the surface is uneven; there is no energy dissipation measures; downstream flood discharge canal is not compatible with the upstream design; there is no seepage monitoring facilities; there is no drainage at the dam access road; several road sections are too steep; many sections of the road are damaged and cannot meet the requirement of emergency access road.	(1) Curtain grout to the dam. (2) Reinforce the spillway. (3) Build a reservoir administration building. Construct seepage drain behind the drainage prism. Construct measuring weir to monitor seepage of the dam. (4) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 3,500,000		
45	Chun'an County Daoren Reservoir Dam		Chun'an County Water Resource Bureau organized project completion acceptance inspection of the rehabilitation and reinforcement of the reservoir in 2013. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The construction quality met the requirements of design specifications. The reservoir has been operated for 6 year after the completion of the project. It can be operated as per design. However, some issues still need to be addressed: there is no administration building; there is no seepage drain behind the	(1) Construct seepage drain and measuring weir for seepage monitoring. (2) Build reservoir administration building. (3) Improve emergency response plan for flood control Time of completion: 30 Nov 2019 Cost estimation: CNY 500,000		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			drainage prism; emergency response plan needs to be further improved; Follow-up actions are needed.			
	46	Chun'an County Songkeng Reservoir Dam	Chun'an County Water Resource Bureau organized project completion acceptance inspection of the rehabilitation and reinforcement of the reservoir in 2015. The design of the rehabilitation and reinforcement project met the requirements of relevant codes and standards. The construction quality met the requirements of design specifications. The reservoir has been operated for 4 year after the completion of the project. It can be operated as per design. However, some issues still need to be addressed: the width of the dam is less than 3m which cannot meet the requirements of standards; there are weeds at the dam crest, dam slopes, spillway outlet and drainage prism; water level sensor is damaged. Follow-up actions are needed.	(1) Removed the weeds at the dam crest, dam slopes, and spillway outlet and drainage prism. (2) Repair the water level sensor as soon as possible. (3) Thicken the downstream dam slope and widen the dam crest to 4m. Time of completion: 30 Nov 2019 Cost estimation: CNY 1,400,000		
	47	Sanzhawu Reservoir	Jiande Municipal Water Resource Bureau planned to implement the rehabilitation and reinforcement of the reservoir in 2019.	(1) Carry out reinforcement of the dam according to the dam safety assessment (2) Carry out hilly pond reclamation according to standard practices (3) Improve emergency response plan for flood control Time of completion: By end of 2021 for Item (1) Cost estimation: CNY 19,700,000		
	48	Yakeng Reservoir	Jiande Municipal Water Resource Bureau commenced the rehabilitation and reinforcement of the reservoir in 2017.	(1) Carry out reinforcement of the dam according to the dam safety assessment (2) Carry out hilly pond reclamation according to standard practices (3) Improve emergency response plan for flood control Time of completion: By end of 2019 for Item (1) Cost estimation: CNY 18,300,000		
	49	Hongtang Reservoir	Hongtang Reservoir was assessed as Class I Dam. The quality of the reservoir is generally good and there is no need for reinforcement. Jiande Municipal Water Resource Bureau commenced the standardized maintenance program of the reservoir in 2017. No follow-up action is	(1) Improve emergency response plan for flood control Time of completion: Feb 2018 Cost estimation: CNY 20,000		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
			needed.			
	50	Wutang Reservoir	The reservoir has been operated for 7 years after the completion of the rehabilitation and reinforcement project in 2009. Jiande Municipal Water Resource Bureau began to establish the standardized management of Wutang Reservoir in June 2017. The reservoir is maintained in good condition. No follow-up action is needed.	(1) Improve emergency response plan for flood control Time of completion: Feb 2018 Cost estimation: CNY 20,000		
	51	Bailingkeng Reservoir	The rehabilitation and reinforcement project of the reservoir commenced in 2015. The standardized management of Bailingkeng Reservoir was established in 2017. The reservoir is maintained in good condition. No follow-up action is needed.	(1) Improve emergency response plan for flood control Time of completion: Feb 2018 Cost estimation: CNY 20,000		
	52	Houlongtang Reservoir	Houlongtang Reservoir was assessed as Class III Dam by the dam safety assessment in Dec 2012. It has not been reinforced. So far no follow-up action is needed.	(1) Carry out reinforcement of the dam according to the dam safety assessment (2) Carry out hilly pond reclamation according to standard practices (3) Improve emergency response plan for flood control Time of completion: By end of 2022 for Item (1) Cost estimation: CNY 1,770,000		
	53	Dawo Reservoir	The rehabilitation and reinforcement project of the reservoir was implemented in 2009 and there is no updated safety assessment after the project. Jiande Municipal Water Resource Bureau began to establish the standardized management of Dawo Reservoir in June 2017. The reservoir is maintained in good condition. No follow-up action is needed.	(1) Improve emergency response plan for flood control Time of completion: Feb 2018 Cost estimation: CNY 20,000		
	54	Pangangshan Reservoir	The rehabilitation and reinforcement project of the reservoir was implemented in 2013. Jiande Municipal Water Resource Bureau began to establish the standardized management of Dawo Reservoir in June 2017. The reservoir is maintained in good condition. No follow-up action is needed.	(1) Improve emergency response plan for flood control Time of completion: Feb 2018 Cost estimation: CNY 20,000		
	55	Yangwu Reservoir	The reservoir has been operated for 7 years after the completion of the rehabilitation and reinforcement project in 2009. The reservoir is generally maintained in good condition. There are some follow-up actions.	(1) Carry out hilly pond reclamation according to standard practices (2) Improve emergency response plan for flood control		

Table 4-2: Key Environmental Impacts and Mitigation Measures

Stage	Environmental factor	Potential impact	Mitigation measures	EP investment (CNY'0000)	IA	Supervisory Agency
				Time of completion: By end of 2019 for reinforcement of the reservoir Cost estimation: CNY 440,000		
	56	Pingtang Reservoir	The reservoir has been operated for 2 years after the completion of the rehabilitation and reinforcement project in 2015. The reservoir is generally maintained in good condition. There are some follow-up actions.	(1) Carry out hilly pond reclamation according to standard practices (2) Improve emergency response plan for flood control Time of completion: By end of 2019 for reinforcement of the reservoir Cost estimation: CNY 250,000		
	57	Watang Reservoir	The reservoir has been operated for 9 years after the completion of the rehabilitation and reinforcement project in 2007. The reservoir is generally maintained in good condition. There are some follow-up actions.	(1) Carry out hilly pond reclamation according to standard practices (2) Improve emergency response plan for flood control Time of completion: By end of 2019 for reinforcement of the reservoir Cost estimation: CNY 440,000		

5. Environmental Monitoring Plan

5.1 Objectives of Environmental Monitoring

Environmental monitoring covers the construction stage and the operation stage of the Project and aims to acquire full and timely information on the pollution conditions of the proposed project, the degree of changes made and scope of impacts brought by the project construction to and on the environment quality of the project area as well as the status of environmental quality in the operation stage so as to give timely feedbacks to the competent authority and provide a scientific basis for the environment management work of the Project.

5.2 Environment Monitoring Agency

Environmental monitoring in the construction stage and the operation stage is undertaken by a qualified monitoring agency entrusted by and on behalf of the project contractor or operator. The undertaking agency should be certified in the national environmental quality certification program, have complete equipment and strong technical competence and are able to carry out the respective environmental monitoring task in a satisfactory manner.

Sensitive and concerned spots that probably involve significant pollution as shown in the prediction results of environment impacts are chosen as the monitoring spots to follow up with the pollution status of the monitored items in the construction stage and the operation stage. Noise, ambient air and surface water that involve significant environmental impacts are chosen as the monitoring contents. The monitoring factors are determined based on the pollution characteristic factors of the Project. The monitoring and analysis method for the respective items specified in the Technical Specifications on Environmental Monitoring promulgated by MoEP is chosen and the national standards confirmed in the EIA of each subproject are adopted as the assessment standard.

5.3 Environmental Monitoring Plan and Budget

The environmental monitoring plan and budget for the construction stage and operation stage of the Project is shown in Table 5-1 in detail. The requirements of the monitoring plan of the linked projects are shown in Table 5-2.

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
Chun'an County Rural Drinking Water Safety Improvement	Construction stage	Monitoring contents include status of land disturbance, borrow fill (stone, material), spoil (stone, slag), soil erosion, and water and soil conservation measures.	Positioning and monitoring frequency: once a month in the months of April to October; once every 3 months in the other months; 1 additional monitoring in case of a daily rainfall greater than 50mm. Monitoring frequency of surveys and inspections: Status of temporary stockpiling sites in use and implementation of water and soil conservation measures in effect is usually monitored and recorded once every 10 days during the construction period; Area of land disturbance and retaining effectiveness of water and soil conservation engineering measures should be monitored and recorded at least once a month; progress of the main works construction, soil erosion factors, plant growth of water and soil conservation measures during the construction stage should be monitored and recorded once a quarter. In case of heavy rain, strong wind and other conditions, additional monitoring should be conducted. Engineering	Totally 6 monitoring sites during the construction stage; 3 monitoring sites each for the cross-village centralized water supply project and the existing WTP pipeline extension project, respectively being sedimentation tank at Wangfu WTP, pipeline excavation section for Wangfu WTP water supply pipeline construction project, pipeline excavation section for Zitong Town, pipeline excavation section for Langchuan	soil erosion, etc.	58	Water and soil conservation monitoring agency	Chun'an County WRB	Chun'an County EPB

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
			design, management and responsibility system of water and soil conservation measures should be monitored from time to time.	Township, pipeline excavation section for Fenkou Town and pipeline extension project for Jieshou Township.					
		Noise	Once a month monitoring, once a day; 1 time in day and 1 time at night in case of night construction	Wangjia Village close to Xiashan WTP	L_{Aeq}	0.8	Qualified monitoring agency		
		Air	1 time/year; 3 days/time in the peak construction stage	Wangjia Village close to Xiashan WTP	TSP	1.2			
	Operation stage	Noise	1 time/year, 1 day/time, 1 time in day and 1 time in night, until project account closure.	Noise monitoring sites on the boundary of the 8 new and expanded WTPs	$L_{A}eq$	1.68	Qualified monitoring agency	WTPs	Chun'an County EPB
		Surface water	1 time/month, 2 day/time, once in morning and once in afternoon per day, until project account closure.	Each water intake and water source of the 8 new WTPs, including	Color, odor, turbidity, visible matters, pH, total hardness (calculated as CaCO3),	168.0			

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
				Tongshan River, Guanchuan Power Station, No. 3 open diversion ditch, Yanjia Reservoir, Xin'anjiang Reservoir, Wuqiangxi Stream (Huixi Stream) and Qiuyuanxi Stream, etc.	chloride, sulfate, total dissolved solids, nitrate, nitrite, ammonia nitrogen, total phosphorus, total nitrogen, volatile phenol, anionic surfactant, COD, fluoride, arsenic, iron, manganese, copper, zinc, cadmium, lead, chromium, mercury, total bacteria, total coliforms.				

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
Chun'an County Dike Reinforcement and River Rehabilitation	Construction stage	Monitoring contents include status of land disturbance, borrow fill (stone, material), spoil (stone, slag), soil erosion, and water and soil conservation measures.	Positioning and monitoring frequency: once a month in the months of April to October; once every 3 months in the other months; 1 additional monitoring in case of a daily rainfall greater than 50mm. Monitoring frequency of surveys and inspections: Status of temporary stockpiling sites in use and implementation of water and soil conservation measures in effect is usually monitored and recorded once every 10 days during the construction period; Area of land disturbance and retaining effectiveness of water and soil conservation engineering measures should be monitored and recorded at least once a month; progress of the main works construction, soil erosion factors, plant growth of water and soil conservation measures during the construction stage should be monitored and recorded once a quarter. In case of heavy rain, strong wind and other conditions, additional monitoring should be conducted. Engineering design, management and responsibility system of water and soil conservation measures should be monitored from time to time.	32 fixed monitoring sites for dike reinforcement works, 28 fixed monitoring sites for river rehabilitation based on the project characteristics and site survey; totally 60 fixed monitoring sites for the Project as a whole	soil erosion, etc.	40.1	Water and soil conservation monitoring agency	Chun'an County WRB	Chun'an County EPB

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
		Production wastewater	1 monitoring every 2 days in the peak time of the construction stage	Dike at Zuochuan Village, Zhongzhou Town on Wuqiangxi Stream; dike at Fulin Village, Jiangjia Town on Yuchuanxi Stream, Dike at Dongyuan Village, Weiping Town on Liuduyuan Stream, dike at Huangjiayuan Village, on Shangwuxi Stream and other construction wastewater discharge outlets	pH, SS, COD, NH3-N	2.0	Qualified monitoring agency	Contractor	

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
Chun'an County Small Watershedr Rehabilitation	Construction stage	Monitoring contents include status of land disturbance, borrow fill (stone, material), spoil (stone, slag), soil erosion, and water and soil conservation measures.	Positioning and monitoring frequency: once a month in the months of April to October; once every 3 months in the other months; 1 additional monitoring in case of a daily rainfall greater than 50mm. Monitoring frequency of surveys and inspections: Status of temporary stockpiling sites in use and implementation of water and soil conservation measures in effect is usually monitored and recorded once every 10 days during the construction period; Area of land disturbance and retaining effectiveness of water and soil conservation engineering measures should be monitored and recorded at least once a month; progress of the main works construction, soil erosion factors, plant growth of water and soil conservation measures during the construction stage should be monitored and recorded once a quarter. In case of heavy rain, strong wind and other conditions, additional monitoring should be conducted. Engineering design, management and responsibility system of water and soil conservation measures should be monitored from time to time.	6 ground observation sites to be located at the dike works, the river rehabilitation works, the ecological water landscape layout site, the construction site, the waste disposal site and the top soil stockpiling site, respectively being the construction sites at Changgeng Village of Zhongzhou Town and Sixia Village of Fenkou Town; the top soil stockpiling site at Shuangxikou Village, Miaoling Village for ecological water landscape layout, waste disposal site at Yejia Village and Changning Village of Zitong Town.	soil erosion, etc.	69.4	Water and soil conservation monitoring agency	Chun'an County WRB	Chun'an County EPB

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
		Production wastewater	1 monitoring every 2 days in the peak time of the construction stage	Qiduyuan Dike, Jinxianxi Dike and other construction wastewater discharge outlets	pH, SS, COD, NH3-N	1.0	Qualified monitoring agency	Contractor	

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
Jiande City Water Conservancy Facility Subproject	Construction stage	Monitoring contents include status of land disturbance, borrow fill (stone, material), spoil (stone, slag), soil erosion, and water and soil conservation measures.	Positioning and monitoring frequency: once a month in the months of April to October; once every 3 months in the other months; 1 additional monitoring in case of a daily rainfall greater than 50mm. Monitoring frequency of surveys and inspections: Status of temporary stockpiling sites in use and implementation of water and soil conservation measures in effect is usually monitored and recorded once every 10 days during the construction period; Area of land disturbance and retaining effectiveness of water and soil conservation engineering measures should be monitored and recorded at least once a month; progress of the main works construction, soil erosion factors, plant growth of water and soil conservation measures during the construction stage should be monitored and recorded once a quarter. In case of heavy rain, strong wind and other conditions, additional monitoring should be conducted. Engineering design, management and responsibility system of water and soil conservation measures should be monitored from time to time.	5 ground observation sites to be located at the dike works, the construction site, the waste disposal site and the top soil stockpiling site.	soil erosion, etc.	49.3	Water and soil conservation monitoring agency	Jiande City WRB	Jiande City EPB

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
		Production wastewater	1 monitoring every 2 days in the peak time of the construction stage	Wulongxi Stream Dajian Bridge, Shouchang River Wutan Section Wutan Old Bridge, Datongxi Stream Wenjiayan Dam, Zhenyuanxi Stream and Songxi Stream No. 2 cofferdam, Qingtanxi Stream Panshan No. 1 cofferdam and other construction wastewater discharge outlets	pH, SS, COD, NH3-N	2.0	Qualified monitoring agency	Contractor	

Table 5-1 Project Environmental Monitoring Plan and Cost Estimate

Subproject	Stage	Monitoring content	Monitoring time and frequency	Monitoring site	Monitoring item	Cost estimate (CNY10000)	IA	Responsible agency	Supervision agency
Jiande City Municipal Engineering Facilities Subproject	Operation stage	Water purification effect of Hangtou Composite Wetland Subproject	1 time/month, 2 day/time, once in morning and once in afternoon per day, until project account closure.	1 monitoring cross sections at the wetland inlet and outlet	pH, COD, NH3-N, TP	12.0	Qualified monitoring agency	Jiande City Xinshui Co., Ltd.	Jiande City EPB
		Surface water	4 period/year，2 day/period，1 times/day， until project account closure.	500m upstream and downstream of pollutant discharge outlet of Shouchang WWTP	COD, BOD_5, SS, petroleum, NH3-N, TP	4.0		Shouchang WWTP	
		Air	4 period/year，1 day/period，4 times/day， until project account closure.	4 boundaries of Shouchang WWTP	H_2S, NH_3, odor concentration	10.56			
		Wastewater	1 time/month, 1 day/time, once in morning and once in afternoon per day.	2 monitoring cross sections at the intake and outlet of Shouchang WWTP	pH,COD,BOD_5, SS, petroleum, NH3-N, TP	14.4			
		Noise	4period/year，2 day/period，2 times/day (Once each in day and night), until project account closure.	4 boundaries of Shouchang WWTP	$L_A$eq	1.92			
Total:						436.36			

Table 5-2: Environment Monitoring Plan of Linked Projects

Linked project	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client	Standard in force
Hangzhou Lijia Environmental Service Co., Ltd.	Exhaust gas	Smoke dust, hydrogen chloride, hydrogen fluoride, mercury, dioxin	Discharge outlet of incinerator	2 periods/year	Qualified monitoring agency	Project owner	"Pollution control standards for incineration of hazardous wastes" (GB18484-2001)
	Wastewater	PH, COD, BOD5, ammonia nitrogen, suspended matter, mercury, chromium	Discharge outlet of WWTP	2 periods/year	Qualified monitoring agency		Class I standard specified in Integrated Wastewater Discharge Standard (GB8987-1996)
	Boundary noise	dB(A)	Noise at 4 boundaries	2 periods/year	Qualified monitoring agency		Class 2 standard specified in the “Environmental noise emission standard on the boundaries of industrial enterprises” (GB12348-2008)
Jiande City Domestic Waste Landfill	Exhaust gas	Total suspended particulate matter, hydrogen sulfide, ammonia, odor concentration	Upwind and downwind of Jiande City Domestic Waste Landfill	2 periods/year	Qualified monitoring agency	Project owner	Class II standard specified in the “Odor Pollutant Discharge Standard” (GB14554-1993)
	Wastewater	PH value, chromaticity, chemical oxygen	Effluent discharge of leachate treatment station	2 periods/year	Qualified monitoring agency		Class 2 standard specified in the “Pollution Control Standard for Domestic Solid Wastes Landfills”

Table 5-2: Environment Monitoring Plan of Linked Projects

Linked project	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client	Standard in force
		demand, five day biochemical oxygen demand, suspended matter, ammonia nitrogen, total phosphorus, total nitrogen, fecal coliform bacteria, total mercury, total cadmium, total chromium, hexavalent chrome, total arsenic, total lead					(GB16889-2008)
	Boundary noise	dB(A)	Eastern, southern, western and northern boundaries of Jiande City Domestic Waste Landfill	2 periods/year	Qualified monitoring agency		Class 2 standard specified in the “Environmental noise emission standard on the boundaries of industrial enterprises” (GB12348-2008)
	Ground water	PH value, total	Upstream and	2 periods/year	Qualified monitoring		Class III standard specified in the

Table 5-2: Environment Monitoring Plan of Linked Projects

Linked project	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client	Standard in force
		hardness, permanganate index, ammonia nitrogen, nitrate, nitrite, sulfate, chloride, volatile phenol, cyanide, fluoride, arsenic, mercury, six valence chromium, copper, zinc, lead, cadmium, iron, manganese, total coliform group	downstream groundwater monitoring wells		agency		“Ground Water Quality Standard” (GB14848-2017)
Linqi Town WTP, Pingshan WTP, Jieshou WTP, Langchuan Township WTP, Fenkou Town WTP, Qiaobei WTP, Jiangjia Town WTP, Qiandao Lake	Surface water	Color, odor, turbidity, visible matters, pH, total hardness (calculated as CaCO3), chloride, sulfate, total dissolved solids, nitrate, nitrite, ammonia nitrogen, total phosphorus,	Water intakes of each WTP	1 time/month	Qualified monitoring agency	Project owner	Class III standard specified in the “Surface Water Quality Standard”(GB3838-2002)

Table 5-2: Environment Monitoring Plan of Linked Projects

Linked project	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client	Standard in force
WTP, totally 8 WTPs		total nitrogen, volatile phenol, anionic surfactant, COD, fluoride, arsenic, iron, manganese, copper, zinc, cadmium, lead, chromium, mercury, total bacteria, total coliforms.					
	Noise at site boundary	dB(A)	4 boundaries of WTPs	2 periods/year	Qualified monitoring agency		Class 2 standard specified in the "Environmental noise emission standard on the boundaries of industrial enterprises" (GB12348-2008)
Note: By compared with the WBG EHS Guidelines, the more stringent National Standards will be applied to the monitoring of linked projects for compliance. The monitoring plan required in the EIA of the linked projects should be incorporated into this ESMP to confirm that they will continue to comply with relevant requirements, and the associated cost will be covered by the daily operational cost of these linked projects.							

6. Capacity building and Training

6.1 Training objectives

In order to assure smooth and effective implementation of the environment management work, it is necessary to provide environment management training to enable the relevant staff to get familiar with the contents and procedures of environment management and promote their environment management competence to assure effective implementation of the various environmental protection measures. The key objects of environmental capacity building are the environment managers and construction supervision engineers, training for whom is one of the key component of technical supports under the Project. In addition, training for the construction contractor and the construction workers is also needed in the implementation process of the Project. Before the commencement of the construction works, all the IAs, management units and contractors must attend environment, health and safety training.

6.2 Personnel arrangement and proposed trainees

The Provincial PMO and the 2 county/city subproject management offices should assign special personnel to be responsible for execution of the EMP, who should have the knowledge of environmental protection and be familiar with laws and regulations on environmental protection, the safeguard policies of the World Bank and the Environment Management Plan.

The proposed trainees to take part in the environment management training in the construction stage include personnel from the Provincial PMO, the 2 county/city subproject management offices, the subproject IA, the supervision engineer, representatives of the environment monitoring agency, the engineering technology supervisor and full-time managers of the contractor.

The proposed trainees to take part in the environment management training in the operation stage mainly include the operational management personnel of each subproject.

6.3 Training Contents

Environment management training in the construction stage includes the following contents:

1. Laws and regulations, documents and requirements of the national government and Zhejiang Province on environmental protection and water and soil conservation in the management of construction projects;
2. World Bank requirements on environment management for construction projects; the environment management model of the World Bank and environment-related articles in the loan covenants of the World Bank;
3. Environmental protection measures proposed in the project design and

the environmental protection requirements for the construction stage;

4. Environmental protection guidelines for the construction stage of the Project;

5. Training about the Environmental Management Plan (ESMP) of the Project provided by the PMO to the contractors and supervision companies prior to the commencement of the Project;

6. Responsibilities and their correlation for the environment management personnel, the supervision engineer and the contractor;

7. Preparation of the Environment Management Work Report, the Supervision Work Report, the Environment Monitoring Report and the contractor's monthly reports;

8. Training on NPS pollution.

Chief environmental protection designers of the EPB, the design institute, and experts from the EIA consultant and supervision and control agency and environmental specialist of the World Bank may be invited as the trainers for such training workshops.

Environment management training for the operation stage includes the following contents:

1. Laws and regulations, documents and requirements of the national government and Zhejiang Province on environmental protection in the management of construction projects;

2. Requirements on final acceptance of environmental protection and the "three simultaneousness management" for construction projects;

3. Operational management of WWTPs, WTPs, pump stations, pipeline networks, artificial wetland, forest form maintenance;

4. Operational management of relevant environmental protection measures in the operation stage.

Environmental protection specialists from universities, research institutes and operation and management units may be invited to give lectures or attend the short-term training workshops.

6.4 Personnel training plan

Fund needed for the training on the EMP in the construction stage will be included into the project budget while the fund for training in the operation stage will be included into the operation and maintenance cost. See Table 6.4-1 for the Schedule of Capacity building and Training.

Table 6.4-1 Schedule of Capacity building and Training

Training topic	Trainees	Training contents	No. of training sessions	No. of days per session	No. of persons per session	Budget (CNY10000)
Construction stage						
EP laws and policies	County/city PMO, project owner, construction contractor, monitoring agency, supervision agency	I. Laws and regulations on environmental protection	1	1	3	14
		II. Environmental policies and plans	1	1	3	
		Ⅲ. World Bank environment management	1	1	3	
EMP of construction stage	Construction contractor Project owner[1]	I. Responsibilities of environmental protection in the construction stage of a project	1	0.5	4	14
		II. Key assignments of environmental protection in the construction stage of a project	1	0.5	4	
		Ⅲ. Key contents of environmental protection in the construction stage of a project	3	0.5	4	
		Ⅳ. EMP (including ECOP)	2	0.5	4	
		Ⅴ. Improvements or amendments to EMP	1	0.5	4	
		Ⅵ Internal monitoring methods; data collection and treatment, etc.	1	0.5	4	
Subtotal for the construction stage						28
Operation stage						
Environment monitoring and inspection, reporting	Project owner	EP facilities, ecological restoration, environmental quality monitoring, report preparation	2	1	2	14
EP facilities and measures	Project owner	Ⅰ. Rules and regulations and specifications on environmental safety	2	1	2	14
Control of NPS pollution	Project owner, county agriculture authority, project area farmer representatives	Training on use of low toxicity and harmless pesticides and integrated management of agricultural pests	2	1	A few	4.8
Subtotal for the operation stage						32.8
Total						60.8

Note 1: The PMO shall provide a training to the construction contractors on the general requirements of ESMP before mobilization and the contractors shall develop their own Site Environment Management Plans based on the ESMP and organize internal staff training respectively.

7. Reporting mechanism

7.1 Information exchange

Environment management requires necessary exchange of information among the PMO, the Project Owner, and the Contractor, the Operator and the different departments and jobs in the organization and also requires disclosure of relevant information to the external parties (stakeholders, general public, etc.).

Internal information exchange may be implemented in diversified forms, such as meetings, internal briefings, but at least 1 formal meeting must be organized each month. All information exchange should be recorded and archived. External information exchange is implemented on a half-year or one-year basis. For information exchange with the cooperative units, meeting minutes shall be developed and put into archives.

7.2 Record mechanism

In order to assure the effective operation of the environment management system, the organization must set up a sound record system and keep records in the following aspects:

（1） Laws and regulations;

（2） Government permits;

（3） Environmental factors and the relevant EIA documents and EMP reports;

（4） Training records;

（5） Records of inspections, calibrations and maintenance activities;

（6） Monitoring data;

（7） Effectiveness of corrective and preventive measures;

（8） Information of stakeholders; grievance redress procedure and records of results;

In addition, the aforesaid records shall be subject to necessary control, including identification, collection, cataloging, archiving, storage, management, maintenance, inquiry, retention life and disposal of records.

7.3 Reporting mechanism

The Contractor, the Operator, the Monitoring Agency, the construction supervision engineer and the PMO shall keep records of project progress, EMP execution status, environmental monitoring results throughout the implementation of the Project and report in a timely manner to the concerned departments. Monitoring records of the operation status of the solid waste landfills, hazardous waste accepting unit and WTPs involved in the linked projects and the due diligence study shall also be acquired and collected on a

periodical basis. The relevant requirements shall be incorporated into the monitoring plan, which mainly consist of the six aspects as follows:

（1） The construction supervision engineer of the Project shall keep detailed records of the execution status of the EMP on a monthly basis and submit the monthly report to the Project Owner and the PMO in a timely manner. The monthly reports should include information on the execution status of the environmental protection measures, and the progress and data of environmental monitoring.

（2） The Contractor and Operator shall keep detailed records of the progress of the Project and the execution status of the EMP on a monthly basis and submit a half-year report to the PMO, with a copy to the local EPB. Such requirement shall be explicitly specified in the Contractor's contract documents.

（3） The Monitoring Agency shall submit the monitoring report to the Contractor (Operator) and the construction supervision engineer in a timely manner after the monitoring assignment is carried out.

（4） The Contractor and the Operator shall submit the Environmental Monitoring Report of the Project to the local EPB and PMO in a timely manner. The PMO shall submit the monthly report, the quarterly report and the yearly report on the progress and effectiveness of the execution of the EMP of the Project to the local EPB and the relevant organizations and, when necessary, to the World Bank.

（5） In the event of any specific non-compliances in terms of environmental protection, the construction supervision engineer and the PMO shall submit a report to the local competent authority of environmental protection and to the superior levels if necessary.

（6） 2 EMP Execution Reports should be submitted each year to the World Bank. The EMP Execution Report may include the following contents:

a. Project implementation progress, e.g. construction progress and length of sections completed in the dike construction works, the river rehabilitation works, the pavement works and the pipeline works;

b. Execution status of the environmental protection measures of the Project;

c. Implementation status and key results of environmental monitoring;

d. Implementation status of the training program;

e. Information of continuous public participation; public complaints and the records of key contents, solution and public satisfaction of such complaints, if any;

f. Existing problems and solutions;

g. EMP Execution Plan for the second half of the year.

8. Grievance Redress Mechanism

The grievance redress mechanism of the Project covers all stages of implementation of the Project, including resettlement, resident disturbance in the construction stage and supervision of the operation stage.

Stage 1: If not satisfied with the resettlement plan, the APs can express their complaints to the “Xin’an River – Qiandao Lake Comprehensive Environment Improvement Project Villager Support Team”, which shall respond to the complaints within 2 weeks;

Stage 2: If the APs are still not satisfied with the responses, an appeal can be filed to the Village Committee or the Project Resettlement IA in oral or written form; if it is an oral appeal, the Village Committee or the Project Resettlement IA shall make a resolution and keep a written record within 2 weeks.

Stage 3: If the APs are still not satisfied with the resolutions made in Stage 2, an appeal can be filed to the World Bank PMO/management agency after such resolution is received and the World Bank PMO / management agency shall make a further resolution within 2 weeks.

Stage 4: If the APs are still not satisfied with the resolutions made in Stage 3, an appeal can be filed to the government department with the right of administration level by level according to the Administrative Procedural Law of the People’s Republic of China for arbitration.

Stage 5: If the APs are still not satisfied with the decision of arbitration, an law suit can be filed to the Civil Court based on the “Civil Procedure Law” after the arbitration decision is received.

（1） Public complaints on resettlement issues: The affected persons will sign the agreement to confirm their rights and entitlements if they are satisfied with the proposed compensation. A procedure for information disclosure in the process of resettlement is helpful to increase the transparency of the Project. Through information disclosure, the APs will be informed of the multiple complaint channels (including village committees, departments, PMO, land acquisition and demolition office, external monitoring agency, government petition office, and court) and a variety of ways (such as petition and telephone) to express complaints and appeal.

In the process of development and implementation of the RP of the Project, great attention will be paid to the participation of affected persons and a grievance redress mechanism will be established to handle complaints and appeals from the APs in the following procedure:

（2） Public grievances in the construction period: The Contractor of the Project and the PMO, the project owner and EPB shall follow up with the progress of the Project in a timely manner to learn about inconveniences brought to the local people in the construction of the Project. The construction contractor shall make public the responsible person's name and contact information for the sake of public supervision and complaint. The PMO shall set up a special reception window and assign special personnel to collect the public opinions in a timely manner. Public opinion books should be provided so that records are kept of telephone calls or personal visits, including the name and contact information of the callers and visitors, impacts from project implementation and their opinions. Such records shall be archived and reported in a timely manner and questions raised by the public shall be replied within three working days and a solution shall be proposed and implemented within 10 to 15 working days depending on the level of difficulty. The final results of the process of implementation and coordination and resolution shall be added into the Public Opinion Book. If the complainant remains dissatisfied with the resolution made the PMO or EPB, he / she may, upon receipt of such resolutions, file a lawsuit at the local people's court according to the Civil Procedure Law of the People's Republic of China.

（3） Operation stage supervision: The public may raise any questions in the operation stage directly to the PMO or EPB (EP complaint hotline: 12369), which shall record, study and discuss and respond to such questions within 3 working days and propose and implement a solution within 10 to 15 working days depending on the level of difficulty. If the complainant remains dissatisfied with the resolution made the PMO or EPB, he / she may, upon receipt of such resolutions, file a lawsuit at the local people's court according to the Civil Procedure Law of the People's Republic of China.

The aforesaid channels of grievance redress shall be made public via meetings or by other means to enable the public to be fully aware of their rights to complain. In addition, the public media shall be utilized for extensive advertisement. The grievance redress institution shall handle the complaints free of charge and all expenses incurred therefrom shall be disbursed as a part of the contingency fee by the PMO.

9. Investment Estimation for Environmental Protection

Table 9-1 shows the estimated investment required for the aforesaid additional environmental measures needed in the design stage, construction stage and operation stage of the Project.

Table 9-1: Investment Estimation for Environmental Protection of the Project

SN	Stage	Cost description		Estimated investment (CNY10000)	Fund sources
1	Design stage	EIA		203	Provincial PMO
	Subtotal			**203**	
2	Construction stage	Additional environmental protection measures	Noise pollution control in construction stage	20.0	Project construction cost, out of project budget
			Disposal of domestic and production wastewater in construction stage	200	
			Dust pollution control measures in the construction stage	20.0	
			Removal of domestic solid wastes in the construction stage	10.0	
3		Additional water and soil conservation measures	Jiande City Water Conservancy and Road Construction	659.4	Project construction cost, out of project budget
			Chun'an County Rural Drinking Water Safety Improvement	521	
			Chun'an County Dike Reinforcement and River Rehabilitation	577.9	
			Chun'an County Small Watershed Rehabilitation	1257	
4		Water and soil conservation monitoring	Jiande City Water Conservancy and Road Construction	49.3	Project construction cost, out of project budget
			Chun'an County Rural Drinking Water Safety Improvement	58	
			Chun'an County Dike Reinforcement and River Rehabilitation	40.1	
			Chun'an County Small Watershed Rehabilitation	69.4	
		Temporary access bridge		12.0	Project construction cost, out of project budget
		Implementation of Dam Safety Action Plan		5956	Financial budget or special fund for water conservancy works
5		Environmental monitoring		7.0	ESMP cost, out of project
6		Operation of external monitoring agency		24	

Table 9-1: Investment Estimation for Environmental Protection of the Project

SN	Stage	Cost description		Estimated investment (CNY10000)	Fund sources
7		Staff training in the construction stage		28	budget
	Subtotal			**9509.1**	
8	Operation stage	Final acceptance of environmental protection		80	Project construction cost, out of project budget
9		Training and monitoring of agricultural pests		229	ESMP cost, out of project budget
10		Training and monitoring of forestry pests		559.9	
		Noise pollution prevention and control measures	Shouchang WWTP	5.0	Project construction cost, out of project budget
			8 new WTPs	29.0	
		Underground domestic sewage treatment devices for 8 WTPs		80.0	
11		Environmental monitoring		212.56	Operation cost
12		Shouchang WWTP biological deodorization		200	Project construction cost, out of project budget
		Cost of sludge and domestic waste removal for WWTP and WTPs		10	Operational cost
13		Operation of external monitoring agency		20	ESMP cost, out of project budget
14		Staff training in the operation stage		32.8	
	Subtotal			**1458.26**	
	Total			**11170.36**	

Annex 1: ECOP for Small Civil Works

Environmental Codes of Practice for Small Civil Works

Contents

1. GENERAL

1.1 Project background

In accordance with the requirements of environmental assessment by the World Bank, it is necessary to develop the Environmental Codes of Practice (ECOP). This annex is the ECOP for the small civil works and reference was made to the EHS Guidelines and Operation Policies as well as the safeguard policies of the World Bank during the development of this ECOP. This ECOP is applicable to all the civil works under the World Bank Loan Zhejiang Qiandao Lake and Xin'an River Basin Water Resource and Environmental Protection Project.

1.2 Objectives of ECOP

The ECOP is developed to present a set of detailed, technically feasible, and financially sustainable and operable environmental measures regarding to the inevitable and potential negative environmental impacts involved in the small civil works, identify the measures and arrangements of environmental pollution mitigation, environment management and institutional building to be implemented by the project owner, the construction contractors, the supervision engineers and the environment management bodies in the tendering, design and construction stages of the Project so as to eliminate or remedy and reduce the adverse environmental and social impacts generated in the construction of the Project to an acceptable level. The specific objectives of the ECOP include:

(1) Identifying the obligations of environment management of the project-related bodies

The project management unit, the project owner, the design unit and the EIA unit should carry out a detailed on-site review and verification of the environmental protection objectives, confirm the rationality of site selection and propose effective environmental pollution mitigation measures.

In the tendering stage of the Project, it should be explicitly specified that it is an obligation of the bid winner to implement the requirements included in the ECOP, which should be incorporated into the actual activities of engineering design and construction of the Project.

(2) Serving as the operational guidelines of environment management

The ECOP specifies the environment management system of the civil works construction component and the roles and responsibilities of each unit involved in the EMP of the Project and defines the procedures and approaches of communication between the different units. This document will be provided to the engineering design unit that wins the bid as an important basis of engineering design and also to the construction unit as a guidelines of practices in terms of environment management in the construction stage to effectively assure the smooth implementation of the proposed environmental pollution mitigation measures.

1.3 Applicable laws and regulations and World Bank safeguard policies/guidelines

(1) Environmental Protection Law of the People's Republic of China (January1,

2015);

(2) Law of the People's Republic of China on Prevention and Control of Water Pollution (amended in February 2008);

(3) Law of the People's Republic of China on Prevention and Control of Air Pollution (amended in August 2015);

(4) Law of the People's Republic of China on Prevention and Control of Noise Pollution (amended in October 1996);

(5) Law of the People's Republic of China on Prevention and Control of Environmental Pollution of Solid Wastes (amended on April 24, 2015)；

(6) Law of the People's Republic of China on Environmental Impact Assessment (amended in September 2016);

(7) Land Administration Law of the People's Republic of China (amended on Aug. 28, 2004);

(8) Water and Soil Conservation Law of the People's Republic of China (amended in March 2011);

(9) Law of the People's Republic of China on Wildlife Protection (August 2004);

(10) Regulations of the People's Republic of China on Protection of Wild Plants (September 1996)；

(11) Regulations on Protection of Basic Farmland, State Council Decree No. 257 (December 1998);

(12) Regulations on Management of Environmental Protection for Construction Projects (October 2017);

(13) Management Catalogue of Environmental Impact Assessment Categories of Construction Projects (amended on June 1, 2015);

(14) Regulations of Zhejiang Province on Prevention and Control of Air Pollution(Amendment), effective on July 1, 2016);

(15) Regulations of Zhejiang Province on Prevention and Control of Environmental Pollution of Solid Wastes, March 29, 2006, Circular No. 54 by the Standing Committee of Zhejiang Province People's Congress;

(16) Regulations of Zhejiang Province on Prevention and Control of Water Pollution, Sept. 19, 2008, Circular No. 5 by the Standing Committee of Zhejiang Province People's Congress;

(17) Methods for environment protection management of construction projects in Zhejiang Province, March 13, 2014;

(18) Environmental Assessment (OP, BP and GP4.01), Natural Habitats (OP/BP 4.04); Forestry (OP/GP4.36); Safeguarding Cultural Property (OP4.11), Involuntary Resettlement (OP/BP 4.12); Pest Management (GP4.09); Safety of Dams (OP/BP4.37);

(19) Environmental, Health and Safety (EHS) General Guidelines of the World Bank Group;

(20) Environmental, Health and Safety (EHS) Guidelines of the World Bank Group

for Water and Sanitation;

(21) Environmental, Health and Safety Guidelines of the World Bank Group for Waste Management Facilities.

2. General requirements of the ECOP

In the construction process of the Project, the contractor of the civil works construction component will play a critical role in implementing the environment management, pollution control and prevention measures. In order to assure the execution of the ECOP, the contents included in this Section are general requirements in the construction process of the Project and the construction contractor should enforce the environment management measures proposed in the ECOP under the coordination and supervisory management of the various management agencies.

2.1 Implementation of environmental measures during construction drawing design and tendering document preparation

As the Project enters the implementation stage, relevant procurement activities will be implemented according to the Procurement Guidelines of the World Bank. The various organizations of the county / city governments participating in the Project are required to include the mitigation measures proposed in the ECOP against any potential adverse environmental impacts into the technical specifications of the tendering documents and the construction design under the coordination, guidance and supervision of the Provincial PMO. The tendering documents need to require the tenderer to make commitments on the following environment management requirement in the bid document and incorporate such contents into the construction contract of the civil works.

1. The civil works contractor is required to provide 1 to 2 site environment engineers on each construction site responsible for implementing the environmental protection measures throughout the construction stage to assure that the construction activities of the contractor and its subcontractors (if any) satisfy the various requirements of this ECOP and necessary environmental protection measures are taken in the construction process.

2. In the construction process, the contractor is required to communicate and negotiate with the local people in the project area and set up a bulletin board at the entrance of each construction site to disclose detailed information to the public such as construction works, construction time as well as the contact person and contact information for complaints and advices;

3. The contractor should actively assist the construction supervision agency commissioned by the owner in carrying out the various environmental supervision tasks in the construction stage.

4. The contractor must include the “Site Environment Management Plan” in its construction program after the contract is signed and before the commencement of the construction works.

5. The contractor must respect the local construction safety and civilization requirements.

6. The civil works contractor and the construction supervision unit must receive training on environmental protection and environment management before the commencement of the construction works.

7. The civil works contractor should take timely remedial measures in case of any serious environmental impacts arising from non-compliance of environmental protection measures proposed in this ECOP and a report should be delivered within 24 hours to the respective county/city World Bank PMO. The county/city PMO should supervise and assist the civil works contractor to take such remedial measures. The contractor must keep records of the implementation status of such measures and report to the construction supervision unit and the county PMO.

2.2 Preparations before construction

After the tendering process is ended and a contract is signed with the civil works contractor, the contractor should conduct a visit to the construction site to identify environmental restriction factors in the project area. Prior to the commencement of the civil works, a construction site checklist should be prepared and completed to inspect the sensitivity of the various environmental elements on site to provide an important basis for environmental protection of the civil works in the future.

The purpose of the construction site checklist is to identify the relevant issues of environmental safety and identify and screen environmentally sensitive issues needing special protection measures.

Based on the results of construction site inspection, the civil works contractor should prepare the “Site Environment Management Plan”, which should incorporate the requirements of the ECOP and get approval by the construction supervision unit.

2.3 Environment management of the construction site

During the construction of the civil works, the civil works contractor should accept the supervision by the construction supervision unit commissioned by the county PMO.

The civil works contractor should implement the various environmental protection measures based on the requirements of environment management in the construction contract and the “Site Environment Management Plan” approved by the construction supervision unit. The construction supervision unit should carry out direct full-process supervision over the implementation of the environmental protection measures taken by the contractors while the local environmental protection administrative authority and its environmental surveillance unit and the public stakeholders in the project area should conduct external environment management monitoring.

Throughout the construction stage, the civil works contractor should actively coordinate with the construction supervision unit and the environmental monitoring unit to perform their duties.

The construction contractors should provide adequate information to the public in the affected area, in particular, local residents likely to be directly affected by the

construction activities in the project area. Key measures to be taken include:

(1) Setting up a bulletin board at the entrance of the construction site to disclose information such as project name, key construction works, construction time as well as the contact person and contact information for complaints and advices;

(2) Fulfilling the relevant formalities for and disclose to the local residents information on any nighttime construction required for the sake of construction technology and workmanship. Information to be disclosed in such cases include beginning and ending time of as well as the permit granted by the environmental protection authority on nighttime construction.

(3) A public announcement should be posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, telephone and bus service) needed for the implementation of the construction works.

(4) All feedbacks, comments and questions from the public should be recorded and archived. Questions raised by the public should be answered and responded in a timely manner, with the results of answers and responses recorded and archived for future inspection by the supervision unit.

2.4 Corrective measures to non-conformities to the ECOP requirements

The contractor and subcontractors (if any) of the small civil works must respect the requirements included in the ECOP and upon the occurrence of any pollution accidents (or events) due to failure in respecting the environmental protection measures specified in the ECOP:

1. The civil works contractor should take immediate measures and trigger the emergency response plan of environmental pollution accidents to eliminate the pollution sources and control the resulted environmental pollution.

2. The civil works contractor should immediately notify the construction supervision unit and the project management unit while the construction supervision unit and the project management unit should provide assistance and guidance to the construction contractor to take remedial measures to reduce or eliminate environmental impacts. A report should be delivered within 24 hours to the local environmental protection administration authority (or local environment monitoring authority) for inspection and guidance to minimize the impact.

3. The civil works contractor should keep record of the implementation status of the pollution control measures and propose and submit corrective measures to the construction supervision unit and the county PMO. Such records should be put into archives and registration by the construction supervision unit and the county PMO and the implementation status of such remedial measures will be reported by the county PMO to the provincial PMO.

4. The civil works contractor should conduct an in-depth analysis of the causes of environmental pollution and develop preventive measures and improve the construction design proposal to prevent recurrence of similar accidents. The preventive measures developed by the contractor should be approved by the construction supervision unit and the county PMO and archived and registered.

5. The county (city) PMO should take disciplinary and punishment actions to the civil works contractor according to the stipulations in the contract based on the nature, scope and degree of impact of the pollution accident and the implementation status of the contractor's remedial measures and report the results of such actions to the local environmental protection administration authority.

2.5 Management of environment management files

Proper management of the environment management files contributes significantly to the implementation of the ECOP. Table 2.5-1 shows the List of Major Environment Management Files.

Table 2.5-1: List of Major Environment Management Files

Document preparation unit	List of documents	Remarks
Provincial PMO	Records of inspections of the implementation status of the environmental protection measures of the Project	Such inspections should include the records of environmental protection inspections carried out by the county PMO, records of the project environment checklists and the records of the archiving of environmental correction notices and feedbacks; once every half a year;
County (city) World Bank PMO	Records of inspections of the implementation status of the environmental protection measures of the Project	Such inspections should include the records of the project environment checklists and the records of the archiving of environmental correction notices and feedbacks; once every month;
Environment supervision unit	Construction site checklist prior to construction	To be prepared before entering the construction site
	Construction site environment checklist	Once a week
	Instructions on corrective measures of environmental protection and records of corrections	Not on a periodical basis
	Environmental protection checklist before final hand-over of the Project	Environmental protection checklist before the final hand-over of the Project
Construction contractor	Monthly environment report for the construction stage	Once a month
Environment monitoring agency	1. Implementing the monitoring plan in the EMP and submitting the monitoring report at the earliest possible date after the monitoring is completed to the contractor (or operator) and the construction supervision engineer; 2. Including the monitoring report into the Project Progress	The monitoring report should be submitted together with the project progress report of the current month.

Table 2.5-1: List of Major Environment Management Files

Document preparation unit	List of documents	Remarks
	Report, putting it into archives and submitting it in a timely manner to the PMO and respective management authorities to enable these agencies to be aware of the execution status and effectiveness of the environmental protection measures in a timely manner.	

3. ECOP for the construction stage

3.1 General requirements

The purpose of developing the ECOPs for the construction stage is to protect the physical health and safety of the operators, improve their working environment and living conditions, protect the ecological environment, and prevent soil erosion in the construction process and prevent environmental pollution and various diseases occurred in the construction process.

This section presents the environmental protection measures that the civil works contractors should take in the construction of small civil works component, mainly including environmental management of construction sites, control of dust pollution, control of hazardous gases, control of water pollution, control of noise pollution, control of construction wastes and soil erosion, etc..

The general requirements of the ECOP of the construction stage include:

(1) Effective measures for prevention and control of air, water, noise, solid waste pollution and soil erosion and improvement of environmental sanitation should be included in the construction organization design of the Project.

(2) The environmental protection measures included in the construction organization design should be implemented in the construction process to assure that the quality of the ambient air, surface water and acoustic and ecological environment in the project area satisfies the requirements of the functional zone and is subject to supervision by the environment supervision unit and management unit.

(3) Environmental protection and environmental sanitation management and inspection system must be set up on the construction sites and inspection records should be properly maintained.

(4) The construction contractor should take effective measures for prevention and control of occupational diseases and provide the operators with necessary protective devices and organize physical examination and training for workers engaged in operations involving hazards of occupational diseases (at least once a year).

(5) The construction contractors should take account of the seasonal characteristics and take effective actions to properly implement activities of food hygiene assurance, hot weather and cold weather protection and epidemic prevention.

(6) Education and training and assessment for operators on construction sites should include contents of laws and regulations related to environmental protection and environmental health.

(7) Construction contractors should develop public health emergency response plans for the construction sites in accordance with the respective laws and regulations.

3.2 ECOP for the construction sites

3.2.1Site arrangement and temporary facility construction

The scope of construction sites consists of construction area, office area and living area.

(1) The construction area on the construction site should be clearly separated from the office area and the living area with corresponding separating measures and should be kept tidy and in good order.

(2) Facilities of environmental protection or measures for mitigating environmental impacts should be provided in the construction area and the living area. For example, in the construction area, wastewater sedimentation tanks and measures for dust prevention and noise reduction should be provided; in the office and living areas, facilities for treatment of domestic sewage, canteen wastewater and domestic solid wastes should be available.

(3) Company name or company logo should be displayed at the entrance and exit of the construction sites. A project introduction bulletin board should be set up at obvious positions at the main entrance and exit and the general layout map of the construction site as well as bulletin boards introducing the rules and regulations on production safety, fire and security protection, environmental protection and civilized construction should be erected inside the main gate.

(4) A public announcement should be posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, telephone and bus service) needed for the implementation of the construction works. Offices, dormitories, canteens, toilets, shower rooms, hot water supply, conference room and enclosed garbage stations (or containers) and washing facilities among other temporary facilities should be provided on the construction sites. Existing buildings and infrastructures should be utilized as a priority on the construction sites. If new temporary buildings are needed, land use should be optimized to occupation of land resources. Use of clay bricks in construction of temporary facilities on construction sites is prohibited and the safety and fire protection requirements and relevant national regulations should be respected..

(6) A special storage space should be provided for oils stored in the construction sites. Warning signs should be erected; floor should be subject to anti-seepage treatment and absorbing bags, sand and chips among other emergency response

materials should be prepared

(5) Staff dormitories must not be located in buildings under construction.

All temporary facilities should be demolished within one month as of the completion of the construction works.

3.2.2 Working conditions and environmental safety

(1) Construction sites should be enclosed with color steel fences at a height of not less than 2.5m and, in sensitive areas, not less than 3m.

(2) Bulletin boards should be erected on the construction sites to disclose information on the site layout plan and rules and regulations on safety production, fire protection, environmental protection, civilized construction as well as emergency response flow chart.

(3) The construction contractor should take protective measures to ensure the safety of buildings, structures and underground pipelines adjacent to the construction works.

(4) Large and high scaffolds, tower cranes and other large mechanical equipment on the construction sites should have a safety distance from overhead power transmission lines; high voltage electricity cables should be properly shielded and insulated for the sake of safety protection.

(5) During the construction, hard safety protection measures should be taken for sidewalks and vehicle entrances and exits in the vicinity of the construction works and lighting and indication devices should be provided at night.

(6) Visible safety warning signs should be erected at entrances and exits of construction site, location of lifting machinery, temporary electricity facilities, scaffolds, passageways and storage places of hazardous gases and liquid and other dangerous positions. such safety warning signs must comply with the national standards.

(7) Appropriate safety and technical measures should be taken In different construction stages and construction seasons and upon changes of climate and surrounding environment so as to achieve the conditions of safe and civilized construction.

(8) Fire extinguishing devices should be properly maintained and the escape routes must be free of obstacles.

3.3ECOP for pollution control

3.3.1Pollution control for dusts

Major sources of construction dust include: dust generated by vehicles on construction sites and access roads, dust generated from stockpiling of construction materials and earth, dust generated in the transportation process of earth, debris and construction wastes, dust generated from house demolition and dust generated in the operation of concrete and mortar mixing.

With regard to the aforesaid dust pollution sources, this ECOP proposes the following dust pollution control measures:

(1) The existing or planned roads on and around the construction sites should be

utilized to the best possibility as access roads on site. New access road should be paved based on their usages. Site pavement should be handled based on the usage of the respective sites. For example, roads allowing the passage of heavy-duty vehicles should be paved with recyclable load-bearing bricks (structures) while ordinary sidewalks should be paved with recyclable seepage bricks. Dust along road sections prone to dust generation should be suppressed by water spraying.

(2) Materials on the construction site should be stockpiled in a compact way. The access roads should be arranged in such a way that both permanent and temporary roads are considered to reduce land occupation. Barren land, waste land or unused land should be considered with priority if the construction site available is too small and a second site is needed for material stockpiling or processing.

(3) The sites for storage and process of materials on the construction sites should be flat and solid.

(4) Dust-prone, fine and bulk materials stockpiled on the construction sites should be stored in an enclosed space and proper covering measures should be taken in the course of loading and unloading and transportation.

(5) Earth materials should be stockpiled at a centralized site and measures should be taken for proper covering, curing or greening. Excavation and fill balance calculation should be conducted in advance for excavated spoil where stockpiling site is available; otherwise, such spoil should be utilized for backfill where possible through resource allocation with earthwork demand in the adjacent construction sites so as to achieve excavation and fill balance. Disposal of spoils, if any, should be carried out at designated places of disposal.

(6) Dust suppression should be carried out through water spraying on exposed surfaces in the office and living areas on construction sites and landscaping and beautification measures may be taken if needed.

(7) Earth, debris and construction waste must be transported using enclosed vehicles. Vehicle washing facilities should be provided at the entrances and exits of the construction sites. Vehicles leaving the construction sites should be cleaned. Roads between the vehicle washing facility and the exit of the construction site should be paved with concrete, asphalt or crushed bricks to prevent dust and dirt from being carried away from the construction sites.

(8) Before the demolition of a house, the civil works contractor should develop a house demolition program and submit it to the construction supervision agency and the county PMO for approval. Dust prevention and control measures should be taken during house demolition including removal of cumulated dust, spraying water on the demolished structure and erecting fences. A site for stockpiling of garbage and debris should be designated on the construction site of house demolition and the debris and construction waste should be removed out of site in a timely manner and transported along the approved route and within the approved time period to a designated disposal site.

(9) Pre-mixed concrete and pre-mixed mortar is encouraged on construction sites.

(10) Dust prevention and dust removal measures should be taken during operation

of concrete and mortar mixing.

(11) Earthwork backfilling and transportation and other dust-prone construction activities are prohibited in windy days with a strong wind of or above Grade 4.

(12) The construction unit should handle soil spoils in a timely and planned manner and cover vehicles transporting waste soil with tarpaulins (to assure enclosed transportation). Water should be sprayed on transportation roads with non-earth pavements and earthwork excavation and material handling should be avoided where possible in windy days. Overloading should be avoided and actions should be taken to prevent spillage of soil spoils during transportation. Before leaving the site, the vehicle wheels should be cleaned to prevent possible environmental impacts from dirt carried on the vehicle wheels. An access road cleaning mechanism should be established to assure that any soil spoils on the access roads are cleaned in a timely manner.

(13) A special personnel should be assigned to be responsible for the operation area on the construction site to make sure that the construction activities are managed in scientific way and implemented in a civilized way; during the construction of ground works, measures should be taken to speed up the progress as much as possible and earth and stone should be transported to the designated place in time to shorten the stockpiling cycle.

(14) Sand, cement and other dust-prone materials stockpiled in open air should be covered with canvas or plastic sheets to prevent dust diffusion.

(15) Upon the completion of construction activities, surface, roads and vegetation should be restored in a timely manner for sites occupied during construction.

(16) Special personnel should be assigned to be responsible for regular water spraying on construction sites at frequencies determined based on the weather conditions. Water should be sprayed once or twice a day on ordinary days and at a greater frequency in windy or dry days.

3.3.2 Emission control of hazardous gases

Hazardous gases involved in the construction process of the civil works mainly include exhaust gas emitted by construction plants and transportation vehicles and fume emitted from staff cafeteria in the living area. Regarding the aforesaid exhaust gases, this ECOP proposes the following emission control measures:

(1) Burning of wastes is prohibited on the construction sites.

(2) Construction vehicles and plants should be maintained and serviced on a periodical basis to keep them in excellent condition and make sure tail gas emitted by such vehicles and plants complies with the national emission standards.

(3) Clean energy, such as natural gas, electricity, should be used for cooking on the construction camps according to the requirements of local EP authorities；

(4) Treatment devices should be installed according to the requirements of the local EP authorities for pollution control of kitchen fume.

(5) Construction plants and transportation vehicles complying with the national standards on health protection must be selected to assure that the national standards on tail gas are respected. In addition, measures for overload control,

speed control and tail gas purification should be taken to reduce the impacts on local residents from tail gas emitted by construction plants and transportation vehicles.

3.3.3 Water pollution control

Wastewater generated in the construction process of the civil works mainly comprises of production wastewater generated from the construction activities and domestic sewage of construction staff. The production wastewater generated from the construction activities mainly include wastewater from concrete mixer and vehicle washing and wastewater of slurry. With regard to such wastewater, this ECOP proposes the following pollution control measures:

(1) Sedimentation tanks should be provided at sites for washing and cleaning of concrete mixers and transportation vehicles on the construction sites. Direct discharge of wastewater into the municipal sewage pipelines or rivers is prohibited. Such wastewater may be recycled or used for dust suppression after secondary sedimentation. Sediments in the sedimentation tanks should be removed when 1/4 of the sedimentation depth is reached. Sediments from the sedimentation tanks should be transported to sites designated by local EP authorities and must not be disposed in an uncontrolled manner.

(2) Oil or grease traps should be provided in the canteen and a qualified unit with the waste digestion qualification certificate and business license approved by the competent authority should be employed to assure timely removal of wastes;

(3) Enclosed swill buckets should be provided outside the canteen and emptied in a timely manner.

(4) Temporary toilets and septic tanks should be provided on the construction sites and should be subject to anti-seepage treatment.

(5) Drainage gutters and sedimentation tanks should be provided on the construction sites. Filters should be installed on sewer pipes of canteen, washrooms and shower rooms. Construction wastewater should not be discharged into the municipal sewage pipeline or natural rivers until properly settled. In the meanwhile, the drainage ditches should be kept tidy and free of obstacles to assure smooth drainage.

(6) Domestic sewage generated by construction workers must be reused in farmland irrigation or afforestation after treated to the required standard and shall not be discharged at in an uncontrolled manner. It is recommended to use the existing facilities of local villagers. On construction sites where sewers are available, such domestic sewage should be incorporated into the sewers.

(7) Muddy water generated in the construction sites of the Project should be sedimented in the sedimentation tanks and then the supernatant liquid should be discharged and the sediments should be dried and transported to landfill sites or may be reused in the Project for roadside landscaping or backfill.

(8) Storm water, wastewater and muddy water from the construction sites should be collected for sedimentation and discharged after treated to the respective standards. Stronger efforts should be made in maintenance and servicing of construction plants, which should be inspected prior to a construction activity to avoid possible leakage of oils in the construction process.

(9) If any drinking water source preservation zones or Class II water bodies are involved in the construction areas of the Project, construction wastewater shall not be discharged into such preservation zones and must be collected for treatment and then transported out of site or reused.

(10) Wastewater from pipe flushing or pressure test should be sedimented and filtered and then discharged into the adjacent ditches or canals.

(11) Construction of river-crossing pipelines should be conducted, where possible, in non-flood season and at the permission of the competent authorities and in strict accordance with the local river management regulations.

(12) Stockpiling of cement, oils and chemicals and other construction materials should be subject to strict management. During stockpiling, the materials should be covered with tarpaulins and fenced up, when necessary, to prevent possible river pollution caused by rain runoffs in rain season or during rain storms. Stockpiling of such materials by the river is not prohibited.

(13) Debris and construction wastes generated from construction of river-crossing pipelines must not be dumped into the rivers and should, instead, be transported to designated subgrade fill sites for reuse or to a designated site for centralized disposal.

(14) Actions should be taken to prevent serious oil leakage from construction plants and oily wastewater generated from the construction plants in operation must not be discharged into the adjacent water bodies. Oily wastewater from maintenance of construction plants must not be discharged into the water bodies.

3.3.4 Noise pollution control

Noise sources in the construction stage mainly include construction plants and transportation vehicles and the acoustic environment around the construction sites and on both sides of the roads is affected. Based on the characteristics of noise pollution in the civil works component, this ECOP proposes the following control measures:

(1) The construction period in a day should be strictly limited in the period from 8:00am to 20:00pm and construction activities should be banned in the noon nap hours from 12:00am to 14:00pm. The operation time of construction vehicles must comply with the requirements of local government. Where continuous nighttime construction is truly necessary, an announcement should be made to local residents and approval procedure should be fulfilled to minimize impacts on local residents.

(2) Noise absorption and insulation measures such as fencing, enclosing and landscaping should be taken on construction sites.

(3) State-of-the-art construction technologies should be used. Construction plants and equipment with low noise level should be selected and necessary measures of noise absorption, vibration insulation and reduction should be taken. The mechanical equipment should be properly maintained on a routine basis.

(4) Noise-generating equipment on the construction sites should be located on the far side from the residential areas and noise reduction measures, such as enclosure of noise-generating equipment, may be taken.

(5) The speed of material transportation vehicles travelling on construction sites should not be greater than 20km/hour; honking is prohibited.

(7) Stronger efforts should be made in environment management of construction sites and the requirements specified in the Ambient Noise Discharge Standard on the Boundaries of Construction Sites should be strictly followed to assure that the noises on the boundaries meet the respective standard.

(8) The construction time should be reasonably scheduled and high-noise construction activities should be banned at night. A reasonable layout plan should be developed so that high-noise equipment are concealed. A prior approval should be obtained from the EPB before any night construction is carried out according to the respective specifications.

(9) For sensitive sites such as schools; the operation time of high-noise equipment should be planned in such a way that the school hours are avoided; for residential areas, the noon nap time should be avoided. In sensitive areas such as hospitals or government office buildings, the operation time of high-noise equipment should be shortened as much as possible and low-noise machinery should be used where possible. For example, small machinery may be used for construction.

(10) In order to assure the health of the construction workers, the construction contractor should make a reasonable arrangement of the working time of construction workers to enable them to operate the high-noise construction plants in turns and reduce time of exposure to high noises. Advices should be given to operators and the concerned personnel to take personal protection measures, such wearing earmuffs or helmets.

(11) Low-noise construction plants and technologies should be selected where possible; vibration reduction base should be provided for fixed machinery with relatively strong vibration; maintenance and servicing of construction plants should be strengthened. Stronger efforts should be made in management of noise pollution sources on construction site. Metallic materials should be handled with care during loading and unloading operations.

3.3.5 Waste control

Solid wastes involved in the construction stage include construction wastes, waste oil, chemical solvent and domestic waste, with construction wastes the main solid waste mainly comprising of substances such as soil, muck, loose mortar and concrete, bricks and concrete debris from chiseling , reinforced concrete pile heads, metal, bamboo and wood, decoration wastes, packaging materials and other wastes, etc. This ECOP proposes the following measures for control of solid wastes generated during the construction stage of the Project:

(1) Enclosed garbage stations should be provided on construction sites and construction wastes and domestic wastes should be stored separately and removed out of site in a timely manner.

(2) Construction wastes inside buildings must be removed out of the buildings in containers or via pipelines and aerial casting is prohibited.

(3) Wastes generated from the activities of construction, demolition and site clearing should be separately treated. Directly reusable or renewable materials should be separately collected and reused while the remaining wastes should be

removed out of site in time by an authorized unit that holds the waste digestion qualification certificate and business license granted by the concerned authorities.

(4) Waste oil and chemical solvents should be stored at a centralized site and treated by a qualified agency. Uncontrolled dumping is prohibited.

(5) The construction plants should be properly maintained to avoid oil spillage. A designated equipment maintenance zone should be provided in the construction area to assure that all the equipment maintenance activities are carried out in the designated maintenance zone.

(6) Enclosed garbage stations should be provided in the construction camps for timely collection, removal and digestion of domestic solid wastes of staff according to the respective requirements.

(7) Enclosed slop pails should be provided outside the canteen and be emptied and cleaned in a timely manner.

(8) The septic tanks should be emptied and cleaned by the authorized unit and should be backfilled upon the completion of the construction works.

(9) Solid wastes generated in the construction process must be fully removed out of site upon completion of the construction works.

3.3.6 Soil erosion control

In order to control soil erosion arising in the construction stage, this ECOP proposes the following soil erosion control measures:

(1) Existing legal borrow areas and waste disposal sites determined by local EP authorities should be utilized with priority and construction debris and wastes should not be disposed in an uncontrolled manner.

(2) New borrow areas should not be constructed until an approval is obtained from the competent authority. Attention should be paid to slope protection of borrow pits as well as clearing and storage of top soil upon borrow operation, which may be used for vegetation restoration after the construction works is completed.

(3) Interception and diversion ditches should be constructed based on the terrain features to divert storm water formed in rain season and avoid runoff scours.

(4) Upon completion of the construction works, temporarily occupied land parcels should be cleaned up and rehabilitated by means of demolishing temporary buildings, clearing the ground surface, loosening and then compacting soil and backfilling and greening depressions in a timely manner to minimize soil erosion.

(5) Attention should be paid to stockpiling of earth on the construction sites to keep the stockpiling site away from rivers and avoid possible runoff into the rivers so as to minimize impacts of soil erosion on the rivers. The sand and gravel stockpiling sites should be fenced up with bagged sand and simple drainage ditch may be excavated around the site to divert water collected on the site.

(6) Top soil stripped from arable land, garden land or forest land in the right of way of the construction works, if necessary, should be temporarily stockpiled and reused in the future for vegetation restoration.

(7) Corresponding arbor and shrub planting methods should be selected in accordance with the Technical Regulations on Artificial Afforestation

(GB/T15776-2006) and following the principle of “suitable trees (grass) for suitable land” based on the different site conditions and the different requirements of water and soil conservation and ecological and landscaping. Arborvitae, maple, camphor, sweet-scented osmanthus, Du Ying, privet, Shu cypress may be selected as the arbor species while Pittosporum tobira, cuckoo, ilex crenata convexa, Euonymus japonica, etc., may be selected as the shrub species. Manila turf and mixed grass seeds of Bermudagrass and white clover may be selected.

(8) Earth and stone generated from excavation in the construction stage must not be dumped into rivers. Earth and stone in the river channels left over in the course of transportation and construction must be cleaned up to keep the river free of obstacles. Wastes and mud from boring must not be dumped into rivers and ponds to avoid possible siltation and impacts on flood discharge.

(9) Temporary drainage gutters should be provided on construction sites and a trapezoidal cross section with a bottom width of 0.3m, a depth of 0.3m and a slope ratio of 1:1 may be used. After excavation, the gutter bottom and the side slope should be compacted. Earth from excavation of drainage gutter should be fully used for construction of the outer cofferdam around the earth stockpiling site. Upon completion, the drainage gutters should be backfilled and leveled.

(10) The right of way should be used where possible upon selection of sites for temporary stockpiling of earth, which should be surrounded by temporary drainage gutters and covered with geotextiles.

3.4 Safeguarding cultural properties

In accordance with Article 32 of the Law of the People’s Republic of China on Cultural Relics Protection (Oct. 28, 2002), “in the course of project construction or agricultural production, all units and individuals that discover cultural relics shall keep the scene intact and immediately report to the local administrative department for cultural relics; after receiving the report, the department shall, except under special circumstances, rush to the scene within 24 hours and put forth its proposals on the handling of the matter within seven days. The administrative department for cultural relics may report to and request the local people’s government to inform the public security organ of the matter and to seek its assistance in keeping the scene intact; and where important cultural relics are discovered, the matter shall immediately be reported to the administrative department for cultural relics under the State Council, which shall put forth its proposal on the handling of the matter within 15 days after receiving the report. The cultural relics discovered in such a manner as mentioned in the preceding paragraph belong to the State, and no unit or individual may plunder, privately divide or conceal them.”

This ECOP proposes the following requirements on management of cultural properties occasionally discovered in the construction stage:

(1) In accordance with Article 11, Chapter 2 of the Law of the People’s Republic of China on Cultural Relics Protection, no other construction works shall be implemented within the scope of protection of a cultural relics protection unit. If needed for special reasons, a consent shall be obtained from the people’s government that made the announcement and the cultural administration authority of the superior level. For other construction works implemented in the scope of protection of national key cultural relics protection units, a consent must be

obtained from the people's government of the respective province, autonomous region or directly administered municipality and the cultural administration authority of the national government.

(2) If any cultural relics and historic sites are discovered or suspected in the construction stage, the construction contractor shall immediately protect the site and submit a report to the local cultural relics bureau for further action in accordance with the "Law of the People's Republic of China on the Protection of Cultural Relics" (29, December 2007) and the World Bank Policy on Physical Cultural Resources. The construction works shall not be resumed until an action is taken by the Cultural Relics Bureau.

(3) Where it is necessary to relocate or demolish a cultural relics protection unit to meet the constructional needs and other special needs, a consent shall be obtained from the people's government of the same level and the cultural administration authority of the superior level based on the classification of the respective cultural relics protection unit. Relocation or demolition of a national key cultural relics protection unit shall be reported by the people's government of a province, autonomous region or directly administered municipality to the State Council for decision. Cost and labor needed for such relocation and demolition shall be included by the construction contractor into the investment plan and labor plan.

(4) Revolutionary sites, memorial buildings, ancient tombs, ancient buildings, grotto temples, stone carvings (including appendages of buildings) certified as cultural relics protection units shall be repaired, maintained and relocated according to the principle that the original state of cultural relics shall not be altered.

(5) If any cultural relics or suspected cultural relics are discovered in the construction process, the construction contractor should:

- immediately stop the construction works at the location where the cultural relics is discovered and protect the scene;
- submit a report to the police and cultural relics administration authority in time for further action;
- immediately designate the scope of protection for those certified as cultural relics by experts;
- take emergency action to rescue the cultural relics in the event that the construction schedule is tight or there are risks of natural damages;
- Rescue excavation of cultural relics shall be conducted by professionals using professional equipment and the construction contractor shall not carry out any excavation without prior permission.
- In the event of any major discovery of cultural relics, a justification action should be taken to decide whether it is necessary to alter the site of the construction works.

3.5 Tomb protection

Compensation shall be made according to the respective requirements of the Resettlement Plan of the Project if it is necessary to relocate any tombs discovered during the survey. Tomb relocation should be conducted following the local customs and habits.

3.6 Vegetation protection

In order to protect vegetation in and around the project area as well as the ecological environment, this ECOP proposes the following vegetation protection measures:

(1) Felling of trees outside the construction areas is prohibited.

(2) The layout of the construction sites should be reasonably optimized to minimize the scope of construction activities and reduce the level of damages to vegetation from implementation of the construction works.

(3) Effective measures shall be taken in a timely manner against vegetation damaged and exposed surface resulting from the construction activities to avoid soil erosion and loss. For example, the exposed surface may be covered with sand and gravels or planted with fast-growing grass.

(4) Upon the completion of the construction works, the sites where original vegetation is damaged shall be restored or reasonably landscaped. Local species shall be selected upon vegetation restoration and landscaping to avoid possible introduction of alien species.

3.7 Risk prevention

The construction contractor shall develop an accident prevention plan and assign responsible persons so that any accidents are handled in time and reported to the supervision engineer and the county PMO.

3.8 Occupational health

(1) Warning signs or instructions should be provided at job positions and equipment or sites prone to occupational diseases and hazards on the construction site.

(2) Occupational health training and physical examinations should be provided to operators engaged in toxic and hazardous operations on a periodical basis and guidance should be provided to personnel on correct use of occupational disease prevention devices and personal labor protection devices (at least once a year).

(3) The construction contractor should provide the construction workers with safety helmets, safety belts and safety boots and working clothes and other personal labor protection devices suitable to the job types they are engaged in.

(4) Low-noise equipment should be used on the construction sites and automated and enclosed construction technologies should be promoted to reduce mechanical noises. Operators should wear earmuffs during operation to protect hearing.

(5) Operators working in sites involving toxic and hazardous gases should wear gas masks or protective masks.

(6) Water spraying facilities should be provided in dusty operation sites to reduce the dust concentration and operators should wear dust masks; operators in welding operations should wear protective masks, goggles and gloves and other personal protective equipment.

(7) Summer cooling supplies should be provided on construction sites where high-temperature operations are involved and reasonable work and rest timetable should be developed.

(8) Prior to the commencement of the construction works, the Contractor should develop a Health & Safety Management Plan (HSMP) to include analysis of occupational hazards and all the measures necessary to ensure health and safety of the works, which is subject to the prior approval of the Supervision Engineer.

(9) Separate access roads should be provided for pedestrians and vehicles inside and outside the buildings and such access roads should be easy to use, safe and reliable and meet the respective needs;

(10) The employer should ensure that satisfactory first aid is available at all times. Efforts should be made in the entire workplace to provide an easily accessible first aid station equipped with appropriate first aid devices; if the first aid measures at the workstation should include immediate flushing of eyes with fresh water as recommended, an eyewash station and / or emergency shower equipment should be provided in the vicinity of all such workstations; documented emergency procedures should be avaid at remote locations to deal with traumatic or critically ill patients until it is likely to transfer the patient to an appropriate medical facility.

(11) During the work hours, the work places, the boilets and the other amenities should be maintained at a temperature within the range of temperature complying with the usage of the respective space.

(12) Occupational health and safety training should be provided all newly hired staff to give them a briefing on the basic rules of work and personal protection and how to prevent injuries to other employees. Such training should include basic knowledge of hazards, specific hazards at the workplace, codes of conduct of work safety, fire emergency response procedures, evacuation procedures, and natural disaster management procedures. Such training should introduce in detail the specific hazards in the workplace and the color codes used.

(13) Basic vocational training courses and special courses should be provided, as needed, to ensure that employees are aware of the specific hazards involved each job assignment. Training should be provided to all managers, supervisors, employees, and occasional visitors allowed to enter areas involving risks and hazards; employees with rescue and first aid responsibilities should receive special training to prevent themselves or other employees from unintended exposure to more significant impacts and health hazards. Such training should include contents on how to prevent infection of pathogen in blood due to contact with body fluids and human tissue.

(14) Correct signs should be provided to indicate hazardous areas (e.g. power distribution rooms, compressor rooms, etc.), fixtures, materials, safety precautions, emergency exits, etc. Such signs should conform to international standards and be familiar and easy to understand for staff, visitors, the general public (as the case may be).

(15) Personal Protective Equipment (PPE) is designed to protect workers from possible harms from hazards at the workplace. Table 3.8-1 lists the various occupational hazards and the personal protective equipment provided for all purposes. The personal protective equipment should be used in the workplace in the following manners:

a) Personal Protective Equipment (PPE) should be used in an active manner if it is unlikely to eliminate or adequately reduce the degree of hazard or

exposure using the other methods, work plans or operation procedures;

b) Suitable personal protective equipment should be identified and provided so that the respective worker, the other workers and occasional visitors are fully protected without causing unnecessary inconvenience to users.

c) The personal protective equipment should be correctly maintained, including cleaning contaminated appliances, replacing damaged or worn appliances. Proper use of personal protective equipment should be included as a content in the routine staff training;

d) Personal protective equipment should be selected according to the hazards existing on site and the classification methods mentioned earlier in this chapter and with reference to the performance and test standards determined by the recognized authorities.

3.9 Traffic safety

The project staff should maintain traffic safety en route to and from the work places and during operating project equipment on free or public roads. Safety measures designed to prevent and control casualties in traffic accidents aim to protect project staff and road users and victims of road traffic accidents. Based on the scope and nature of the project activities, the following safety measures should be implemented:

(1) Safety education and training should be organized on a periodical basis to particularly make the drivers aware of the importance of safe driving.

(2) To avoid fatigue driving, actions should be taken to limit driving time and make sure drivers drive in turns. To minimize traffic accidents, driving on dangerous roads and time periods should be avoided.

(3) Vehicles should be regularly maintained using manufacturer-approved spare parts, which should be purchased in a timely manner to prevent possible serious accidents due to equipment faults or premature failure of spare parts.

(4) Separation of pedestrian and motor vehicles should be realized.

(5) Traffic safety control measures should be taken and road signs and signal should be used to warn pedestrians and vehicles of any traffic dangers; road signs may be improved through cooperation with the local community and the competent authorities improve visibility of road signs and enhance traffic safety in an all-around way.

(6) Traffic safety and pedestrian safety education should be conducted in the communities in the vicinity of the project area and schools.

(7) To assure that appropriate first aid is provided in case of any accidents, communications should be kept with the emergency response workers.

(8) Locally purchased materials should be used where possible to minimize transportation distance;

(9) Driving techniques should be improved and drivers must be mandatorily required to be licensed.

(10)Prior to the commencement of the construction works, the Contractor should develop a Health & Safety Management Plan (HSMP), which should include

analysis of occupational hazards and be subject to the approval and consent of the Supervision Engineer.

3.10 Health and epidemic prevention

(1) The respective health standards should be satisfied in terms of meals, drinking water, rest places provided for staff on the construction sites;

(2) Dormitories, canteens, bathrooms and toilets should be properly ventilated and illuminated, with full-time personnel assigned and responsible for their routine maintenance.

(3) Openable windows must be provided for dormitories on construction sites. Beds in staff dormitories should not be more than 2 tiers and large multi-person bed is prohibited.

(4) Valid health permits issued by the relevant departments should be available at canteens and all cooking devices should be cleaned according to the respective specifications and all cooks should hold valid health certificates;

(5) The canteens should be located away from toilets, garbage stations, toxic and hazardous places and other pollution sources.

(6) Independent preparation rooms and storage room should be provided in the canteens and mouse guards of no less than 0.2m high should be provided beneath the doors.

(7) Toilets, sanitary facilities, drainage gutters and dark and humid areas should be sterilized on a periodical basis;

(8) Enclosed containers should be provided in the living areas; flies should be periodically killed and containers emptied in a timely manner;

(9) Clinics should be provided on construction sites and equipped with health kits, frequently used drugs and bandages, tourniquets, neck care, stretchers and other first aid devices.

(10) Any incidents of infectious diseases (the statutory infectious diseases are atypical pneumonia, plague, cholera, viral hepatitis, bacterial and amoebic dysentery, typhoid and paratyphoid, AIDS, gonorrhea, syphilis, poliomyelitis, measles, whooping cough, diphtheria, epidemic Meningitis, epidemic hemorrhagic fever, rabies, leptospirosis, brucellosis, anthrax, epidemic and endemic typhus, encephalitis, malaria, malaria, dengue, Tuberculosis, schistosomiasis, filariasis, hydatid disease, leprosy, influenza, mumps, rubella, neonatal tetanus, acute hemorrhagic conjunctivitis, and infectious diarrhea), food poisoning, acute occupational poisoning of the construction workers should be promptly reported to the local health and epidemic prevention authorities and construction administration authorities so that corresponding actions are taken in accordance with the relevant provisions of the health and epidemic prevention authorities.

3.11 Environmental protection training and education

Training and education on environmental protection should include the following contents:

(1) Prior to the commencement of the Project, the municipal and county PMO should assign an environmental specialist to provide environmental protection

training for the contractors and construction supervision agencies of the small civil works;

(2) Prior to the commencement of the construction works, the contractor of the small civil works should organize training and examinations for the operators on the construction sites on laws and regulations on environmental protection and health and sanitation;

(3) The contractor of the civil works should organize staff training on the risk emergency response plan as well as emergency response rehearsals on a yearly basis.

(4) The contractor of the civil works should organize occupational health training and physical examination on a half-year basis for operators handling toxic and hazardous substances and provide guidance to such operators on correct use of occupational disease prevention devices and personal labor protection devices.

(5) The civil works contractor should prepare a training plan to provide appropriate site briefing, dialogue toolkits, safety guidance to all employees and visitors. The training plan should also include details on training time and frequency.

3.12 Public participation

The construction contractors should provide adequate information to the public in the affected area, in particular, local residents likely to be directly affected by the construction activities in the project area. Key measures to be taken include:

(1) A bulletin board should be erected at the entrance of the construction site to disclose information such as project name, key construction works, construction time as well as the contact person and contact information for complaints and advices;

(2) Arrangements should be made for site environment engineer to answer questions from the public on environmental protection;

(3) The relevant formalities should be fulfilled to disclose to the local residents information on any nighttime construction required for the sake of construction technology and workmanship. Information to be disclosed in such cases include beginning and ending time of as well as the permit granted by the environmental protection authority on nighttime construction.

(4) A public announcement should be posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, telephone and bus service) needed for the implementation of the construction works.

(5) All feedbacks, comments and questions from the public should be recorded and archived. Questions raised by the public should be answered and responded in a timely manner, with the results of answers and responses recorded and archived for future inspection by the supervision unit.

Annex Table 1: Construction Site Checklist Prior to Mobilization

Name of subproject: Contract No. and Subproject Location:

Name of construction site: Weather condition:

Checked by: Date of construction site check:

S.N	Environmental issues	Results (Please place a " √ " to mark the answer)	Note / Recommended actions
1	Does the Project trigger the World Bank safeguard policies on natural habitat, physical cultural resources and non-voluntary resettlement?	Yes ☐ No ☐ N/A ☐	
2	Are there any vegetation and trees for preservation in the land occupation area of the Project?	Yes ☐ No ☐ N/A ☐	
3	Will the construction access roads of the Project produce significant impacts on the traveling convenience of local residents?	Yes ☐ No ☐ N/A ☐	
4	Are there any public prone to construction impacts in the vicinity of the project area (residents, schools, hospitals and office areas)?	Yes ☐ No ☐ N/A ☐	
5	Will the Project result in deterioration of livelihood of urban residents?	Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐	
6	Is it necessary to interrupt the municipal services (including water supply, power supply, and telephone and bus lines) during the construction of the Project?	Yes ☐ No ☐ N/A ☐	
7	Is resettlement necessary in the construction of the Project?	Yes ☐ No ☐ N/A ☐	
8	Will flood impacts arise in the rain season?	Yes ☐ No ☐ N/A ☐	
9	Does the temporary land occupation under the project involve any land outside the project area?	Yes ☐ No ☐ N/A ☐	
10	Are there any power, telecommunication and municipal service pipelines in and around the construction area of the Project?	Yes ☐ No ☐ N/A ☐	
11	Are there any surface waters in and adjacent to the construction area of the Project?	Yes ☐ No ☐ N/A ☐	
12	Others		

Annex Table 2: Checklist for Environment Protection Inspection on Construction Sites

Instructions:
This table is the checklist for environmental protection inspections in the construction stage of the small civil works and includes the environmental protection measures tailored to the specific subprojects and the local environmental conditions, which may be added or adjusted if necessary.

Name of subproject: Contract No. and Subproject Location:

Name of construction site:

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
I. General requirements	1.1 Are effective measures for prevention and control of air, water, noise, solid waste pollution and soil erosion and improvement of environmental sanitation included in the construction organization design of the Project?				
	1.2 Is an Environmental protection and environmental sanitation management and inspection system set up on the construction sites?				
	1.3 Are records kept of inspections of environmental protection and environmental sanitation management on the construction site?				
	1.4 Are necessary protective devices provided to the operators and effective measures taken for prevention and control of occupational diseases?				
	1.5 Are periodical physical examination and training organized for workers engaged in operations involving hazards of occupational diseases?				
	1.6 Are effective actions taken to properly implement activities of food hygiene assurance, hot weather and cold weather protection and epidemic prevention with the seasonal characteristics taken into account?				
	1.7 Does the education and training and assessment for operators on construction sites include contents of laws and regulations related to environmental protection and environmental health?				
	Others (please specify)				
II. Site arrangement and temporary facility construction	2.1 Is the construction area on the construction site clearly separated from the office area and the living area with corresponding separating measures taken?				
	2.2 Is the construction area kept tidy and in good order?				
	2.3 Is the company name or company logo displayed at the entrance and exit of the				

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
	construction sites? Is a project introduction bulletin board set up at obvious positions at the main entrance and exit?				
	2.4 Is a public announcement made in advance to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, and telephone and bus service) needed for the implementation of the construction works?				
	2.5 Are existing buildings and infrastructures utilized with priority as temporary facilities on the construction sites?				
	2.6 Is land occupation involved in the newly constructed temporary buildings reasonable? Are the safety and fire protection requirements satisfied?				
	2.7 Are clay bricks used in the construction of the temporary facilities?				
	2.8 Is a special storage space provided for oils and chemical solvents stored in the construction sites? Are warning signs erected?				
	2.9 Is the floor in the warehouse of oils and chemical solvents subject to anti-seepage treatment? Are absorbing bags, sand and chips among other emergency response materials prepared in the warehouse?				
	2.10 Are staff dormitories located in buildings under construction?				
	2.11 Are all the temporary facilities demolished within one month as of the completion of the construction works?				
	Others (please specify)				
III. Working conditions and environmental safety	3.1 Are the construction sites enclosed with color steel fences at a height of not less than 2.5m and, in sensitive areas, not less than 3m?				
	3.2 Are acceptable bulletin boards erected on the construction sites to disclose information on the rules and regulations on environmental protection and civilized construction?				
	3.3 Does the construction contractor take protective measures to ensure the safety of buildings, structures and underground pipelines adjacent to the construction works?				
	3.4 Is a safety distance set for large and high scaffolds, tower cranes and other large mechanical equipment on the construction sites from overhead power transmission lines?				
	3.5 Are hard safety protection measures taken for sidewalks and vehicle entrances and exits in the vicinity of the construction works? Are lighting and indication devices provided at night?				
	3.6 Are visible safety warning signs complying with the national standard erected at dangerous positions on construction sites?				
	3.7 Are appropriate safety and technical measures taken on construction sites based on seasonal changes achieve the conditions of safe and civilized construction?				
	3.8 Are fire extinguishing devices properly maintained and the escape routes kept free of obstacles?				

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
	Others (please specify)				
IV. Dust pollution control	4.1 Are the existing or planned roads on and around the construction sites utilized to the best possibility as access roads on site?				
	4.2 Are the new access roads paved based on their usages? Is dust along road sections prone to dust generation suppressed by water spraying?				
	4.3 Are materials on the construction site stockpiled in a centralized way?				
	4.4 Is the site for material stockpiling selected in a reasonable way?				
	4.5 Are the sites for storage and process of materials and storage of large formworks on the construction sites flat and solid?				
	4.6 Are dust-prone, fine and bulk materials stockpiled on the construction sites stored in an enclosed space and proper covering measures taken in the course of loading and unloading and transportation?				
	4.7 Are measures taken for proper covering, curing or greening for sites for centralized stockpiling of earth materials?				
	4.8 Are the soil spoils utilized in a comprehensive way or transported to designated places for disposal?				
	4.9 Is dust suppression carried out through water spraying on exposed surfaces in the office and living areas on construction sites? Are landscaping and beautification measures taken if needed?				
	4.10 Are earth, debris and construction waste transported using enclosed vehicles?				
	4.11 Are vehicle washing facilities provided at the entrances and exits of the construction sites?				
	4.12 Are pre-mixed concrete and pre-mixed mortar used on construction sites?				
	4.13 Are dust prevention and dust removal measures taken during operation of concrete and mortar mixing?				
	4.14 Are earthwork backfilling and transportation and other dust-prone construction activities prohibited in windy days with a strong wind of or above Grade 4?				
	Others (please specify)				
V. Emission control of hazardous gases	5.1 Is Burning of wastes prohibited on the construction sites?				
	5.2 Are the construction vehicles and plants maintained in excellent condition and tail gas emitted by such vehicles and plants complying with the national emission standards?				
	5.3 Are construction materials tested and accepted by lawful test bodies selected as the decoration materials?				
	5.4 Are bitumen, coal tar and similar anticorrosion and moisture proof treatment agents prohibited for wood panels and other wood materials used in the decoration works?				
	5.5 Are fume treatment facilities installed in kitchens in the living areas on construction sites according to the respective requirements?				

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
	Others (please specify)				
VI. Water pollution control	6.1 Are sedimentation tanks provided at sites for washing and cleaning of concrete mixers and transportation vehicles on the construction sites?				
	6.2 Is direct discharge of wastewater into the municipal sewage pipelines or rivers prohibited?				
	6.3 Is wastewater recycled or used for dust suppression after secondary sedimentation?				
	6.4 Are sediments in the sedimentation tanks removed when 1/4 of the sedimentation depth is reached? Are sediments from the sedimentation tanks transported to designated sites ?				
	6.5 Are oil or grease traps provided in the canteen and a qualified unit with the waste digestion qualification certificate and business license approved by the competent authority employed to assure timely removal of wastes?				
	6.6 Are enclosed swill buckets provided outside the canteen and emptied in a timely manner?				
	6.7 Are the temporary toilets and septic tanks provided on the construction sites subject to anti-seepage treatment?				
	6.8 Are drainage gutters provided on the construction sites and the wastewater discharged into the municipal sewage pipeline or natural rivers after properly settled? Are the drainage ditches kept tidy and free of obstacles to assure smooth drainage?				
	Others (please specify)				
VII. Noise pollution control	7.1 Are the requirements of construction time strictly followed?				
	7.2 Are announcements made to local residents and approval procedure fulfilled where continuous nighttime construction is truly necessary?				
	7.3 Are noise absorption and insulation measures such as fencing, enclosing and landscaping taken on construction sites?				
	7.4 Are low-noise equipment selected and proper maintenance provided for equipment?				
	7.5 Are noise-generating equipment located on the far side from the residents?				
	7.6 Are noise-reduction measures, such as enclosure, taken for noise-generation equipment?				
	7.7 Are the construction vehicles subject to measures of speed limit and honking prohibition?				
	7.8 Are noise-generating equipment (air compressors, power generators, etc.) located in an enclosed facility?				
VIII. Waste control	8.1 Are enclosed garbage stations provided on construction sites and construction wastes and domestic wastes stored separately and removed out of site in a timely manner?				
	8.2 Are construction wastes inside buildings removed out of the buildings in containers or via pipelines?				
	8.3 Are wastes generated from the activities of construction, demolition and site clearing separately treated and collected for reuse?				

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
	8.4 Does the construction waste transportation unit hold a waste digestion qualification certificate and business license granted by the concerned authorities?				
	8.5 Are waste oil and chemical solvents stored at a centralized place and handled by a qualified agency?				
	8.6 Are obvious oil spillage noticed of the construction equipment?				
	8.7 Are enclosed garbage stations provided in the construction camps for timely collection, removal and digestion of domestic solid wastes of staff according to the respective requirements?				
	8.8 The septic tanks should be cleaned in time by the qualified agency and filled with soil after the construction is over.				
	8.9 Are all the solid wastes generated during construction fully removed after the construction is over?				
	Others (please specify)				
IX. Soil erosion control	9.1 Are the existing legal borrow areas and waste disposal sites determined by the local EP authorities utilized?				
	9.2 Is an approval obtained from the concerned authority on the construction of a new borrow area? Are measures taken to protect the slope of borrow pits?				
	9.3 Is attention paid to clearing and storage of top soil to make sure it is used for vegetation restoration after the construction works is completed?				
	9.4 Are interception and diversion ditches constructed to divert storm water formed in rain season and avoid runoff scours?				
	Others (please specify)				
X. Safeguarding of cultural properties	10.1 If any cultural relics and historic sites are discovered or suspected in the construction stage, the construction contractor shall immediately suspend the works and protect the site and submit a report to the local cultural relics bureau for further action. The construction works shall not be resumed until an action is taken by the Cultural Relics Bureau.				
	Others (please specify)				
XI. Vegetation protection	11.1 Are there any activities of tree felling outside the construction area?				
	11.2 Is the layout of the construction sites reasonably optimized (judged based on the level of reduction of damages to vegetation from implementation of the construction works)?				
	11.3 Are effective measures taken in a timely manner against vegetation damaged and exposed surface resulting from the construction activities to avoid soil erosion and loss (e.g., covering the exposed surface with sand and gravels or planting fast-growing grass)?				
	11.4 Are the sites where original vegetation is damaged restored or reasonably landscaped upon the completion of the construction works?				
	11.5 Are alien species introduced upon vegetation restoration and landscaping?				

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
	Others (please specify)				
XII. Risk prevention	12.1 Is an accident prevention plan developed?				
	Others (please specify)				
XIII. Occupational health	13.1 Are warning signs or instructions provided at job positions and equipment or sites prone to occupational diseases and hazards on the construction site?				
	13.2 Do operators should wear earmuffs during high-noise operation to protect hearing?				
	13.3 Do operators working in sites involving toxic and hazardous gases wear gas masks or protective masks?				
	13.4 Do operators in dusty operation sites wear dust masks?				
	13.5 Do operators in welding operations wear protective masks, goggles and gloves and other personal protective equipment?				
	13.6 Are summer cooling supplies provided on construction sites where high-temperature operations are involved and reasonable work and rest timetable developed?				
	Others (please specify)				
XIV. Health and epidemic prevention	14.1 Are the respective health standards satisfied in terms of meals, drinking water, and rest places provided for staff on the construction sites?				
	14.2 Are dormitories, canteens, bathrooms and toilets properly ventilated and illuminated, with full-time personnel assigned and responsible for their routine maintenance?				
	14.3 Are openable windows provided for dormitories on construction sites?				
	14.4 Are valid health permits issued by the relevant departments available at canteens and do all the cooks hold valid health certificates?				
	14.5 Are the canteens located away from toilets, garbage stations, toxic and hazardous places and other pollution sources as required?				
	14.6 Are independent preparation rooms and storage room provided in the canteens and mouse guards of no less than 0.2m high provided beneath the doors?				
	14.7 Are toilets, sanitary facilities, drainage gutters and dark and humid areas sterilized on a periodical basis?				
	14.8 Are enclosed containers provided in the living areas and flies periodically killed and containers emptied in a timely manner?				
	14.9 Are clinics provided on construction sites and equipped with health kits, frequently used drugs and bandages, tourniquets, neck care, stretchers and other first aid devices?				
	14.10 Are incidents of infectious diseases, food poisoning, acute occupational poisoning of the construction workers promptly reported to the local health and epidemic prevention authorities and construction administration authorities so that corresponding actions are taken in accordance with the relevant provisions of the health and epidemic prevention authorities?				
	Others (please specify)				

Current construction stage: inspection items		Inspection result (" √ ")			Notes / Recommended actions
		Yes	No	N/A	
XV. Traffic safety	15.1 Is safety education and training organized to particularly make the drivers aware of the importance of safe driving?				
	15.2 Are actions taken to limit driving time and make sure drivers drive in turns? Are actions taken to avoid driving on dangerous roads and time periods to minimize traffic accidents?				
	15.3 Are vehicles regularly maintained using manufacturer-approved spare parts, which should be purchased in a timely manner?				
	15.4 Is separation of pedestrian and motor vehicles realized?				
	15.5 Are road signs improved through cooperation with the local community and the competent authorities to improve visibility of road signs?				
	15.6 Are activities of traffic safety and pedestrian safety education conducted in the communities in the vicinity of the project area and schools?				
	15.7 Are locally purchased materials used where possible to minimize transportation distance?				
	15.8 Are drivers mandatorily required to be licenses?				
	Others (please specify)				

Stage of inspection: _____
Date of inspection: _____
Time of inspection: _____
Checked by: (signature) _____
Supervision Engineer: (signature) _____

Notes:

(1) Information to be noted may include remarks on non-conforming situations observed on site, and recommended corrective or preventive actions.

(2) In the event of any unacceptable measures or situations requiring further improvement identified during site inspection, the Supervision Engineer may immediately issue an "Instruction on Environmental Protection Corrections" to the contractor and indicate the serial number of the Instruction herein. Details of corrective actions taken by the contractor need to be recorded separately.

(3) This table is the checklist for environmental protection inspections in the construction stage of the small civil works and is applicable to the specific subprojects and specific environmental problems. This table may be adjusted and corresponding measures of environmental protection may be taken, where appropriate, based on local environmental conditions and construction components.

Annex Table 3: Instruction on Environmental Protection Corrections

When the Supervision Engineer discovers, during site inspection, any non-conforming environmental protection measures or situations requiring improvement or violating the contract clauses, the Supervision Engineer shall immediately issue an “Instruction on Environmental Protection Corrections” to the Contractor and note the serial number of the “Instruction on Environmental Protection Corrections” in the Remarks column.

Instruction on Environmental Protection Corrections
S. N.: _____ Contract Number and Description: _____ Name of Subproject:_____ _____ Name of Construction Site: _____ Current Construction Stage: _____
Problems existing during site inspection: Checked by:_____ Date:_____
Contractor’s cause analysis and corrective actions: Contractor: _____ Date:_____
Comments by Supervision Engineer: Supervision engineer:_____Date:_____
Opinions by Environmental Protection Authority (when necessary): Contact person:_____ Date:_____
Deadline of correction: To be corrected by (Date): _____ Contractor:_____Date: _____ Supervision Engineer:_____Date:_____
Conclusion of review: Reviewed by: _____Date:_____

Annex 2: ECOP for River Rehabilitation

Environmental Codes of Practice for River Rehabilitation

Contents

1. General

1.1 Project background

The Project is classified as a Category B Project through environmental screening of the category, location, sensitivity and scale of the Project as well as the characteristics and scale of potential environmental impacts based on the requirements of environmental screening and categorization specified in the World Bank safeguard policies on environmental assessment (OP4.01) and requires the development of Environmental Codes of Practice (ECOP). This report is the Environmental Codes of Practice for the Dike Construction developed with reference to the EHS Guidelines, Operation Policies and Safeguard Policies of the World Bank and is applicable to the revetment, dike and cofferdam works to be constructed or reconstructed in the river rehabilitation subproject.

1.2 Applicable laws and regulations and World Bank safeguard policies/guidelines

(1) Environmental Protection Law of the People's Republic of China (January1, 2015);

(2) Law of the People's Republic of China on Prevention and Control of Water Pollution (amended in February 2008);

(3) Law of the People's Republic of China on Prevention and Control of Air Pollution (amended in August 2015);

(4) Law of the People's Republic of China on Prevention and Control of Noise Pollution (amended in October 1996);

(5) Law of the People's Republic of China on Prevention and Control of Environmental Pollution of Solid Wastes (amended on April 24, 2015)；

(6) Law of the People's Republic of China on Environmental Impact Assessment (amended in September 2016);

(7) Land Administration Law of the People's Republic of China (amended on Aug. 28, 2004);

(8) Water and Soil Conservation Law of the People's Republic of China (amended in March 2011);

(9) Law of the People's Republic of China on Wildlife Protection (August 2004);

(10) Regulations of the People's Republic of China on Protection of Wild Plants (September 1996)；

(11) Regulations on Protection of Basic Farmland, State Council Decree No. 257 (December 1998);

(12) Regulations on Management of Environmental Protection for Construction Projects (October 2017);

(13) Management Catalogue of Environmental Impact Assessment Categories of

Construction Projects (amended on June 1, 2015);

(14) Regulations of Zhejiang Province on Prevention and Control of Air Pollution(Amendment), effective on July 1, 2016);

(15) Regulations of Zhejiang Province on Prevention and Control of Environmental Pollution of Solid Wastes, March 29, 2006, Circular No. 54 by the Standing Committee of Zhejiang Province People's Congress;

(16) Regulations of Zhejiang Province on Prevention and Control of Water Pollution, Sept. 19, 2008, Circular No. 5 by the Standing Committee of Zhejiang Province People's Congress;

(17) Methods for environment protection management of construction projects in Zhejiang Province, March 13, 2014;

(18) Environmental Assessment (OP, BP and GP4.01), Natural Habitats (OP/BP 4.04); Forestry (OP/GP4.36); Safeguarding Cultural Property (OP4.11), Involuntary Resettlement (OP/BP 4.12); Pest Management (GP4.09); Safety of Dams (OP/BP4.37);

(19) Environmental, Health and Safety (EHS) General Guidelines of the World Bank Group;

(20) Environmental, Health and Safety (EHS) Guidelines of the World Bank Group for Water and Sanitation;

(21) Environmental, Health and Safety Guidelines of the World Bank Group for Waste Management Facilities.

1.3 Objectives of ECOP

The ECOP is developed to present a set of detailed, technically feasible, and financially sustainable and operable environmental measures regarding to the inevitable and potential negative environmental impacts involved in the small civil works, identify the measures and arrangements of environmental pollution mitigation, environment management and institutional building to be implemented by the project construction contractors, the supervision engineers, the operators and the environment management bodies in the construction and operation stages of the Project so as to eliminate or remedy and reduce the adverse environmental and social impacts generated in the construction of the Project to an acceptable level. The specific objectives of the ECOP include:

(1) Identifying the obligations of environment management of the construction contractor and operators of the Project

The project management unit, the project owner, the design unit and the EIA consultant should carry out a detailed on-site review and verification of the environmental protection objectives involved in the project area and develop, in association with the local environmental characteristics and project features, and include practical and feasible environmental protection and pollution prevention and mitigation measures into the project design.

In the tendering stage of the Project, it should be explicitly specified that it is an

obligation of the bid winner to implement the requirements included in the ECOP, which should be incorporated into the actual activities of engineering design and construction of the Project.

(2) Serving as the operational guidelines of environment management

The construction supervision plan proposed in the ECOP for the pre-construction stage and the construction stage as well as the reporting mechanism and the file management procedure can assure the effective implementation of the environmental pollution mitigation measures. To be provided as environmental protection documents to the construction supervision unit, the environmental monitoring unit and other relevant agencies, these documents will specify the responsibilities and roles of the relevant functional departments and management bodies as well as the channels and means of communication between these departments and bodies to effectively assure the smooth implementation of the environmental pollution mitigation measures.

1.4 Applicability

This ECOP is mainly applicable to river rehabilitation. The Project will produce impacts of different degrees in the construction stage and the operation stage and requires corresponding environment management mechanisms, environmental protection and mitigation measures to reduce such impacts to the minimum.

This ECOP aims to provide the environment management agencies, construction supervision agencies and construction contractors with guidelines on the various measures for mitigation and monitoring of adverse environmental impacts in the process of project implementation and operation

2. General requirements of the ECOP

In the construction process of the Project, the contractor of the river rehabilitation component will play a critical role in implementing the environment management, pollution control and prevention measures. In order to assure the execution of the ECOP, the contents included in this Section are general requirements and measures applicable to the major agencies involved in the construction process of the Project and the construction contractor should enforce the environment management measures proposed in the ECOPs under the coordination and supervisory management of the various management agencies.

2.1 Implementation of environmental measures during construction drawing design and tendering document preparation

As the Project enters the implementation stage, relevant procurement activities will be implemented according to the Procurement Guidelines of the World Bank.

The tendering document preparation unit and the construction design unit are required to include the mitigation measures proposed in the ECOP against any potential adverse environmental impacts into the technical specifications of the tendering documents and the construction design of different stages under the coordination, guidance and supervision of the municipal PMO. The tendering documents need to require the tenderer to make commitments on the following environment management requirement in the bid document and incorporate such contents into the construction contract.

(1) The construction design unit should propose measures to mitigate potential adverse environmental impacts in the construction design of different stages. In the feasibility study stage, the environmental impacts should be analyzed and assessed and ECOP should be developed; in the preliminary design stage, the environmental protection measures proposed in the EIA and ECOP should be implemented; in the construction design stage, environmental protection engineering design should be produced based on the comments of ratification of the preliminary design.

(2) The contractor of the river rehabilitation component is required to provide 1 to 2 site environment engineers on each construction site responsible for implementing the environmental protection measures throughout the construction stage to assure that the construction activities of the contractor and its subcontractors (if any) satisfy the various requirements of this ECOP and necessary environmental protection measures are taken in the construction process.

(3) The contractor of the river rehabilitation component must include the “Site Environment Management Plan” in its construction program after the contract is signed and before the commencement of the construction works.

(4) The contractor of the river rehabilitation component must respect the local construction safety and civilization requirements.

(5) The contractor of the river rehabilitation component and the construction supervision unit must receive training on environmental protection and

environment management before the commencement of the construction works.

2.2 Preparation before construction

After the contract award and before commencement of the river rehabilitation component, the ECOP document should be provided by the project owner to the river rehabilitation contractor and the construction supervision unit should be determined.

After the tendering process is ended and a contract is signed with the contractor, the contractor should conduct a visit to the construction site to identify environmental restriction factors in the project area. Prior to the commencement of the construction works, a construction site checklist should be prepared and completed to inspect the sensitivity of the various environmental elements on site to provide an important basis for environmental protection of the river rehabilitation component in the future.

The purpose of the construction site checklist is to identify the relevant issues of environmental safety and identify and screen environmentally sensitive issues needing special protection measures.

Based on the results of construction site inspection, the contractor should prepare the “Site Environment Management Plan”, which should incorporate the requirements of the ECOP and get approval by the construction supervision unit.

2.3 environment management in the construction stage

During the construction of the river rehabilitation component, the contractor should accept the supervision by the construction supervision unit commissioned by the project owner.

The contractor of the river rehabilitation component should implement the various environmental protection measures based on the requirements of environment management in the construction contract and the “Site Environment Management Plan” approved by the construction supervision unit. The construction supervision unit should carry out direct full-process supervision over the implementation of the environmental protection measures taken by the contractors while the local environmental protection administrative authority and its environmental surveillance unit and the public stakeholders in the project area should conduct external environment management monitoring.

Throughout the construction stage, the contractor of the river rehabilitation component should actively coordinate with the construction supervision unit and the environmental monitoring unit to perform their duties as detailed in “2.2 Responsibilities and Staffing of Agencies involved in the Environment Management System”.

The construction contractor should coordinate closely with the local government departments and other authorities to assure full compliance with the requirements of the laws and regulations of China.

2.3.1 Full-process construction supervision

The key assignments of the construction supervision unit include:

（1） Mainly responsible for supervising the construction activities of the contractor and other relevant activities, e.g. land occupation and compensation, etc. to assure that the aforesaid activities comply with the requirements, investment and objectives of environmental protection; responsible for coordinating the relationship between the land administration authority and the environmental monitoring authority on the construction site;

（2） Responsible for supervising and guiding on a regular basis the contractor's environmental behaviors and assuring that the requirements of ECOP are satisfied;

（3） Responsible for review and approval of the "Site Environment Management Plan" of the contractor;

（4） Following up with and monitoring the implementation status of measures taken by the contractor in environmental protection and avoiding and mitigation of adverse environmental impacts;

（5） Monitoring and checking whether the construction behaviors of the contractor comply with the requirements of this ECOP;

（6） Making sure that an investigation should be immediately conducted and a report submitted to the project owner or local environmental protection administration authority for a solution in case of any non-compliance with the environmental protection requirements or any adverse environmental impacts or any complaints from local residents on environmental protection in the project area; issuing simultaneously to the contractor an Instruction on Environmental Protection Corrections and making sure the corrective measures are taken by the contractor under supervision.

（7） Stopping any activities or behaviors by the contractor violating the environmental protection requirements;

（8） Providing on-the-job training to the contractor to avoid and abate possible adverse impacts on the local environment;

（9） Conducting site environment inspections on a weekly basis and preparing, archiving and incorporating the Environmental Protection Checklist in the Construction Stage into the "Site Inspection Report" for monthly submission to the project owner;

（10） Conducting a further site environment inspection prior to the environmental protection acceptance upon the completion of the construction works and preparing and putting into archives the Environmental Protection Acceptance Checklist.

2.3.2 Supervision by environmental protection unit and public opinion

The construction contractors should coordinate closely with the local governments and other authorities throughout the construction stage to assure full compliance with this ECOP and provide adequate information to the affected public, in particular information on construction behaviors affecting public safety, matters infringing upon public interests and sensitive areas and temporary stockpiling sites,

etc. The local EPB should carry out sample inspections over the environmental protection measures taken by the construction contractors, receive site inspection reports submitted by the owner and the PMO and carry out its administrative duties based on the reported information and make arrangements for emergency responses to any abnormal environmental conditions arising in the construction process.

The contractors will assure that information to be disclosed to the public is posted at sites in the vicinity of local residential buildings in the project area, including name of contractor, name and telephone number of environment management coordinators, environmental impacts likely to arise in the construction process and preventive measures to be taken as well as the estimated duration of such impacts. In the meanwhile, the contractor needs to provide an open and transparent way of public participation and hotline telephone number and complaint handling office to receive public consultation and advices. Environmental issues reflected in the public feedback should be immediately investigated and addressed within the shortest possible time

2.4 Corrective measures to non-conformities to the ECOP requirements

The contractor and subcontractors (if any) of the small waterworks component must respect the requirements included in the ECOP and upon the occurrence of any pollution accidents (or events) due to failure in respecting the environmental protection measures specified in the ECOP:

（1） The Contractor of the river rehabilitation component should take immediate measures and trigger the emergency response plan of environmental pollution accidents to eliminate the pollution sources and control the resulted environmental pollution.

（2） The contractor of the river rehabilitation component should immediately notify the construction supervision unit and the project management unit while the construction supervision unit and the project management unit should provide assistance and guidance to the construction contractor to take remedial measures to reduce or eliminate environmental impacts. A report should be delivered within 24 hours to the local environmental protection administration authority (or local environment monitoring authority) for inspection and guidance to minimize the impact.

（3） The contractor of the river rehabilitation component should keep record of the implementation status of the pollution control measures and propose and submit corrective measures to the construction supervision unit and the owner. Such records should be put into archives and registration by the construction supervision unit and the project owner and the implementation status of such remedial measures will be reported by the owner to the municipal PMO.

（4） The contractor of the river rehabilitation component should conduct an in-depth analysis of the causes of environmental pollution and develop preventive measures and improve the construction design proposal to prevent recurrence of similar accidents. The preventive measures developed

by the contractor should be approved, archived and registered by the construction supervision unit and the project owner.

（5）The owner should take disciplinary and punishment actions to the contractor of the river rehabilitation component according to the stipulations in the contract based on the nature, scope and degree of impact of the pollution accident and the implementation status of the contractor's remedial measures and report the results of such actions to the local environmental protection administration authority.

3. ECOP in the stage of construction site preparation

The purpose of developing the ECOPs for the construction stage is to protect the physical health and safety of the operators, improve their working environment and living conditions, protect the ecological environment, and prevent soil erosion in the construction process and prevent environmental pollution and various diseases occurred in the construction process.

This section presents the environmental protection measures that the civil works contractors should take in the construction of river rehabilitation component, mainly including environmental management of construction sites, control of dust pollution, control of hazardous gases, control of water pollution, control of noise pollution, control of construction wastes and soil erosion, etc..

The general requirements of the ECOP of the construction stage include:

(1) Effective measures for prevention and control of air, water, noise, solid waste pollution and soil erosion and improvement of environmental sanitation should be included in the construction organization design of the Project.

(2) The environmental protection measures included in the construction organization design should be implemented in the construction process to assure that the quality of the ambient air, surface water and acoustic and ecological environment in the project area satisfies the requirements of the functional zone and is subject to supervision by the environment supervision unit and management unit.

(3) Environmental protection and environmental sanitation management and inspection system must be set up on the construction sites and inspection records should be properly maintained.

(4) The construction contractor should take effective measures for prevention and control of occupational diseases and provide the operators with necessary protective devices and organize physical examination and training for workers engaged in operations involving hazards of occupational diseases (at least once a year).

(5) The construction contractors should take account of the seasonal characteristics and take effective actions to properly implement activities of food hygiene assurance, hot weather and cold weather protection and epidemic prevention.

(6) Education and training and assessment for operators on construction sites should include contents of laws and regulations related to environmental protection and environmental health.

(7) Construction contractors should develop public health emergency response plans for the construction sites in accordance with the respective laws and regulations.

(8) The construction and production areas mainly include the concrete mixing plants and precast yards and should be located in a centralized way. Prior investigations should be carried out to identify any reliable and available concrete mixing plants. Where possible, commodity concrete should be selected as a priority. The construction and production areas should be selected in accordance with the requirements in Table 3-1.

Table 3-1: Requirements on selection of construction and production areas

Non-selectable		Selectable	
1	Land parcels located upwind of sensitive sites such as residential buildings, schools, etc.	1	Land parcel within the scope of permanent land use
2	Land parcels located within a distance of 200m downwind of sensitive sites such as residential buildings, schools, etc.	2	Wasteland
3	Basic farmland	3	Abandoned farmland
4	Homestead	4	Land parcels with relatively high terrain
5	Forest land	5	Other low-quality land parcels
6	Land parcels within a distance of 200m from the land territory of a river way		
7	Land parcels located within a distance of 1000m at the upper reaches and 500m at the lower reaches of the drinking water sources and inside the protection area of drinking water sources		
8	Low-lying land or paddy fields		
9	Land with excellent vegetation cover		
10	Land of special usages		

(9) Existing buildings and infrastructures should be utilized as a priority as construction camps to reduce soil and water conservation and environmental impacts caused by construction of construction camps; in case of any operation difficulties, the construction camps should be selected in accordance with the requirements in Table 3-2.

Table 3-2 Requirements on siting of construction camps

Non-selectable		Selectable	
1	Land parcels near residential buildings	1	Wasteland
2	Basic farmland	2	Abandoned farmland
3	Homestead	3	Land parcels with relatively high terrain
4	Forest land	4	Other low-quality land parcels
5	Land parcels within a distance of 200m from the land territory of a river way		
6	Land parcels located within a distance of 1000m at the upper reaches and 500m at the lower reaches of the drinking water sources and inside the protection area of drinking water sources		
7	Low-lying land or paddy fields		
8	Land with excellent vegetation cover		
9	Areas with hazards of collapses and landslides		
10	Areas prone to mud slides		
11	Land of special usages		

(10) Existing roads should be utilized to the best possibility as access roads for construction of road and pipeline networks and such access roads should be located far away from sensitive sites such as residential buildings, schools and hospitals.

New access road should be paved based on their usages. Site pavement should be handled based on the usage of the respective sites. For example, roads allowing the passage of heavy-duty vehicles should be paved with recyclable load-bearing bricks (structures) while ordinary sidewalks should be paved with recyclable seepage bricks. Dust along road sections prone to dust generation should be suppressed by water spraying.

(11) Construction material stockpiling sites generally include sand and aggregate stockpiling sites, borrowing sites and soil-spoiling and waste disposal sites.

Quarries: Aggregates needed for construction of the Project should unexceptionally be purchased locally. No quarries are to be set up for the river rehabilitation works of each subproject.

Borrowing sites: Earthwork backfill for river rehabilitation works generally uses their own excavation earth and no borrow areas are to be provided for the river rehabilitation works of each subproject.

Soil-spoiling and waste disposal sites: In the process of revetment, embankment and cofferdam construction, a certain volume of construction wastes and debris will likely be generated, mainly including waste soil from excavation, waste materials of road construction and waste rocks and mud from clearing and grubbing. In the construction site preparation stage, the

destination of such wastes should be selected in a reasonable way based on the results of calculation of earthwork and stonework balance in the design stage and local recycling or borrowing site vegetation restoration should be selected as a top priority.

4. Management of construction sites and facilities

4.1. Management of construction sites

The scope of construction sites consists of construction area, office area and living area.

(1) The construction area on the construction site should be clearly separated from the office area and the living area with corresponding separating measures and should be kept tidy and in good order.

(2) Facilities of environmental protection or measures for mitigating environmental impacts should be provided in the construction area and the living area. For example, in the construction area, wastewater sedimentation tanks and measures for dust prevention and noise reduction should be provided; in the office and living areas, facilities for treatment of domestic sewage, canteen wastewater and domestic solid wastes should be available.

(3) Company name or company logo should be displayed at the entrance and exit of the construction sites. A project introduction bulletin board should be set up at obvious positions at the main entrance and exit and the general layout map of the construction site as well as bulletin boards introducing the rules and regulations on production safety, fire and security protection, environmental protection and civilized construction should be erected inside the main gate.

(4) A public announcement should be posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, telephone and bus service) needed for the implementation of the construction works.

(5) Existing buildings and infrastructures should be utilized as a priority on the construction sites. If new temporary buildings are needed, land use should be optimized to occupation of land resources. Use of clay bricks in construction of temporary facilities on construction sites is prohibited and the safety and fire protection requirements and relevant national regulations should be respected.

(6) Staff dormitories must not be located in buildings under construction.

(7) All temporary facilities should be demolished within one month as of the completion of the construction works.

4.2 Management of construction plants

In order to strengthen management of construction equipment, the following pollution control measures are proposed:

（1） Pollution control measures through reduction of oil leakage

a) State-of-the-art equipment and machinery should be selected, if possible, to effectively reduce the number of oil leakage and machinery repair and thus the generation of oily wastewater.

b) In the process of inevitable oil leakage, solid oil-absorbing materials (e.g. cotton yarns, wood chips, oil-absorbing paper) should be used, if possible, and the waste oil should be collected and transformed into the solid substances to avoid excessive generation of oily wastewater.

c) Maintenance and servicing of machinery, equipment and transportation vehicles should be carried out at centralized maintenance sites along each road section, if possible, for the sake of easy collection of oily wastewater.

d) Horizontal sedimentation tanks should be provided in the machinery maintenance sites and the oily wastewater will be collected in the sedimentation tanks for simple treatment such as acid-alkaline neutralization, sedimentation, oil separation and debris removal before discharge. The sedimentation tanks should be backfilled with soil for landscaping upon completion of the construction works.

e) The ground surface of the equipment maintenance sites should be paved and subject to anti-seepage treatment to avoid possible contamination of soil caused by oil leakage.

f) Records of equipment repair and maintenance should be developed to enable periodical maintenance based on the operation status of equipment.

（2） Pollution control measures against equipment operation noises:

a) The construction contractor must select construction equipment and machinery and transportation vehicles conforming to the relevant national standards and select, if possible, low-noise construction plants.

b) Shock absorbers should be provided on the bases of fixed mechanical equipment with strong vibration. Fixed strong noise sources (e.g. the power-generation trucks) should be provided with sound insulators or positioned and operated indoors.

c) Maintenance and servicing of the various construction equipment should be strengthened to keep them in fine operation to fundamentally reduce the intensity of noise and vibration sources.

（3） The construction contractor must select construction equipment and machinery and transportation vehicles conforming to the relevant national health protection standards and assure that the exhaust gas emission of such equipment and vehicles conforms to the relevant national standards.

（4） Pollution control measures against solid wastes:

a) Waste oil and chemical solvents are hazardous wastes and should be separately stored based on their nature. Sites for temporary storage of hazardous wastes should be provided with obvious signs and constructed in accordance with the "Pollution control standards for storage of hazardous wastes" (GB18597-2001). Such hazardous wastes should be treated and disposed by a qualified unit and must not be dumped in a random way.

b) Toxic and hazardous wastes requiring recovery (e.g. oil buckets) should be recovered by material suppliers in principle and such responsibilities should be defined in the material procurement contract.

c) Recovery and disposal of hazardous wastes generated in a decentralized way (e.g. oil gloves, oil yarn heads) should be carried out by qualified agencies authorized by the PMO.

d) Oil and grease leaked into the soil should be collected in a timely manner with scrapping devices and sealed up and transported to a qualified treatment plant for centralized treatment.

e) When it is unlikely to carry out the maintenance and servicing of machinery, equipment and transportation vehicles at a designated maintenance site for each road section, containers or solid oil-absorbing materials should be used to collect the oily wastewater generated from such equipment, which should be sealed up and transported to an external site for further treatment. A nearby disposal plant with the required qualifications for disposal of such wastes should be selected.

5. ECOP for construction camps

With regard to the various pollution sources in the construction and operation processes of the construction camps, the construction contractor should take the following pollution control measures

1. The following pollution control measures should be taken in the course of site leveling of the construction camps:

(1) Construction wastes and debris as generated should be cleared out of site in a timely manner and enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes, which should be subject to reasonable disposal according to the requirements of “Section VII ECOP of Construction Material Stockpiling Sites”.

(2) Serious attention should be paid to dust suppression through water spraying so as to abate dust pollution.

(3) In order to prevent soil erosion, respective water and soil conservation measures should be taken according to the requirement of Section VIII --- Management of Water and Soil Conservation

2. The following pollution control measures should be taken against domestic sewage of the construction camps:

(1) Oil or grease traps should be provided in the canteen and a qualified unit with the waste digestion qualification certificate and business license approved by the competent authority should be employed to assure timely removal of wastes.

(2) Temporary toilets and septic tanks should be provided on the construction camps and should be subject to anti-seepage treatment.

(3) Drainage gutters and sedimentation tanks should be provided on the construction camps. Filters should be installed on sewer pipes of canteen, washrooms and shower rooms. Construction wastewater should not be discharged into the municipal sewage pipeline or natural rivers until properly settled.

(4) The construction camps should be kept in a smooth drainage condition and free of ponding of black and odor wastewater and unregulated urination and defecation.

(5) Uncontrolled dump and discharge of domestic wastewater into agricultural irrigation canals is prohibited. No domestic solid wastes and construction wastes should be stockpiled around the aforesaid areas.

3. Domestic exhaust gas control measures:

Clean energy, such as natural gas, electricity, should be used for cooking on the construction camps according to the requirements of local EP authorities.

4. Solid waste treatment measures:

(1) Recoverable wastes (e.g. waste paper, etc.) should be recovered and disposed by an authorized unit.

(2) Enclosed garbage stations should be provided in the construction camps for timely collection, removal and digestion of domestic solid wastes of staff

according to the respective requirements.

(3) Enclosed slop pails should be provided outside the canteen and be emptied and cleaned in a timely manner.

(4) The septic tanks should be emptied and cleaned by the authorized unit and should be backfilled upon the completion of the construction works.

5. Control measures for ecological impacts:

(1) All temporary facilities should be demolished and the occupied site restored to the pre-construction state within one month as of the completion of the construction works.

(2) Arable top soil stripped during the construction should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities.

6. Other environmental protection requirements:

The civil works contractor should strictly abide by the following bans in the construction process of the construction camps:

(1) Use of clay bricks in construction of temporary facilities in the construction camp is prohibited and the safety and fire protection requirements and relevant national regulations should be respected.

(2) The construction camps should be clearly distinguished from the construction areas and separation measures should be taken to assure that the construction camps remain in a tidy and orderly condition.

(3) Burning of wastes is prohibited in the construction camps.

6. Management of construction material stockpiling sites

6.1 Quarries

The area where the river rehabilitation component of the Project is located does not have the conditions required for setting up an independent quarry. Sand and gravels needed for the construction works are usually sourced from qualified quarries. In this Project, sand and gravels needed for the construction works are purchased from quarries with official business licenses in the region where this project is located, but strict actions should be taken to manage and control noises and dust generated in the course of loading and unloading and transportation of such materials as well as the stockpiling process in the construction sites.

6.2 Soil-spoiling and waste disposal sites

Construction wastes (debris) generated in the construction process of the Project mainly comprises of construction wastes and waste soil generated from rehabilitation of channels, dredging and dike excavation. The construction wastes will be utilized in a comprehensive way or subject to disposal in strict accordance with the soil and water conservation program, with corresponding protective measures implemented.

Windproof and stormproof measures should be taken for temporary waste (debris) disposal sites and fences should be erected if necessary. Water spraying should be conducted on a periodical basis for the sake of dust suppression. In bad weathers, the waste (debris) disposal sites should be covered with tarpaulins; in addition, reusable waste soil (debris) should be used in time and the residual waste soil (debris) should be removed out of site in time. Covering measures should be taken during transportation and the routes and timing of transportation should be properly planned to minimize environmental impacts on sensitive sites (areas).

7. Management of water and soil conservation

Water and soil conservation in the river rehabilitation works should be implemented following the principle where “the water and soil conservation activities are integrated with the main works of road and pipeline network construction and equal emphasis is laid on the main works, the ancillary works and the temporary works so that both the fundamental and indicative causes of soil erosion are eliminated through integrated efforts of prevention and control focusing on prevention. In addition, the water and soil conservation facilities should be distributed and arranged in a reasonable way to not only cater for the local circumstances and pursue effectiveness, but also highlight the importance of water and soil conservation in the construction stage. Prevention of soil erosion in the river rehabilitation works should be carried out according to the finalized water and soil conservation program.

7.1 Principles for distribution of water and soil conservation measures

(1) With the actual needs of the Project as well as the current condition of soil erosion in the project area taken into account, the water and soil conservation measures should be distributed and arranged in accordance with such a principle that tailored preventive and control measures are designed against the local circumstances and hazards and an overall plan is developed for the purpose of reasonable distribution and scientific allocation.

(2) The water and soil conservation facilities should be designed, constructed and put into commission simultaneously with the main works.

(3) An effective soil erosion control system should be developed through combination of the structural measures including retaining, draining and land rehabilitation and the vegetation measures such as vegetation restoration.

(4) Attention should be paid to protection of the ecological environment in the construction process and temporary protective measures should be taken to reduce artificial disturbance and waste soil (stone, debris) in the construction process.

7.2 Water and soil conservation measures for the main works

(1) Top soil stockpiling is not permitted in catchment areas of surface runoffs, in sensitive zones such as roads or river ways in the vicinity of the Project, in areas affecting construction or road traffic. In order to reduce the quantity of protection measures, top soil should be stockpiled at unoccupied low-lying land parcels where possible. If the top soil is temporarily

stockpiled on both sides of the right-of-way of the dike (revetment) construction belt, a cofferdam of bagged earth should be built up around the stockpile to avoid possible slides; temporarily stockpiled top soil should be used as topping soil for future side slope landscaping

(2) Top soil stripped in a thickness of 10 to 30cm from existing arable land, forest land and grass land in the right of way of the Project prior to the construction works should be transported to designated top soil stockpiling sites with fencing facilities and reused in the future for vegetation restoration.

(3) Slope protection should be carried out in a timely manner. Permanent drainage ditches are favorable to storm water diversion. Slope surfaces should be vegetated and landscaped to increase the water and soil conservation capacity of the basin.

(4) Temporary retaining ditches should be provided outside the boundary of low-lying areas in the project area to prevent storm water scours in rain season

(5) Sand sedimentation tanks should be provided at the outlet of the temporary drainage gutters

(6) Construction management should be strengthened to make sure that the construction activities are carried out in strict accordance with the engineering design and construction schedule. Rainy days should be best avoided for dike reinforcement, foundation excavation, backfill and drainage and sand sedimentation activities provided that the scheduled construction progress is satisfied so as to minimize soil erosion.

(7) Stockpiling time of fill materials without proper protection measures should be minimized and water spraying should be assured on a periodical basis on access roads to reduce dust pollution;

(8) The completed turf and vegetated revetment in the construction area of the Project should be properly managed and cured and protected from damages; attention should be paid to replanting to assure the survival rate of trees and grass;

(9) Sediments in the sedimentation tanks should be cleared periodically in the construction stage to prevent possible siltation. After the sedimentation tank and drainage gutters are mobilized, attention should be paid to the safe use of such facilities and a responsibility system should be established for proper implementation of periodical inspections and custody. Safety and warning signs should be erected when necessary.

7.3 Protection and control zone for temporary facilities

(1) Prior to site arrangements for construction sites and access roads, top soil in existing arable land or forest land in the land occupation area of the temporary construction facilities should be stripped in a thickness of 10 to 30 cm and the stripped top soil should be temporarily stockpiled on the side of the construction site and reused as top soil for future land reclamation or restoration.

(2) Sites occupied by the construction sites, access roads and stockpiling sites should be leveled in time after such sites are no longer needed as it approaches to the completion time of the construction works.

(3) After site leveling is carried out for the construction sites and access roads, top soil for reclamation with a thickness of 20 to 30cm shall be laid using the top soil stripped in the pre-construction stage.

(4) Reclamation is needed for arable land or forest land in areas occupied temporarily by construction sites, access roads and temporary stockpiling sites after site leveling is carried out in the later stage of the construction works.

(5) Temporary measures for the waste disposal sites

Dry masonry retaining walls should be constructed to fence up the waste disposal site and a drainage ditch (with a cross section of 30m wide at the bottom and 30cm deep) should be formed between the retaining wall and the foundation and the surrounding ridge and connected with the surrounding drainage system. In the process of construction waste stockpiling, the slope of the stockpile should be controlled at 1: 1.5. Upon the completion of the stockpiling operation, the stockpile should be surfaced with the stripped top soil for reclamation and mixed grass seeds should be planted on the slope for landscaping purposes. A drainage ditch should be constructed around the waste disposal site, with a sedimentation tank provided at the outlet of the drainage ditch.

(6) Construction sites mainly include aggregate stockpiling sites, mixing sites, temporary construction materials stockpiling sites. In order to reduce soil erosion during construction, temporary drainage ditches should be excavated around the construction site. Such drainage ditches may be designed with a trapezoidal cross-section with a bottom width of 30cm, a depth of 30cm and a slope of 1:0.75 with reference to the Technical Specifications on Small Water Storage, Drainage and Diversion Facilities for Water and Soil Conservation and Integrated Rehabilitation (GB/T16453.4-2008). Slope formed after the excavation of the drainage ditch should be compacted and the drainage ditch should be connected with the drainage ditch in the construction sites of the main works.

(7) Construction access roads

In order to reduce soil erosion on the access roads in the construction stage, temporary earth drainage ditches with a trapezoidal cross-section with a bottom width of 30cm, a depth of 30cm and a slope of 1:0.75 should be excavated on both sides of the access roads. Earth from excavation of such drainage ditches should be temporarily stockpiled on the outer side of the drainage ditch and compacted to an appropriate degree. Upon the completion of the construction works, such earth will be backfilled and compacted. Drainage ditch along the access roads should be connected with those in the construction areas of the main works.

(8) Top soil stockpiling site

Temporary sites are needed for stockpiling of the stripped top soil before such

top soil is reused for landscaping and reclamation. Such sites should be located in such a manner that relatively centralized stockpiling and easy transportation are facilitated based on the volume and location of the stripped top soil. In addition, the temporary stockpiling sites of top soil should be located on flat areas where possible for the sake of easy protection and reuse.

The stockpiling height at the temporary top soil stockpiling sites should be controlled at around 3m and an earth cofferdam should be constructed around the stockpiles with straw bags filled with top soil and mixed grass seeds should be planted on the exposed surface for protection. On the outer side of the bagged earth cofferdam, a temporary drainage ditch should be excavated to discharge water via the sedimentation tank. Earth from the excavation of the drainage ditch should be stockpiled on one side of the ditch and the stockpile and slope should be compacted. Such earth should be used for backfilling and leveling of the temporary drainage ditches when they are no longer needed.

(9) Temporary material stockpiling site

Prior to site arrangements for the temporary stockpiling sites of construction materials, top soil should be stripped and reused in the future for land restoration after such temporary stockpiling sites are no longer needed. During the stockpiling period, the stockpiling height at the temporary construction material stockpiling sites should be controlled at around 3m and an earth cofferdam should be constructed around the stockpiles with straw bags filled with soil. On the outer side of the bagged earth cofferdam, a temporary drainage ditch should be excavated to discharge water via the sedimentation tank in the vicinity. Earth from the excavation of the drainage ditch should be stockpiled on one side of the ditch with a slope of 1:5 and the stockpile and slope should be compacted. Such earth should be used for backfilling and leveling of the temporary drainage ditches when they are no longer needed. After the temporary construction material stockpiling sites are no longer in use, the site shall be cleared and land restored to its original state.

8. Ambient air quality management

8.1 Construction dust

（1） The construction access roads are simple gravel roads and water will be sprayed periodically to reduce dust.

（2） Fine particle bulky materials stockpiled on construction sites should be enclosed or covered and water should be sprayed over the stockpiles, based on the nature of the material, to effectively suppress dust.

（3） Road fences should be set up for environmentally sensitive sites (zones) along the road sections or pipeline sections under construction.

（4） Removal of construction wastes should be carried out with a closed container and aerial casting is prohibited. The construction wastes should be stored by type in accordance with the relevant classification

management requirements of municipal wastes and should be cleared and digested in a timely manner. Water should be sprayed to an appropriate extent ahead of the clearing operation.

（5） Management of transportation vehicles should be strengthened and those transporting dust-prone materials should be covered with tarpaulins.

（6） Water spraying should be carried out during demolition for the sake of dust suppression. The construction wastes should be cleared out of site within 3 days as of the completion of the demolition activity and the relevant requirements on demolition management should be respected.

（7） Dust-prone areas on the construction sites should be enclosed with fences or sprayed with water for dust suppression.

（8） Earthwork materials on construction sites should be stockpiled at a centralized place and properly covered; vehicles should not be overloaded to avoid spillage en route due to vibration.

（9） Vehicle washing facilities should be provided at the entrance and exit of construction sites and surface mud and earth should be cleaned before vehicles leave the site.

（10） The storage sites of materials and formworks on site should be flat and solid;

（11） The construction sites should be cleaned and sprayed with water in a timely manner;

（12） On account of the dominant wind direction and the objects of environmental protection in the vicinity, stockpiling sites of fine-particle bulky materials and other key dust sources should be located more than 300m away at the downwind side of objects of environmental protection.

（13） Burning of wastes is prohibited.

8.2 Motor vehicle tail gas

（1） Construction plants and vehicles in excellent working condition should be selected.

（2） Fuel-driven construction plants and vehicles must be operated in normal conditions to assure compliant emission of exhaust gas;

（3） Equipment should be used in a reasonable way and stronger efforts should be made in equipment maintenance and repair.

9. Vibration and acoustic environment quality management

9.1 Vibration management measures

Vibration control measures include source control, transmission media control, building protection, reasonable planning and layout and scientific management.

Measures for management of vibration sources include gradual renovation of transportation vehicles, strengthening vehicle maintenance and servicing, introduction of appropriate new technologies of vibration reduction; vibration control measures in terms of transmission media include vibration insulation ditches and walls among other vibration barrier measures aiming to reduce environmental impacts of vibrations. Impacts by vibration on environmentally sensitive objects may also be mitigated by means of altering the functions of buildings and other effective measures.

9.2 Measures for acoustic environment quality management

Noise sources at different stages of the construction stage will produce impacts of different degrees on the acoustic environment quality of the project area. Stronger efforts of management should be made and respective environment control measures should be taken to minimize such impacts.

（1） State-of-the-art and reliable low-noise equipment should be selected upon type selection;

（2） The construction period in a day lasts from 8:00am to 20:00pm and construction activities should be banned in the noon nap hours from 12:00am to 14:00pm. Nighttime construction is restricted, but if continuous nighttime construction is truly necessary, a certificate should be obtained from local construction administration authority, an approval granted by local EP authority and a public announcement made to local residents.

（3） The construction progress should be reasonably scheduled to avoid simultaneous operation of multiple high-noise mechanical plants on the same construction site and at the same time. During construction, efforts should be made to speed up the progress and shorten the duration of noise impacts so as to minimize the impacts of construction noises on the operators.

（4） Noises of transportation vehicles may produce certain impacts on the sensitive sites of acoustic environment along the route. Therefore, the construction contractor needs to strengthen the construction workers' awareness of environmental protection, learn local customs and habits and reasonably schedule the transportation time and take self-conscious measures to limit speed and prohibit honking for vehicles and other construction plants operating in high-density residential areas and other

environmentally-sensitive areas so as to effectively prevent and reduce noise impacts.

（5） Mechanical equipment generating relatively high noise should be located on the far side of the residential area and noise-reducing fences should be erected around construction sites with a distance of less than 5m from residences, schools and similar buildings.

（6） Advices should be given to the construction contractor to reasonably arrange and allocate the construction workers to reduce the operation time of high-noise machinery operators. Earmuffs may be provided to reduce noise impacts on the construction workers.

（7） All the mechanical equipment should be effectively maintained and serviced on a periodical basis to keep them in excellent condition and reduce noise and extent the service life of such equipment.

（8） Strict requirements should be proposed on the management of construction intensity, plants and vehicle operators as well as the codes of operation.

10. Water environment quality management

（1） Wastewater from washing of vehicles, rinsing, and construction materials on the construction sites should be collected via the water troughs and led into the temporary sedimentation tanks for treatment. The temporary sedimentation tanks should be sized in such a way that a wastewater retention time of more than 12 hours is assured. The treated wastewater should be reused in construction site cleaning and construction material washing.

（2） Temporary pit toilets are to be provided on the construction site. Feces should be periodically removed as farmland fertilizer based on the actual living conditions in the rural areas;

（3） Stronger efforts should be made in construction management to strictly control oil leakages of the construction plants; drainage system and water and soil conservation measures should be properly implemented for the temporary stockpiling areas to prevent possible impacts on the water environment by soil erosion at the waste soil stockpiling sites.

（4） The construction units must carry out the treatment measures for construction and production wastewater and domestic sewage to assure that such wastewater is properly treated and disposed.

（5） Environmental protection education for construction workers should be strengthened to enhance their environmental awareness and prevent and stop any random dumping of wastes and wastewater by construction workers.

（6） The low water season should be selected for dredging operations and the construction time should be minimized to reduce disturbances to the water systems.

（7） The construction plants involved in the dredging process must be inspected strictly to prevent oil leakage. Wastewater, solid wastes and oily wastewater must not be discharged into the water systems and should, instead, be collected and treated together with the other construction wastes.

（8） The construction camps and building material stockpiles should be located as far as possible away from wetlands and other surface waters. If it becomes necessary for the sake of construction activities to have ordinary construction materials stockpiles in the vicinity of water systems, the stockpiles must be covered up and fences should be provided if necessary.

（9） Domestic solid wastes generated by construction staff must not be disposed in a random way and must not be dumped into the water systems. Such domestic wastes must be collected for centralized treatment by the environment and sanitation authority on a periodical basis;

（10） Waste oil and other solid wastes involved in the construction process must neither be dumped or cast into nor placed around the water systems and should, instead, be transported to designated sites or treated according to the relevant requirements in a timely manner.

（11） The pipeline construction quality should be strictly controlled to avoid leakage or flooding of sewage due to failure of sewage pipelines that might lead to pollution of ground water environment and the branch channel water environment.

11. Ecological protection management

（1） The layout of the construction sites should be reasonably optimized to minimize the scope of construction activities and reduce the level of damages to vegetation from implementation of the construction works.

（2） Construction materials outsourced for the construction works, such as stone, sand, cement, etc., should be transported on a demand-driven basis to minimize land occupation and vegetation damage. Upon completion of the construction works, the construction sites should be cleaned and landscaped in time to restore damaged vegetation to the maximum extent.

（3） Temporary protective fences should be erected before the commencement of the construction works to protect trees left undisturbed on the construction sites based on the site visit results.

（4） The excavation scope should be subject to strict control and must not occupy land and waters outside the boundary; efforts should be made to shorten the construction period to reduce the impact on aquatic organisms due to disturbance of waters and increase of suspended matters.

（5） The construction contractor should minimize the duration of temporary land occupation and control the earthwork construction time provided that the construction quality is assured and a stable excavation and fill slope should be maintained to reduce impacts on areas outside the construction area of the Project.

（6） Dredging works should be conducted in the low water season and the construction time should be reasonably arranged to reduce disturbances of waters;

（7） Ecological restoration of the construction sites should be carried out prior to the final acceptance of the Project.

（8） Temporary interception ditches should be constructed on the construction sites and flood diversion channels should be constructed for the surface runoff passageways damaged by the Project to divert flood formed in rain season and avoid scours by surface runoff to the construction works.

12. Social environment management

In order to mitigate the impacts on the livelihood of local residents due to construction of the river rehabilitation component, the following environmental impact control measures should be taken:

（1） The various LAR subsidies should be allocated to the concerned village groups and individuals based on the national and provincial compensation standards, the local circumstances and the agreements signed with the LAR affected households. The various compensations should be reasonably allocated and utilized through full promotion of democracy and respect of the basic citizen rights; the arable land and labor force should be reasonably adjusted through full enforcement of the relevant policies.

（2） Local roads occupied or damaged in the construction stage should be relocated or subject to protective treatment such as pavement rehabilitation and landscaping. In addition, compensation of a certain amount should be paid to local governments to safeguard the righteous interests of local governments and residents.

（3） Construction and transportation vehicles should avoid the peak hours of local roads to prevent traffic congestion and accidents.

13. Solid waste treatment management

According to the requirements of the relevant laws and regulations, solid wastes such as construction wastes, waste soil (debris) and domestic solid wastes and dredged sludge must be properly collected and reasonably treated.

（1） Arrangements should be made to achieve comprehensive use of construction wastes in the road and pipeline network component simultaneously implemented, with the remnants stockpiled at a designed stockpiling place on the construction site and transported in a timely manner based on the construction progress to the solid waste landfills of each project town for disposal.

（2） Removal of construction wastes should be carried out with a closed container and aerial casting is prohibited. The construction wastes should be stored by type in accordance with the relevant classification management requirements of municipal wastes and should be cleared and digested in a timely manner.

（3） Water should be sprayed to an appropriate extent ahead of the clearing operation.

（4） Domestic wastes should be collected in the garbage bins and bags provided on the construction sites and then transported to a designated place for centralized treatment and disposal;

（5） Burning of toxic and hazardous substances is not permitted on construction sites. Toxic and hazardous substances should be disposed according to the relevant requirements and stipulations.

（6） Temporary land occupation should be minimized through timely removal and transportation of dredged sludge.

14. Risk control measures

The primary risk of small waterworks construction is construction safety of water-related construction activities. Therefore, the flood season risk control measures and technical codes of construction and operation safety for water-related construction works should be developed and implemented to put hazardous factors likely to arise in the water-related construction works under strict control and assure construction safety of the water related construction works.

14.1 Risk control measures for flood season construction

（1） On the premise that organizational assurances are available, the importance of flood control should be highly recognized and strong efforts of advertisement and safety education should be made to the depth of typhoon and flood risk control and to enable the construction workers to be seriously aware of and act as a group to truly enforce and implement the various flood prevention and control measures.

（2） In the flood season, staffing arrangements should be made to assure 24-hour non-interrupted on-duty operation and specific personnel should be assigned to listen to weather forecasts so that flood control actions are immediately mobilized and effective measures are taken when any rainstorm, floods or disastrous weathers are forecasted to assure the safety of the construction works, the construction equipment and personal life and properties.

（3） Records should be properly kept during rainstorms or floods and close attention should be paid to water level and possible impacts on the Project.

（4） The construction activities should be immediately stopped 2 days ahead of the forecast date of flood arrival and the construction equipment on site should be evacuated to get fully prepared for the coming flood.

（5） A telecommunication system mainly comprising of mobile and fixed telephones should be set up and all participating staff of the construction works must keep mobile phones accessible 24 hours.

（6） Woven bags, excavators, power generators, water pumps, dump trucks, life jackets and waterproof flashlights and other respective flood control and rescue materials and devices should be provided.

14.2 Flood and waterlogging prevention and control

（1） Weather forecast, hydrological forecast and water level monitoring mechanisms should be established for management of the construction stage and operation stage of the Project so that physical and human resources needed for flood control and rescue are prepared in time. The flood control and rescue activities in the rescue process should be well implemented according to the professional and technical requirements.

（2） In the flood season, the overflow dam involves a big water depth and improvement of the river water environment will also increase the level of participation in the river. Therefore, safety guardrails and the warning signs should be set up to improve the capacity of drowning prevention. In extreme weathers, local residents should be evacuated within the forecast period.

（3） A reasonable layout plan should be developed for the construction areas and diesel, engine oil, lubricants, paint and similar materials stored in the construction production areas should be kept far away from the river and appropriate isolation measures should be taken to prevent leakage during the flood season.

14.3 Construction safety

（1） The construction contractors responsible for construction of flood control and diversion facilities in the flood season should develop and submit to the designated authority specified in the construction contract for approval the respective construction program based on design requirements and engineering needs, which shall be submitted by the EA to the competent department of flood control for approval.

（2） Small waterworks construction workers and operators should wear protective gloves and other necessary labor protection devices. Construction workers on site must wear safety helmets and those working on the revetment slope must wear safety ropes. Safety fences should be erected on the levee crest to prevent possible falls.

（3） In the event of an over-standard flood, the emergency response plan should be triggered and emergency response actions taken in a timely manner.

（4） Production safety advertisement boards and signs and marks should be erected on construction sites. Safety signs warning against “Deep Water, No Swimming, Drowning Danger” and other dangers and risk and construction road signs should be provided at obvious locations around water pits generated from embankment foundation pits that are not backfilled in time.

15. Public participation

The construction contractors should provide adequate information to the public in the affected area, in particular, local residents likely to be directly affected by the construction activities in the project area. Key measures to be taken include:

（1） Setting up a bulletin board at the entrance of the construction site to disclose information such as project name, key construction works, construction time as well as the contact person and contact information for complaints and advices;

（2） Making arrangements for site environment engineer to answer questions from the public on environmental protection;

（3） Fulfilling the relevant formalities for and disclose to the local residents information on any nighttime construction required for the sake of construction technology and workmanship. Information to be disclosed in such cases include beginning and ending time of as well as the permit granted by the environmental protection authority on nighttime construction.

（4） A public announcement should be posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, and telephone and bus service) needed for the implementation of the construction works.

（5） All feedbacks, comments and questions from the public should be recorded and archived. Questions raised by the public should be answered and responded in a timely manner, with the results of answers and responses recorded and archived for future inspection by the supervision unit.

16. Construction traffic management

Temporary increase of traffic caused by the construction activities will bring noise impacts and daily life inconvenience for local residents along the transportation routes. Therefore, the following construction traffic management measures are proposed in this ECOP.

（1） A reasonable construction schedule should be developed to shorten the time of temporary land occupation.

（2） Enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes.

（3） Transportation of construction materials at night time should be prohibited on any construction access road with a centralized area of residence in a distance of less than 50m.

（4） Construction and transportation vehicles should avoid the peak hours of local roads to prevent traffic congestion and accidents.

（5） Construction vehicles should travel along designated routes and unauthorized change of routes is prohibited to avoid possible damages to farmland and forest land;

17. Supervision plan

Responsibilities of construction supervision should be incorporated into the environment supervision of the small waterworks component to implement total quality management of the Project following the requirements of both construction quality and environment quality.

17.1 Scope of construction supervision

Areas of and along the Project, mainly construction sites, temporary stockpiling areas causing environmental pollution to the surrounding environment due to production and construction.

17.2 Contents of construction supervision

（1） Reviewing and verifying whether the environmental protection measures proposed in this ECOP are incorporated in the design proposal and the construction drawing design;

（2） Assisting the executive unit in organizing environmental protection training for construction and management staff;

（3） Reviewing clauses on environmental protection in the project contract;

（4） Carrying out the supervision of water, sound and air environment quality in the construction process, the environmental impact mitigation measures and the environmental protection works and organizing staged acceptance based on the respective standards;

（5） Keeping systematic records of the environmental impacts of the construction activities, effects of the environmental protection measures and the implementation status of the environmental protection activities;

（6） Giving timely feedbacks to the construction supervision team on the relevant environmental protection measures and any unanticipated issues arising in the construction process and recommending solutions;

（7） Responsible for preparing the construction supervision plans and summary reports.

17.3 Terms of reference for environment supervision

（1） A sound and robust safeguard system should be set up for environment supervision. It is required that a full-time environmental protection personnel should be assigned in the construction supervision team to conduct total quality management in accordance with the construction quality and environmental quality requirements. The environmental protection and construction supervision work of the Project will be supervised by the Provincial PMO, environmental specialist and the environmental protection bureau.

（2） Environmental protection management methods as well as their detailed rules of implementation should be developed. Environmental protection regulations, such as environmental protection management methods and the detailed rules of implementation of the environmental protection work should be developed based on the specific characteristics of the Project.

（3） A sound work procedure for environment supervision should be established.

a) Work record system, i.e. the “Supervision Diary”, which describes the results of inspection, environmental problems and cause analysis and responsible units as well as the preliminary solution, etc.

b) Reporting system: As the key channel for vertical and horizontal and internal and external communication and transmission of information, the reporting system includes the Engineer’s “monthly reports”, “quarter reports” and “half-year progress evaluation reports” and the contractors’ “monthly environment reports”.

c) Document notification system: Matters that require actions by both the Engineer and the contractors are communicated and confirmed in letters and documents. Verbal notice is allowed for emergency cases, but must be validated with a written document afterwards.

d) Regular environment meeting system: Environmental protection meetings are held once a month to review the work of environmental protection, raise existing problems and correction requirements and develop an implementation plan.

18. Construction safety and health

The construction contractor is obliged to respect all national and local safety requirements and take other measures to avoid accidents and assure the

safety and health of the construction workers.

（1） The construction contractor should ensure that qualified first aid is available. Appropriate first aid devices should be provided at the construction sites and documented emergency handling procedure should be developed for remote sites so that the patient can be transferred to a suitable medical institution;

（2） Occupational health and safety training should be provided all newly recruited construction workers to introduce to them basic work rules on the construction site, rules of personal protection and how to prevent the other staff members from being injured;

（3） Warning signs should be attached on all powered electric devices and wires; all electricity wires, cables and electric tools on hand should be checked for any damaged or exposed wires and the maximum permissible operating voltage of tools on hand should be determined in accordance with the manufacturer's recommendations. All electrical equipment operating in humid (or possibly humid) environment should be double-insulation / grounded;

（4） Appropriate eye protection devices (such as welding goggles and / or masks) should be provided for all operators participating or assisting in the welding operations.

（5） Guardrails (with middle and peripheral baffles) should be installed at the edge of all vulnerable and dangerous areas. In addition, the construction workers should be provided with fall prevention devices (including safety belts and distance limiting ropes).

（6） The construction contractor should determine and provide the construction workers with appropriate personal protective devices that can adequately protect the workers themselves, other workers and occasional visitors and should not bring unnecessary inconvenience to the user.

（7） Health education should be provided to construction workers, e.g. implementing information communication strategies, enhancing face-to-face counseling, addressing systemic problems that affect individual behavior and encouraging individuals to take protective measures and use condoms to avoid spreading diseases to others; in addition, the construction workers should be encouraged to use insect repellent, clothing, mosquito nets and other blocking methods to avoid disease spreading via mosquito bites.

（8） Prior to the commencement of the construction works, the Contractor should develop a Health & Safety Management Plan (HSMP), which

should include analysis of occupational hazards and be subject to the approval and consent of the Supervision Engineer.

（9） Separate access roads should be provided for pedestrians and vehicles inside and outside the buildings and such access roads should be easy to use, safe and reliable and meet the respective needs;

（10） The employer should ensure that satisfactory first aid is available at all times. Efforts should be made in the entire workplace to provide an easily accessible first aid station equipped with appropriate first aid devices; if the first aid measures at the workstation should include immediate flushing of eyes with fresh water as recommended, an eyewash station and / or emergency shower equipment should be provided in the vicinity of all such workstations; documented emergency procedures should be avaid at remote locations to deal with traumatic or critically ill patients until it is likely to transfer the patient to an appropriate medical facility.

（11） During the work hours, the work places, the boilets and the other amenities should be maintained at a temperature within the range of temperature complying with the usage of the respective space.

（12） Occupational health and safety training should be provided all newly hired staff to give them a briefing on the basic rules of work and personal protection and how to prevent injuries to other employees. Such training should include basic knowledge of hazards, specific hazards at the workplace, codes of conduct of work safety, fire emergency response procedures, evacuation procedures, and natural disaster management procedures. Such training should introduce in detail the specific hazards in the workplace and the color codes used.

（13） Basic vocational training courses and special courses should be provided, as needed, to ensure that employees are aware of the specific hazards involved each job assignment. Training should be provided to all managers, supervisors, employees, and occasional visitors allowed to enter areas involving risks and hazards; employees with rescue and first aid responsibilities should receive special training to prevent themselves or other employees from unintended exposure to more significant impacts and health hazards. Such training should include contents on how to prevent infection of pathogen in blood due to contact with body fluids and human tissue.

（14） Correct signs should be provided to indicate hazardous areas (e.g. power distribution rooms, compressor rooms, etc.), fixtures, materials, safety precautions, emergency exits, etc. Such signs should conform to international standards and be familiar and easy to understand for staff, visitors, the general public (as the case may be).

（15） Personal Protective Equipment (PPE) is designed to protect workers from possible harms from hazards at the workplace. Table 3.8-1 lists the various occupational hazards and the personal protective equipment provided for all purposes. The personal protective equipment should be used in the workplace in the following manners:

a) Personal Protective Equipment (PPE) should be used in an active manner if it is unlikely to eliminate or adequately reduce the degree of hazard or exposure using the other methods, work plans or operation procedures;

b) Suitable personal protective equipment should be identified and provided so that the respective worker, the other workers and occasional visitors are fully protected without causing unnecessary inconvenience to users.

c) The personal protective equipment should be correctly maintained, including cleaning contaminated appliances, replacing damaged or worn appliances. Proper use of personal protective equipment should be included as a content in the routine staff training;

d) Personal protective equipment should be selected according to the hazards existing on site and the classification methods mentioned earlier in this chapter and with reference to the performance and test standards determined by the recognized authorities.

19. Traffic safety

The project staff must maintain traffic safety while traveling and leaving the workplace and operating the project equipment on free roads or public roads. The security measures to prevent and control the injury and death of traffic accidents should be designed to protect project workers and road users and victims of road traffic accidents. Based on the size and nature of the project activities, the following safety actions should be taken:

（1） Safety education and training should be organized on a periodical basis to particularly make the drivers aware of the importance of safe driving.

（2） To avoid fatigue driving, actions should be taken to limit driving time and make sure drivers drive in turns. To minimize traffic accidents, driving on dangerous roads and time periods should be avoided.

（3） Vehicles should be regularly maintained using manufacturer-approved spare parts, which should be purchased in a timely manner to prevent possible serious accidents due to equipment faults or premature failure of spare parts.

（4） Separation of pedestrian and motor vehicles should be realized.

（5） Traffic safety control measures should be taken and road signs and signal should be used to warn pedestrians and vehicles of any traffic dangers; road signs may be improved through cooperation with the local community and the competent authorities improve visibility of road signs and enhance traffic safety in an all-around way.

（6） Traffic safety and pedestrian safety education should be conducted in the communities in the vicinity of the project area and schools.

（7） To assure that appropriate first aid is provided in case of any accidents, communications should be kept with the emergency response workers.

（8） Locally purchased materials should be used where possible to minimize transportation distance;

（9） Driving techniques should be improved and it must be regarded as a mandatory requirement that drivers must hold licenses.

（10） Prior to the commencement of the construction works, the Contractor should develop a Health & Safety Management Plan (HSMP), which should include analysis of occupational hazards and be subject to the approval and consent of the Supervision Engineer.

20. Physical cultural resources

In accordance with Article 32 of the Law of the People's Republic of China on Cultural Relics Protection (Oct. 28, 2002), "in the course of project construction or agricultural production, all units and individuals that discover cultural relics shall keep the scene intact and immediately report to the local administrative department for cultural relics; after receiving the report, the department shall, except under special circumstances, rush to the scene within 24 hours and put forth its proposals on the handling of the matter within seven days. The administrative department for cultural relics may report to and request the local people's government to inform the public security organ of the matter and to seek its assistance in keeping the scene intact; and where important cultural relics are discovered, the matter shall immediately be reported to the administrative department for cultural relics under the State Council, which shall put forth its proposal on the handling of the matter within 15 days after receiving the report. The cultural relics discovered in such a manner as mentioned in the preceding paragraph belong to the State, and no unit or individual may plunder, privately divide or conceal them." This ECOP proposes the following requirements on management of cultural properties occasionally discovered in the construction stage:

（1） If any cultural relics are discovered in the course of project construction, the construction works shall be immediately stopped, the scene protected without any unauthorized action, and an immediate report should be submitted to the local administrative department for cultural

relics;

（2） After a solution is proposed by the cultural relics administration authority, the construction contractor should develop its construction program for the concerned section based on such solution proposed by the cultural relics authority and should not proceed with the construction works until such construction program is consented. No organization or individual should continue with any construction or production activities in the archaeological excavation site until such excavation is finished.

（3） No organization or individual may plunder, privately divide or conceal the cultural properties as discovered.

21. Environmental protection training and education

Training and education on environmental protection should include the following contents:

（1） Prior to the commencement of the Project, the owner should assign an environmental specialist to provide environmental protection training for the contractors and construction supervision agencies of the river rehabilitation component;

（2） Prior to the commencement of the river rehabilitation component, the contractor of the road and pipeline network component should organize training and examinations for the operators on the construction sites on laws and regulations on environmental protection and health and sanitation;

（3） The contractor of the river rehabilitation component should organize staff training on the risk emergency response plan as well as emergency response rehearsals on a yearly basis.

（4） The contractor of the river rehabilitation component should organize occupational health training and physical examination for operators engaged in toxic and hazardous operations on a half-year basis and guide the operators to correctly use the occupational disease protection devices and personal labor protection devices.

（5） The civil works contractor oshould prepare a training plan to provide appropriate site briefing, dialogue toolkits, safety guidance to all employees and visitors. The training plan should also include details on training time and frequency.

Annex Table 1: Construction Site Checklist Prior to Mobilization

Name of subproject: Contract No. and Subproject Location:

Name of construction site: Weather condition:

Checked by: Date of construction site inspection:

S.N	Environmental issues	Yes	No	N/A	Note / Recommended actions
1	Is the Project located in a national / provincial/ county-level nature reserve? (If yes, the Project should be cancelled.)				
2	Is the Project located in an experimental zone of a national / provincial / county-level nature reserve? (If yes, the Project is eligible for construction, but permits from the concerned authorities are mandatory.)				
3	Will land acquisition for the Project cause significant deterioration or changes of the natural environment of a protection area, a recommended protection area or an area with unique ecological significance?				
4	Will the Project cause temporary or permanent relocation of or impacts of any other forms on the national / provincial or recommended national / provincial physical and cultural resources or physical and cultural resources identified through discussions with the APs?				
5	Does the Project involve any physical cultural resources that are extremely sensitive for local residents (e.g. tombs)?				
6	Are there any known archaeological, historical or cultural relics (including ancient tombs, mausoleums) in the project area?				
7	Are there any endangered species (aquatic or terrestrial) in the project area?				

S.N	Environmental issues	Yes	No	N/A	Note / Recommended actions
8	Are there any natural habitats in the project area?				
9	Are there any wetlands or saturated soil zones (permanent or temporary) in the project area?				
10	Will the construction of the Project cause any short-term impacts on the villagers' rights of use of the infrastructures, services and relevant resources?				
11	Are there a large number of objects of environmental protection (hospitals, schools, residential areas, villages, etc.) in the project-affected area?				
12	Is transplanting needed for the sidewalk trees involved in the Project?				
13	Are there any existing power supply facilities (cables, poles, and transformers), telecommunication facilities, water supply and drainage facilities and heating facilities in the construction site of the Project?				
14	Are there any conflicts with local traffic due to use of access roads (urban roads) for constructional purposes?				
15	Others (Please specify)				

Annex Table 2: Checklist for Environment Protection Inspection on Construction Sites

Serial No.:

World Bank Loan Zhejiang Qiandao Lake & Xin'an River Basin Water Resources and Ecological Environment Protection Project

Date:

Instructions:
This table is the checklist for environmental protection inspections in the construction stage of the river rehabilitation component of World Bank Loan Zhejiang Qiandao Lake & Xin'an River Basin Water Resource and Ecological Environment Protection Project and includes the environmental protection measures tailored to the specific subprojects and the local environmental conditions, which may be added or adjusted if necessary.

Name of subproject: Contract No. and Subproject Location:

Name of construction site: Weather condition:

Current construction stage:

Date of environmental protection inspection: Specific time:

Weather condition:

Checked by:

Inspection item		Implementation status			Notes
		Yes	No	N/A	
Item	Environmental Protection Measures				
ECOP for construction site preparation	(1) Whether effective measures for prevention and control of air, water, noise, solid waste pollution and soil erosion and improvement of environmental sanitation are included in the construction organization design of the Project?				
	(2) Whether the environmental protection measures included in the construction organization design are implemented in the construction process?				
	(3) Whether an environmental protection and environmental sanitation management and inspection system is set up on the construction sites and inspection records properly				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		maintained?				
		(4) Whether the construction contractor takes effective measures for prevention and control of occupational diseases?				
		(5) Whether the construction contractors take effective actions to properly implement activities of food hygiene assurance, hot weather and cold weather protection and epidemic prevention?				
		(6) Whether education and training and assessment for operators on construction sites is properly carried out?				
		(7) Whether the construction contractors develop public health emergency response plans for the construction sites?				
ECOP for construction camps	Site leveling	(1) Whether construction wastes and debris as generated are cleared out of site in a timely manner and enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
		(2) Whether water is sprayed for dust suppression and reduction of dust pollution?				
	Control of domestic sewage	(1) Whether oil or grease traps are provided in the canteen and a qualified unit with the waste digestion qualification certificate and business license approved by the competent authority is employed to assure timely removal of wastes?				
		(2) Whether temporary toilets and septic tanks are provided on the construction camps and subject to anti-seepage treatment?				
		(3) Whether drainage gutters and sedimentation tanks are provided on the construction camps, filters are installed on sewer pipes of canteen, washrooms and shower rooms and construction wastewater is discharged into the municipal sewage pipeline or natural rivers after proper sedimentation and whether the drainage ditches are kept tidy and free of obstacles?				
		(4) Whether the construction camps are kept in a smooth drainage condition and free of ponding of black and odor wastewater and unregulated urination and defecation?				
		(5) Whether uncontrolled dump and discharge of				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		domestic wastewater into agricultural irrigation canals is prohibited and whether domestic solid wastes and construction wastes are prohibited to be stockpiled around the aforesaid areas?				
	Control of domestic exhaust gas	(1) Whether clean energy, such as natural gas, electricity, are used for cooking on the construction camps according to the requirements of local EP authorities?				
	Control of solid wastes	(1) Whether recoverable wastes (e.g. waste paper, etc.) are recovered and disposed by an authorized unit?				
		(2) Whether enclosed garbage stations are provided in the construction camps for timely collection, removal and digestion of domestic solid wastes?				
		(3) Whether enclosed slop pails are provided outside the canteen and emptied and cleaned in a timely manner?				
		(4) Whether septic tanks are emptied and cleaned by the authorized unit and backfilled upon the completion of the construction works?				
	Control of ecological impacts	(1) Whether all temporary facilities are demolished and the occupied site restored to the pre-construction state within one month as of the completion of the construction works?				
		(2) Whether arable top soil stripped during the construction is stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam? Whether temporary gutters and sand sedimentation measures are provided around the stockpiles? Whether the stockpiled top soil is covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities?				
	Other requirements	(1) Whether use of clay bricks in construction of temporary facilities in the construction camp is prohibited and whether the safety and fire protection requirements and relevant national				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		regulations are respected?				
		(2) Whether the construction camps are clearly distinguished from the construction areas and separation measures are taken to assure that the construction camps remain in a tidy and orderly condition?				
		(3) Whether burning of wastes is prohibited in the construction camps?				
Construction site and facility management		(1) Whether the construction area on the construction site are separated from the office area and the living area with corresponding separating measures and are kept tidy and in good order?				
		(2) Whether facilities of environmental protection or measures for mitigating environmental impacts are provided in the construction area and the living area?				
		(3) Whether company name or company logo are displayed at the entrance and exit of the construction sites?				
		(4) Whether a public announcement is posted in advance to notify the public of the beginning and ending time of any possible suspension of municipal services needed for the implementation of the construction works?				
		(5) Whether existing buildings and infrastructures on the construction sites are utilized with priority?				
		(6) Whether a special storage space is provided for oils and chemical solvents and other substances stored in the construction sites with warning signs erected?				
		(7) Whether staff dormitories are located in buildings under construction?				
		(8) Are all temporary facilities are demolished within one month and restored to pre-construction state as of the completion of the construction works?				
ECOP for management of construction sites	Construction material stockpiling sites	(1) Whether windproof and stormproof measures are taken on temporary waste (debris) disposal sites, which, when necessary, are fenced up and sprayed with water periodically for dust suppression and covered with tarpaulins in bad weathers?				.
		(2) Whether waste soil (debris) eligible for comprehensive utilization are utilized in time and the residual waste soil (debris) removed				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		out of site in time?				
		(3) Whether waste soil (debris) during transportation are covered with tarpaulins and transported along planned routes and at scheduled time to minimize environmental impacts on sensitive spots (areas)?				
Water & soil conservation management		(1) Whether top soil on the existing arable land, forest land, and grass land is stripped prior to construction?				
		(2) Whether protective measures are taken for side slopes excavated in the construction process?				
		(3) Whether temporary protection and drainage measures are taken on the temporary stockpiling sites?				
		(4) Whether topping and reclamation measures are taken for the temporary facilities?				
		(5) Whether the waste materials are removed and transported to the waste disposal site and stockpiled with temporary protection measures?				
Ambient Air Environment Quality Management	Construction dust and exhaust gas from construction plants	(1) Whether the construction access roads are designed into simple gravel roads and water is sprayed periodically to reduce dust?				
		(2) Whether materials on sites are enclosed or covered and water is sprayed over the stockpiles, based on the nature of the material, to effectively suppress dust?				
		(3) Whether road fences are set up when environmentally sensitive sites (zones) are involved?				
		(4) Whether the construction wastes are stored by type in accordance with the relevant classification management requirements of municipal wastes and cleared and digested in a timely manner? Whether water is sprayed to an appropriate extent ahead of the clearing operation?				
		(5) Whether management of transportation vehicles is strengthened and those				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		transporting dust-prone materials are covered with tarpaulins?				
		(6) Whether water spraying is carried out during demolition for the sake of dust suppression?				
		(7) Whether dust-prone areas on the construction sites are enclosed with fences or sprayed with water for dust suppression?				
		(8) Whether earthwork materials on construction sites are stockpiled at a centralized place and properly covered?				
		(9) Whether vehicle washing facilities are provided at the entrance and exit of construction sites and surface mud and earth are cleaned before vehicles leave the site?				
		(10) Whether the storage sites of materials and formworks on site are flat and solid?				
		(11) Whether the construction sites are cleaned and sprayed with water in a timely manner?				
		(12) Whether stockpiling sites of fine-particle bulky materials and other key dust sources are located more than 300m away at the downwind side of objects of environmental protection on account of the dominant wind direction and the objects of environmental protection in the vicinity?				
		(13) Whether burning of wastes is prohibited?				
		(14) Whether the construction machinery and equipment are in excellent condition?				
Acoustic environment quality management		(1) Whether state-of-the-art and reliable low-noise equipment is selected to the best possibility in terms of equipment selection?				
		(2) Whether the construction time is scheduled from 8:00 am to 20:00 pm and construction is banned for the period from 12:00 am to 14:00pm? Whether nighttime construction is restricted?				
		(3) Whether the construction progress is reasonably scheduled to avoid simultaneous operation of multiple high-noise mechanical plants?				
		(4) Whether measures are taken to limit the speed or prohibit honking of vehicles and other				

Inspection item		Implementation status			Notes
		Yes	No	N/A	
Item	Environmental Protection Measures				
	construction plants?				
	(5) Whether mechanical equipment generating relatively high noise are located on the far side of the residential area and noise-reducing fences should be erected around construction sites with a distance of less than 5m from residences, schools and similar buildings?				
	(6) Whether advices are given to the construction contractor to reasonably arrange and allocate the construction workers to reduce the operation time of high-noise machinery operators and earmuffs are provided to reduce noise impacts on the construction workers?				
Water environment quality management	(1) Whether temporary pit toilets are provided on the construction site?				
	(2) Whether stronger efforts are made in construction management to strictly control oil leakages of the construction plants?				
	(3) Whether treatment measures for construction and production wastewater and domestic sewage are implemented to assure that such wastewater is properly treated and disposed?				
	(4) Whether environmental protection education for construction workers is strengthened to enhance their environmental awareness?				
	(5) Whether the low water season is selected for dredging operations and the construction time is minimized to reduce disturbances to the water systems?				
	(6) Whether sludge submersible pumps are used to reduce pollution of water environment in the construction period?				
	(7) Whether the construction plants involved in the dredging process are inspected strictly to prevent oil leakage?				
	(8) Whether the construction camps and building material stockpiles are located as far as possible away from wetlands and other surface waters and the stockpiles are covered and fenced up if it becomes necessary for the sake of construction activities to have ordinary construction materials stockpiles in the vicinity of water systems?				

Inspection item		Implementation status			Notes
		Yes	No	N/A	
Item	Environmental Protection Measures				
	(9) Whether domestic solid wastes generated by construction staff are collected for centralized treatment by the environment and sanitation authority on a periodical basis?				
	(10) Whether waste oil involved in the construction process is transported to designated sites or treated according to the relevant requirements in a timely manner?				
	(11) Whether the pipeline construction quality is strictly controlled to avoid leakage or flooding of sewage due to failure of sewage pipelines that might lead to pollution of ground water environment and the branch channel water environment?				
Solid waste treatment management	(1) Whether the construction wastes are utilized in a comprehensive manner in the construction works of the Project?				
	(2) Whether aerial cast of construction wastes is prohibited? Whether the construction wastes are stored by type in accordance with the relevant classification management requirements of municipal wastes and are cleared and digested in a timely manner?				
	(3) Whether water is sprayed in advance before construction wastes are transported out of the construction sites?				
	(4) Whether domestic wastes are collected and then transported to a designated soil-spoiling and waste disposal site for centralized disposal?				
	(5) Whether waste soil is removed out of site in a timely manner?				
	(6) Whether burning of toxic and hazardous substances is banned on construction sites and toxic and hazardous substances are disposed according to the relevant requirements and stipulations?				
	(7) Whether actions are taken to minimize temporary land occupation and achieve timely removal of solid wastes?				
Ecological protection management	(1) Whether a reasonable and optimized construction site layout plan is developed to reduce the scope of construction activities and the degree of damages to vegetation caused by the implementation of the Project?				
	(2) Whether construction materials outsourced for the construction works, such as stone, sand, cement, etc., are transported on a demand-driven basis to minimize land occupation and vegetation damage；whether the construction sites are cleaned and landscaped in time upon completion of the				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		construction works to restore damaged vegetation to the maximum extent?				
		(3) Whether fences are erected around trees in the construction sites that are not felled or transplanted for the sake of temporary protection?				
		(4) Whether the excavation scope is strictly controlled to avoid occupation of land and waters outside the boundary? whether efforts are made to shorten the construction period to reduce the impact on aquatic organisms due to disturbance of waters and increase of suspended matters?				
		(5) Whether action is taken to minimize the duration of temporary land occupation and controls the earthwork construction time and whether a stable excavation and fill slope is maintained to reduce impacts on areas outside the construction area of the Project?				
		(6) Whether dredging is conducted in low-water season and construction time is reasonably arranged to reduce disturbance of water systems?				
		(7) Whether the construction sites are restored prior to the completion and final acceptance of the construction works?				
Social Environment Management		(1) Whether the relevant policies are enforced based on the national and provincial compensation standards?				
		(2) Whether local roads occupied or damaged in the construction stage are compensated and restored to safeguard the righteous interests of local governments and residents?				
		(3) Whether construction and transportation vehicles avoid the peak hours of local roads to prevent traffic congestion and accidents?				
Risk control measures	Flood season construction disk control measures	(1) Whether strong efforts are made in advertisement and safety education on prevention and control of typhoon and flood risk?				
		(2) Whether staffing arrangements are made in the flood season to assure 24-hour non-interrupted on-duty operation and specific personnel is assigned to listen to weather forecasts so that flood control actions are immediately mobilized and effective measures are taken when any rainstorm, floods or disastrous weathers are forecasted?				
		(3) Whether records are properly kept during rainstorms or floods and close attention is paid to water level and possible impacts on the				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		Project?				
		(4) Whether the construction activities are immediately stopped 2 days ahead of the forecast date of flood arrival and the construction equipment on site should be evacuated to get fully prepared for the coming flood?				
		(5) Whether a telecommunication system mainly comprising of mobile and fixed telephones is set up and all participating staff of the construction works are required to keep mobile phones accessible 24 hours?				
		(6) Whether corresponding flood control and rescue materials and devices are provided?				
	Flood control, waterlogging prevention	(1) Whether mechanisms of weather forecast, hydrological forecast and water level monitoring are established and whether the flood control and rescue activities in the rescue process are well implemented according to the professional and technical requirements?				
		(2) Whether safety guardrails and warning signs are set up to improve the capacity of drowning prevention? Whether local residents should be evacuated within the forecast period in extreme weathers?				
		(3) Whether a reasonable layout plan is developed for the construction areas and diesel, engine oil, lubricants, paint and similar materials stored in the construction production areas are kept far away from the river?				
	Construction safety	(1) Whether the construction contractors responsible for construction of flood control and diversion facilities in the flood season develop and submit to the designated authority specified in the construction contract for approval the respective construction program based on design requirements and engineering needs? Whether such reports are submitted by the EA to the competent department of flood control for approval?				
		(2) Whether construction workers and operators wear protective gloves and other necessary labor protection devices? Whether construction workers on site must wear safety helmets and those working on the revetment slope wear safety ropes? Whether safety fences are erected on the levee crest to prevent possible falls?				
		(3) Whether the emergency response plan is triggered and emergency response actions taken in a timely manner in the event of an over-standard flood?				

Inspection item			Implementation status			Notes
			Yes	No	N/A	
Item		Environmental Protection Measures				
		(4) Whether production safety advertisement boards and signs and marks are erected on construction sites? Whether safety signs warning against “Deep Water, No Swimming, Drowning Danger” and other dangers and risk and construction road signs are provided at obvious locations around water pits generated from embankment foundation pits that are not backfilled in time?				
Public participation		(1) Whether a bulletin board is erected at the entrance of the construction site for information disclosure?				
		(2) Whether arrangements are made to have technicians in the discipline of environmental protection answer public questions on environmental protection?				
		(3) Whether the relevant formalities are fulfilled for and information is disclose to the local residents on any nighttime construction?				
		(4) Whether a public announcement is posted to notify the public of the beginning and ending time of any possible suspension of municipal services needed for the implementation of the construction works?				
		(5) Whether all feedbacks, comments and questions from the public and answers are recorded and archived and subject to inspection by the supervision unit?				
Construction traffic management		(1) Whether a reasonable construction schedule is developed to shorten the time of temporary land occupation?				
		(2) Whether enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
		(3) Whether transportation of construction materials at night time is prohibited on any construction access road with a centralized area of residence in a distance of less than 50m?				
		(4) Whether actions are taken to assure that construction and transportation vehicles avoid the peak hours of local roads to prevent traffic congestion and accidents?				
		(5) Whether construction vehicles are required to travel along designated routes and unauthorized change of routes is prohibited to avoid possible damages to farmland and forest land?				
Constructional safety and health		(1) Whether acceptable first aid is provided?				
		Whether occupational health and safety training is provided for all newly employed construction				

Inspection item		Implementation status			Notes
		Yes	No	N/A	
Item	Environmental Protection Measures				
	workers?				
	Whether warning signs are placed on all powered devices and electric wires?				
	Whether suitable eye protection devices are provided (e.g. welding goggles and / or masks)?				
	Whether guardrails are installed on the boundary of vulnerable and hazardous areas?				
	Whether suitable personal protective devices are provided to construction workers?				
	Whether health education is provided to construction workers?				
Physical cultural resources	(1) Whether the construction works is immediately stopped, scene kept intact under the supervision of the construction supervision engineer and a report immediately submitted to the local cultural relics authority upon the discovery of any immoveable cultural relics during the construction (including ancient ruins, ancient tombs, etc.)?				
	(2) Whether the construction contractor develops a construction program for the concerned section(s) after the discovered cultural relics is identified and handled by the cultural relics authority and does not continue with the construction activities until a consent is obtained from the cultural relics authority?				
	(3) Whether any moveable cultural relics discovered (including any material objects of daily life and production activities of different eras) are handed over to the cultural relics authority?				
	Others (Please specify)				
Traffic safety	(1) Whether safety education and training is organized on a periodical basis to particularly make the drivers aware of the importance of safe driving?				
	Whether actions are taken to limit driving time and make sure drivers drive in turns? Whether actions are taken to avoid driving on dangerous roads and				

Inspection item		Implementation status			Notes
		Yes	No	N/A	
Item	Environmental Protection Measures				
	time periods?				
	Whether vehicles are regularly maintained; whether manufacturer-approved spare parts are used and purchased in a timely manner?				
	Whether separation of pedestrian and motor vehicles is realized?				
	Whether traffic safety control measures are taken and road signs and signal are used to warn pedestrians and vehicles of any traffic dangers; whether road signs are improved through cooperation with the local community and the competent authorities to improve visibility of road signs and enhance traffic safety in an all-around way?				
	Whether traffic safety and pedestrian safety education is conducted in the communities in the vicinity of the project area and schools?				
	Whether communications are kept with the emergency response workers to assure that appropriate first aid is provided in case of any accidents?				
	Whether locally purchased materials are used where possible to minimize transportation distance?				
	Whether it is regarded as a mandatory requirement that drivers must hold licenses?				
Educational protection training and education	(1) Whether an environmental specialist is assigned to provide environmental protection training for the contractors and construction supervision agencies of the river rehabilitation component?				
	(2) Whether training and examinations for the operators on the construction sites are organized?				
	(3) Whether staff training is organized on the risk emergency response plan and emergency response rehearsals is conducted?				

Checked by: (signature)_____ Time:_____

Supervision Engineer: (signature)_____ Time:_____

Notes:

（1） Information to be noted may include problems observed on site, remarks on

Inspection item		Implementation status			Notes
		Yes	No	N/A	
Item	Environmental Protection Measures				
non-conforming situations and recommended corrective or preventive actions. （2） In the event of any unacceptable measures or situations requiring further improvement identified during site inspection, the Supervision Engineer may immediately issue an “Instruction on Environmental Protection Corrections” to the contractor and indicate the serial number of the Instruction herein. Details of corrective actions taken by the contractor need to be recorded separately. （3） This table is the checklist for environmental protection inspections in the construction stage of the river rehabilitation component of World Bank Loan Zhejiang Qiandao Lake and Xin’an River Basin Water Resources and Ecological Environment Protection Project and is applicable to the specific subprojects and specific environmental problems. This table may be adjusted and corresponding measures of environmental protection may be taken, where appropriate, based on local environmental conditions and construction components.					

Annex Table 3: Instruction on Environmental Protection Corrections

When the Supervision Engineer discovers, during site inspection, any non-conforming environmental protection measures or situations requiring improvement or violating the contract clauses, the Supervision Engineer shall immediately issue an "Instruction on Environmental Protection Corrections" to the Contractor and note the serial number of the "Instruction on Environmental Protection Corrections" in the Remarks column.

Instruction on Environmental Protection Corrections
S. N.: _____ Contract Number and Description: _____ Name of Subproject:_____ _____ Name of Construction Site: _____ Current Construction Stage: _____
Problems existing during site inspection: Checked by:_____ Date:_____
Contractor's cause analysis and corrective actions: Contractor: _____ Date:_____
Comments by Supervision Engineer: Supervision engineer:_____Date:_____
Opinions by Environmental Protection Authority (when necessary): Contact person:_____ Date:_____
Deadline of correction: To be corrected by (Date): _____ Contractor:_____Date: _____ Supervision Engineer:_____Date:_____

Conclusion of review: Reviewed by: _____Date:_____

Annex Table 4: Checklist of Environmental Protection Inspection Prior to Project Completion and Hand-over

World Bank Loan Zhejiang Qiandao Lake and Xin'an River Basin Water Resources & Ecological Environment Protection Project

Serial No.:

Date:

Instructions:

This table is the checklist for environmental protection inspections in the construction stage of the river rehabilitation component of World Bank Loan Zhejiang Qiandao Lake and Xin'an River Basin Water Resources & Ecological Environment Protection Project and includes the environmental protection measures tailored to the specific subprojects and the local environmental conditions, which may be added or adjusted if necessary.

Name of subproject: Contract No. and Subproject Location:

Name of construction site:

Current construction stage:

Date of environmental protection inspection: Specific time:

Weather condition:

Checked by:

Item of inspection	Status of implementation		N/A	Note (e.g. problems or non-conformities observed, recommended corrective or preventive actions)
	Implemented	Not Implemented		
1. Are all the construction wastes on the construction sites removed out of site?				
2. Are actions taken against the acoustic environment protection objects?				
3. Are restoration measures taken for the temporary waste (debris) disposal sites?				
4. Have the existing rural roads used as construction access roads deteriorated? Are they still in good traffic condition?				

Item of inspection	Status of implementation		N/A	Note (e.g. problems or non-conformities observed, recommended corrective or preventive actions)
	Implemented	Not Implemented		
5. Have the hardened concrete mixing sites been demolished?				
6. Are land rehabilitation, restoration or landscaping measures taken for land parcels temporarily occupied by the concrete mixing plants?				
7. Are the temporary sedimentation tanks and sand sedimentation tanks demolished?				
8. Are land rehabilitation, restoration or landscaping measures taken for land parcels temporarily occupied by the sedimentation tanks and sand sedimentation tanks?				
9. Are temporary facilities demolished and measures taken for site restoration?				
10. Are the top mellow soil stripped and preserved for restoration of waste (debris) disposal sites?				
11. Are the revetment and embankment slopes landscaped?				
12. Are the drainage system of the revetment and embankment improved?				
13. Have the owners of the subprojects carried out training and education activities?				
14. Are the local public satisfied with the road works constructed under the Project?				

* Any local and existing item recorded as “not implemented” might indicate any condition that is non-conforming or needs further improvement. In such an event, the Supervision Engineer shall immediately issue to the Contractor an “Instruction on Environmental Protection Corrections” and note the serial number. Details of corrective actions taken by the contractor need to be recorded separately.

Site Inspector (signature): Date:

Supervision Engineer (signature): Date:

Annex 3: ECOP for Afforestation

Environmental Codes of Practice for Afforestation

Contents

1. Overview

The Environmental Codes of Practice (ECOP) for Afforestation is developed based on the World Bank requirements on environmental assessment in order to further enhance the ecological and environmental benefits in the implementation of the Forestry Eco-restoration Subproject of Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project and minimize or eliminate the possible negative impacts on the natural environment. This ECOP is intended to provide guidance on the project activities of forest form transformation, barren hill afforestation, landscaping afforestation and other project activities and ensure full realization of the anticipated ecological and environmental benefits and objectives of the Project. In the process of development of this ECOP, the actual circumstances of the Project were taken into account, the experience and lessons of environmental management from previous World Bank loan forestry projects in China were incorporated and full reference was made to the following legal documents:

1) Relevant laws and regulations of the People's Republic of China, namely, the Environmental Protection Law of the People's Republic of China (revised in 2014), Forest Law of the People's Republic of China (2005), Land Administration Law of the People's Republic of China (2004), Law of the People's Republic of China on Soil and Water Conservation (Revised in 2011), Law of the People's Republic of China on Environmental Impact Assessment (2016), Regulations of the People's Republic of China on Prevention and Control of Pests and Diseases in Pests (1989), Regulations of the People's Republic of China on Plant Quarantine (1992), Regulations of the People's Republic of China on Forest Fire Prevention (2009), Regulations on Implementation of the Soil and Water Conservation Law of the People's Republic of China (2014), Regulations of the People's Republic of China on Conversion of Cropland to Forest (2003)，Provisional Measures for Forestation Quality Management "(2010)," Circular on Strengthening the Management of Environmental Impact Assessment of Construction Projects Utilizing Loans from International Financial Organizations "(Huanjian [1993] No. 324);

2) World Bank operational policies, including: Environmental Assessment (OP, BP and GP4.01), Natural Habitats (OP/BP 4.04); Forestry (OP/GP4.36); Safeguarding Cultural Property (OP4.11), Involuntary Resettlement (OP/BP 4.12); Pest Management (GP4.09); Safety of Dams (OP/BP4.37);

3) Environmental, Health and Safety (EHS) Guidelines of the World Bank Group.

2. Experiences in implementation of environmental protection measures in the previous forestry loan projects in the region

China started implementing the World Bank Loan National Afforestation Project in 1990 and ECOPs have been developed since then for each World Bank loan projects for the sake of providing guidance on project design and construction, mitigating or eliminating negative impacts on environment caused by the implementation of such projects and improve the stability and function of environmental protection of the man-made forest eco-system.

In retrospect, the following experiences and lessons may be summarized from the aforesaid World Bank projects in terms of ECOP development and implementation:

(1) Environmental protection measures with strong operability can be developed through strict compliance with the requirements of the World Bank safeguarding policies and the Chinese laws and regulations on environmental protection and close association with the key processes of design and construction of the Project.

(2) Thanks to the actual development and implementation of the ECOPs in the World Bank loan projects, continuous modifications and improvements are effected to the ECOPs and scientific and practical requirements and measures of environmental protection are developed for afforestation and the existing forest form development and improvement projects to assure the realization of the environmental protection objectives of the World Bank loan projects.

(3) Execution of “ECOP” is regarded as one of the criteria for construction quality inspection and acceptance of a project, providing a guarantee for the conscientious enforcement of ECOP and excellent outcomes of environmental protection in project implementation.

(4) Results of environmental monitoring conducted in the project forests indicate that substantially no negative environmental impacts such as soil erosion, soil fertility decrease, etc. are resulted from the construction of a project with ECOPs strictly enforced.

3. Project components and objectives

1) Project components

The construction contents of forest eco-restoration subproject are defined based on the objectives of forest eco-system restoration, i.e. addressing the forest ecological problems and improve the eco-function of forests at important water sources of the strategic water resources:

The first component is forest form improvement. Forest form improvement and reinforcement planting for the inefficient pure forests dominated by pure Pinus massoniana forests; forest form improvement for the degraded Cunninghamia lanceolata forest, pine forest in pest-prone areas, low-efficiency secondary broad-leaved forests, shrub forests, newly established forest and cash forest on deserted land for the purpose of stand improvement.

The second component is landscaping afforestation, including landscaping afforestation on barren hills and land and burning grounds for the purpose of facilitating rapid restoration of forest vegetation.

2) Project objectives

The Project intends to improve and enhance the supply of high-quality water resources in the Xin'an River Basin and build a demonstrative model of landscaping afforestation and forest form improvement with water resource protection as its dominant function through adjustment of stand structure and forest vegetation coverage in the project area so as to increase forest area in the basin, improve forest quality and water conservation, soil and water conservation, forest health, forest landscape, and prevent forest fires, maintain the stability of forest ecosystem, and reinforce the comprehensive benefits and the ecological service functions of forest ecological environment. The Project will finally realize the goal of water environment improvement and protection and create a human-water harmonious and livable environment with clean water, green river shores an beautiful scenery and provide a demonstrative model sustainable development and construction management of multi-function man-made forests for the other areas.

4. Selection of project forest land

The Project involves 20 towns and townships, 187 villages, 16 state-owned forest farms and 61 forest zones covering a total area of 2,379,574 mu in the territory of Chun'an County. The prior watersheds for water source improvement include 5 key watersheds of Wuqiangxi xi Stream, Shangwuxi Stream, Zitongyuan xi Stream, Yuchuanxi Stream and Liuduyuan Stream. The lakeside landscape and ecological conservation zone includes the waterfront mountainous areas, lake island and other ecologically-sensitive zones inside the first course of mountain ridge.

The part of the project area in Jiande City involves 3 townships, 13 villages and 2 state-owned forest farms. With the participating administrative villages and forest areas as the project unit, the project area in Jiande City covers an area of 23935 mu. The first part is the water source protection area on both sides of Shouchang River, a tributary of the Xin'an River, mainly involving barren mountain wastelands and burned-out land in Datong Town and Hangtou Town; the second part is mainly the ecologically sensitive areas on both sides of the key villages, towns and trunk roads.

Forest land with important ecological location should be selected as the forest land for improvement under the Project, including: 1) the 5 key watersheds of Wuqiangxi Stream, Shangwuxi Stream, Zitongyuan Stream, Yuchuanxi Stream and Liuduyuan Stream for prior water source improvement; 2) the lake island landscape and ecological conservation zone including the lake island and lakeside peninsula; 3) the lakeside ecological conservation zone mainly comprising of the waterfront area inside the first course of mountain ridge; 4) other small watersheds; 5) the water source protection area on both sides of Shouchang River, a tributary of the Xin'an River, mainly involving barren mountain wastelands and burned-out land in Datong Town and Hangtou Town; 6) the ecologically sensitive areas on both sides of the key villages, towns and trunk roads.

1) Status quo of property ownership: The mountain forests to be improved have clearly defined ownership and franchise right without any disputes, mainly state-owned or collectively owned, except a small part operated by highly-motivated forest management individuals.

2) Status quo of forest management organizations and individuals: The forest management organizations and individuals, namely the individual farmers and village groups participating in forest management, are highly motivated and express explicit intention of participating in the Project. They recognize highly the importance of the construction of ecological environment and sustainable development of forests and have rich experiences of afforestation and forest management and abundant labor force to carry out the construction works under the Project.

3) Status quo of forest stand or vegetation: The forest land selected for improvement mainly comprises of barren mountains and land, burned-out land, degraded Cunninghamia lanceolata forest, pine forest prone to forest pests, low efficiency P. massoniana forest, low-efficiency secondary broadleaved forest, shrubbery, barren newly afforested land and barren economic forest.

4) Level of protection: Commercial forests or Class II national public welfare forests, provincial public welfare forests, municipal public welfare forests. According to the public welfare forest management method, Class I national public welfare forest shall not be included into the scope of construction projects.

5. Woodland clearing and site preparation

Manual strip or spot clearing of shrubs and grass around the planting holes and stockpiling or burning such shrubs and grass between the strips (spots) for natural decomposition. Vegetation on woodland on steep slopes, hilltops or in valleys shall not be cleared and grubbed.

Eulalia stumping should be carried out first and then the underbrush should be covered with non-woven cloth to suppress regrowth and create a growing condition for the trees and thus achieve higher survival rate.

The hole preparation method should be used for site preparation. Usually with a dimension in the range of 30x30x20cm to 50x50x40cm, the plantation holes

are arranged along the contour line in a triangle layout for the sake of better water and soil conservation.

Burning is prohibited during afforestation on farmland where cultivation is discontinued and barren hills and land.

6. Tree selection

(1) Tree selection

- For better protection of biodiversity, native tree species should be selected as a priority. Excellent provenances, families or clones of excellent native tree species should be selected to enhance their disease and pest resistance and reduce the risk of pest threats. Alien species should be prohibited.
- A multi-species and multi-breed forest arrangement should be adopted to control the scale of continuous plantation of single tree species or single tree type.
- Diversity and adaptability of tree species should be taken into consideration in the selection of replanting tree species. In the selection of forest land for replanting, full consideration should be given to conditions of existing stand in the surrounding forest so that a mixed forest with a multi-species structure is formed with the replanted stand and the existing stand.
- Native species with excellent performance in water source conservation, water and soil conservation and ecological function should be selected and consideration should be given to the rarity, ornamental and fast-growing properties as required.
- The tree species for reinforcement planting and afforestation in each sub-compartment plot should be scientifically selected according to the principles of suitable trees for suitable sites. A scientific choice should be made of sub-compartment management direction and the tree species in the sub-compartment can coexist and a stable forest ecosystem can be formed.

According to the current situation and characteristics of the project area in Chun'an, there are 49 tree species for selection, namely, Castanopsis sclerophylla (Lindl.) Schott, Castanopsis eyrei (Champ.) Tutch., Schima superba Gardn. et Champ., Ilex chinensis Sims, Cinnamomum camphora (L.) Presl, Cinnamomum chekiangense Nakai, Phoebe chekiangensis C.B. Shang, Machilus pauhoi kanehira, Manglietia yuyuanensis Law, Michelia chapensis Dandy, Elaeocarpus sylvestris (Lour.) Poir., 0rmosia henryi Prain, Liquidambar formosana Hance, Albizzia kalkora (Roxb.) Prain, Sapindus mukorossi Gaertn., Koelreuteria integrifoliola, Sapium discolor (Champ. ex Benth), Celtis sinensis Pers, Acer buergerianum Miq, Pistacia chinensis Bunge, Sassafras tzumu (Hemsl.) Hemsl, Liriodendron chinense (Hamsl.) Sarg., Toona ciliata Roem. var. pubescens (Franch.) , Zelkova serrata (Thunb.) Makino, Vernicia montana Lour, Choerospondias axiliaris (Roxb.) Burtt et Hill, Litsea auriculata, Carya cathayensis Sarg, Camellia oleifera Abel, Myrica rubra (Lour.) S. et Zucc., Ginkgo biloba, Taxus mairei SY Hu, Pseudolarix amabilis (Nelson) Rehd,

Keteleeria fortunei var. cyclolepis, Torreya grandis Fort. et Lindl, Magnolia soulangeana Soul.-Bod., cyclobalanopsis gilva, Cercis gigantea, Cunninghamia lanceolata (Lamb.) Hook , Cupressus funebris Endl, Cryptomeria fortunei Hooibrenk ex Otto et Dietr, Betula luminifera H. Winkl, Alnus cremastogyne Burk, Dalbergia hupeana Hance, Pyracantha fortuneana (Maxim.) Li, Cercis chinensis Bunge, Indigofera pseudotinctoria, Nerium indicum Mill, Amorpha fruticosa Linn, etc.

According to the stand growth and existing problems of the project area in Jiande, tree species should be selected with distinct pertinence. Based on the requirements of ecological construction of the Project, there are 22 tree species for selection, namely, Liquidambar formosana Hance, Schima superba Gardn. et Champ., Cinnamomum chekiangense Nakai, Phoebe chekiangensis C.B. Shang, Diospyros kaki Thunb, Zelkova serrata (Thunb.) Makino, Sassafras tzumu (Hemsl.) Hemsl, Betula luminifera H. Winkl, Cyclobalanopsis glauca (Thunb) Oerst, Castanopsis sclerophylla (Lindl.) Schott, Michelia chapensis Dandy, Manglietia yuyuanensis Law, pinus elliottii, Machilus pauhoi kanehira, MaChilus leptophylla Hand.-Mazz., Phoebe sheareri (Hemsl.) Gamble var. sheareri, Machilus thunbergii Sieb. et Zucc, Ilex micrococca Maxim., Magnolia liliiflora Desr, Michelia alba DC., Ginkgo biloba, Carya illinoinensis (Wangenh.) K. Koch, etc.

7. Seedling quality and planting (replanting)

Seedlings to be planted should satisfy the standards specified for Grade I seedlings in GB6001-1985 "Technical specifications on seedling", DB33 / T 179-2005 "Technical specifications on forestry seedling", LY / T 10000-1991 "Container seedling technology" and GB 6000-1999 "Seedling quality classification for main afforestation tree species" and DB33 / 177-2005 "Seedling quality rating for main afforestation tree species".

With thickly grown grass and shrubs under the trees on the plot to be rehabilitated, large seedlings with an age of 3 to 4 years, a ground diameter of more than 2cm and a seedling height of more than 1.5m should be used for afforestation.

A survival rate of more than 90% and a preservation rate of more than 85% should be assured for reinforcement planting.

Reinforcement planting is usually carried out in winter and spring (January to early March). Reinforcement planting with container seedlings has no seasonal restrictions so long as rainwater is available at the time of afforestation.

An appropriate planting depth should be assured to keep the root of seedlings in a vertical position and free of damages and bending. The backfilled pits should be compacted with feet. Before planting of seedlings with exposed roots, the roots should be soaked in yellow mud or treated with rooting powder or water-retaining agent. In addition, the seedlings must be planted the same day of lifting. Otherwise, pseudo-planting measures should be taken to keep the root moist. When container seedlings are planted, the containers should be torn and attention should be paid to prevent the nutrient soil from loosening to

protect the root system.

8. Forest tending and management

(1) Young forest tending

The main contents of young forest tending mainly include earthening-up, weeding, scarification etc., to promote the growth of trees. In order to protect the undergrowth vegetation, soil and water sources, block-type tending is recommended, but herbicides are prohibited.

Seedlings and young trees for reinforced planting or afforestation should be tended carefully for 3 continuous years to assure the survival and growth rate. In the first two years, the trees should be tended twice a year, the first tending in spring and the second in summer and autumn. In the third year, 1 tending should be conducted in summer and another in autumn. The woodland should be separately irrigated, weeded and scarified in blocks. If the root stump of young trees is exposed, they should be earthed up. If grass and shrubs are found growing thickly around the holes, splitting irrigation, hole expansion, scarification and weeding should be conducted around the holes.

(2) Grown forest tending

Grown forest tending should be conducted by means of shrub and grass cutting and coverage for artificial weeding and surface vegetation should be preserved to a certain extent. Herbicides are prohibited and measures should be taken to prevent soil erosion and soil damage.

(3) Weeding and scarification

Herbicides are prohibited. Young forest tending should be conducted using the local tending method to expand the hole, scarify the soil and remove the weeds around the young trees and preserve the natural vegetation on the young forest land where possible. Vegetation residuals left over from weeding should be left in the field as coverage.

Dead twigs and fallen leaves under the trees should not be collected for burning in order to improve the ability of water conservation forest and maintain soil fertility.

(4) Fertilization

Organic fertilizers should be selected where possible while chemical fertilizers should be applied in strict accordance with the afforestation model, with the time, frequency, volume and method of fertilization strictly conforming to the properties and requirements of the respective fertilizer. Random fertilization is prohibited. A fertilization scheme should be developed based on appropriate research outcomes or appropriate soil and plant test results. Fertilizers should be applied in holes or ditches and broadcast fertilization is prohibited. The fertilizers should be placed on the upslope direction of the holes and topped with soil for loss of nutrients and pollution of surface water.

(5) Irrigation

Water-saving irrigation measures, e.g. dry well rainwater collection, reservoirs

among other rainfall interception methods, should be adopted, where possible, to save local water resources and increase the efficient use of natural precipitation.

9. Integrated pest management

The project forest should be subject to integrated pest management to assure healthy growth and development. For this purpose, an “Integrated Pest Management Plan” is developed for the implementation of the Project.

10. Fire management

Fire protection of the project forest must be incorporated into the local forest fire management systems. Each afforestation unit must develop its own forest fire protection plan and set up its fire management body. Detailed plans should be developed for fire protection, public education, patrol and law enforcement and emergency responses to fire accident.

Fire belts must be constructed for forest land under the Project with an area of more than 100 h.a and without a fire belt. The land parcel should be divided into a number of sub-compartments with a unit area of less than 35 h.a. the fire belts should be 10 to 20m wide and river ways and native natural fire-protection plants should be utilized, where possible, as fire belts.

11. Cutting and regeneration

(1) Cutting

Selective cutting or thinning should be conducted for adult pure coniferous forest for reinforcement if the crown density is high and light penetration is poor. Some grown pines should be cut to form a regeneration canopy gap to create conditions of illumination favorable to growth of undertree broad-leaved seedlings and young trees; trees subject to pest hazards should be cut and removed to improve stand health.

A. The cutting operation should be carried out in strict accordance with the “Forest Law” and the “Felling Regulation”.

B. The Project only allows cutting and felling for the purposes of tending and regeneration and does not permit any cutting for commercial purposes.

C. Available thinning method include block felling, group felling and interlaced felling for development of scientific mass mixture and line mixer and the formation of a forest pattern in blocks for the sake of easy reinforcement operations such as replanting and tending.

D. Thinning and tending thinning should be conducted following the principle that the thickly and poorly grown parts should be thinned and the thin and well-grown parts preserved. Profit-making or commercial cutting, unplanned cutting and felling must be terminated. Tree felling direction should be controlled to avoid, where possible, damages and harms of the regenerated young seedlings and trees; treetops and twigs left over from cutting should be removed out of site in a timely manner.

E. Upon cutting, attention should be paid to protection of undergrowth

vegetation, which must be regenerated the second year after cutting.

(2) Forest regeneration

A. For arbor forest, long-cycle forest management model is adopted and selective cutting is adopted for regeneration cutting. The age of selective cutting is more than 50 years for arbor forest, more than 30 years for fir and more than 70 years for broad-leaved trees.

B. Cutting operation should strictly respect the requirements specified in the Management method for forest cutting and regeneration. Slope land with a gradient of more than 15 degrees should use the block cutting method with a cutting surface of no more than 5 h.a and the adjacent cutting faces of the same year should have a spacing of at least 50m. The cutting face of slope land with a gradient of less than 15 degrees, the adjacent cutting face of the same year should have a spacing of at least 100m.

C. Surface vegetation should be protected upon cutting and the cutover land should be regenerated and replanted in the second year after cutting.

Appendix: Introduction of key tree species

1. Castanopsis eyrei (Champ.) Tutch.

Fagaceae evergreen megaphanerophyte widely grown in mountainous areas; 20 m high, with a DBH of 50 cm; deep cracks in bark with a thickness of 1 cm, massive spalling; branches with many lenticels, glabrous branches and leaves. Growing in sparse or dense forests in low hills or mountains 300-1700 meters above sea level. Being a major tree species in the evergreen broad-leaved or coniferous broad-leaved mixed forest. Suitable to grow in fertile and moist acid soil in warm and rainy areas; capable of growing in barren stone soil. Excellent shade tolerance in young ages and requiring certain illumination in adult age. Deep root, strong germination, excellent pollution resistance and long life.

2. Ilex chinensis Sims

Ilex chinensis Sims is an evergreen tree and a type of flowering plant usually with a height of 13m. Ilex chinensis Sims is a subtropical tree preferring warm climate and with a certain cold tolerance. Suitable to grow in fertile, moist and well-drained acid soil, Ilex chinensis Sims has excellent tolerance to damp conditions and strong germination force and resistance to trimming. It has strong resistance to CO_2 and is usually found growing in miscellaneous forest on hill slopes and in and on the verge of evergreen broadleaved forests on hill slopes with an elevation of 500 to 1000m.

3. Cinnamomum camphora (L.) Presl

Evergreen trees, one of the representative constructive species of the zonal evergreen broad leaved forest, growing on mountains, plains and island with an altitude of below 600m; mesophilous-to-intolerant species, with the seedlings slightly shade-tolerant and grown trees intolerant; preferring thick, moist, fertile, well-drained neutral or acid sandy loam, light sandy loam and yellow red soil; prone to yellowing disease in light saline soil; deep and well-developed horizontal and vertical root system, strong germination; excellent wind resistance; fast-growing and with a fast-growing period of: 10~30 years in terms of tree height, 10~40 years in terms of DBH, and 50~60 years in terms of timber volume; long life, mostly ancient trees; widely distributed in the whole province, often artificially cultivated.

4. Elaeocarpus sylvestris (Lour.) Poir.

Evergreen megaphanerophyte, associated tree species of evergreen broad-leaved forest, and suitable for mixed afforestation with Cunninghamia lanceolata (Lamb.) Hook and Chinese red pine; shade-tolerant tree species, intolerant in middle age; suitable to grow in subacidic and neutral red and yellow mountainous soil; deep root; strong germination; fast-growing, capable of growing into large diameter timber. Widely distributed all over the province.

5. Toona ciliata Roem. var. pubescens (Franch.)

Deciduous or nearly evergreen megaphanerophyte of the meliaceae family with a height of up to 20m; often growing in valley forest or hillside open forest of low altitude; intolerant species preferring warm and humid climate; strong adaptability and excellent cold tolerance to a low temperature of -15℃; strong

soil adaptability and capable of growing normally on dry and infertile hill slopes.

6. Koelreuteria integrifoliola

Deciduous trees with a height of more than 20 meters; round and oval tree lenticels; twigs with small warts. K.bipinnata, preferring warm and humid climate, shade-intolerant, slightly tolerant to half-shade; growing in limestone soil, with tolerance to saline soil, frost, drought and barren soil, and tolerance to short-term waterlogging. Deep root, medium growth, slow in young age and faster later on. Strong resistance to wind, dust pollution, sulfur dioxide and ozone.

7. Sapium discolor(Champ. ex Benth

Tree or shrubs, 3-12m high, rarely up to 20m high; totally glabrous; grey brown twigs with lenticels; flower period lasting from April to June; growing in mixed forest in valleys or on hill slopes.

8. Celtis sinensis Pers

Trees, smooth and gray bark, annual branch with dense tomentose mostly growing under shade on plains; scattered growth observed on plains and low mountains; commonly seen around villages; range of altitude: 100~1500 meters. shade-intolerant, suitable to grow in warm and humid climate and flat fertile land. Not stringent on soil requirement, having certain drought resistance, also tolerant to moist and barren soils, with strong adaptability.

9. Acer buergerianum Miq

Deciduous trees with brown or dark brown bark, rough and forward-extending lobes, fully or irregularly serrated leaves. Protruded kernel; fruit wings extended in an acute angle. Growing in broadleaved forest at an altitude of 300 to 1000m; slightly shade-intolerant and slightly shade-tolerant trees; preferring warm and humid environment and neutral to acid soil; good tolerance to cold and wetness; strong germination; good tolerance to trimming; developed root system with strong root tilling.

10. Litsea auriculata

Deciduous trees, with a height of 10-20 m and a DBH of 40-60 cm; peak flowering in mid-April, full leaf expansion in late April, flowering period in March and April, fruit ripening in mid-September, defoliation beginning in mid-November. Growing in deciduous broad-leaved forest or coniferous and broad-leaved mixed forest on hill slopes or in valleys with an altitude of 500 to 1000m. Generally requiring deep, fertile soil and lateral shading.

11. Carya cathayensis Sarg

A deciduous tree belonging to the genus carya of Juglandaceae, with a height of 10 – 20m and a DBH of 30 – 60cm; smooth and white gray barks; suitable to grow at hill foot or in valleys with rich humus with an altitude of 400 – 1200m. The key production areas of Carya cathayensis Sarg include Tianmushan Mountains, Changbei District and Henglu Township on the border of Zhejiang and Anhui.

12. Taxus mairei SY Hu

Evergreen trees with pale gray bark longitudinally cracked into thin slices; obtuse or slightly pointed bud scales, peeled off or partially remaining at the base of branches. Distributed in provinces south of the Yangtze River basin; Class I national key protected wild plants. Shade-tolerant, preferring warm and humid climate, usually growing in the relatively humid hinterland at the foothills.

13. Torreya grandis Fort. et Lindl

A species under the genus torreya under Taxus chinensis; evergreen coniferous trees with a height of 25m and a DBH of 2m; straight and vertical trunk and fully expanded large leaves; an oval-shaped crown; growing in warm and rainy areas with yellow soil, red soil and yellow cinnamon soil; intolerant and preferring cool and humid environment; usually scattered growing in yellow soil valleys with deep soil stratum and trees; intolerant to waterlogging and depressions; poor growth in dry and barren areas; cold resistance; trees with an age of 200 years usually show strong vitality.

14. Magnolia soulangeana Soul.-Bod.

Small deciduous trees with leaves of inverted oval to wide oval with a length of 6 – 15cm and a width of 4 – 15cm; glossed green on the front and light green on the back covered with pubescence; short leave stems covered with pubescence; intolerant and preferring warm and humid weather.

15. Cercis gigantea

Deciduous trees or large trees; The natural plant can grow as high as 30m with a DBH of more than 1500px. It is an excellent native tree species found in recent years. Suitable for planting in dry and sunny places, but not suitable to grow in low-lying waterlogging areas and overshaded areas; Suitable for planting in most parts of the country and being an excellent ornamental tree for its colorful leaves.

16. Cupressus funebris Endl

Trees with a height of up to 35m and a DBH of 2m; light brown grey barks fragmented into narrow low slices; preferring warm and humid climate with an annual average temperature of 13℃-19℃ and an annual rainfall of more than 1000mm; evenly distributed, Cupressus funebris Endl grows well in places with no obvious dry season. With a wide soil adaptability, such trees can grow on neutral and slight acid and calcium soil; tolerant to dry and barren conditions and also slightly tolerant to wetness; main root is shallow and thin, but the lateral root is well developed.

17. Cryptomeria fortunei Hooibrenk ex Otto et Dietr

Trees with a height of up to 48m and a DBH of more than 2m; red brown fiber-shaped barks fragmented into long peel-off slices; medium-intolerant to shade; preferring deep and fertile sandy soil, but intolerant to waterlogging; growing on the edge of valleys and in the wet forests in the valleys with an altitude of 400 – 2500m.

18. Alnus cremastogyne Burk

Trees, up to 30-40 m high; gray and smooth barks, gray or gray brown and glabrous branches; intolerant to shade and preferring warm climate; suitable to grow in low hills and plains and mountains with an annual average temperature of 15~18 and a precipitation of 900~1400mm. Strong adaptability to soil, water and humidity. Mostly growing in river plains and low wetlands.

19. Dalbergia hupeana Hance

Trees with a height of 10 to 20m; dark grey and peel-off barks; light green and glabrous twigs; growing in mountains, low hills and plains; growing in small areas or clusters inside broadleaved forest or pinus massoniana forest; intolerant to shade, but tolerant to dry and barren areas and able to grow in acid, neutral or lime soil; deep rooted and with root stump; capable of nitrogen fixation; pioneer afforestation tree species on barren hills and land; natural forest growing at a slow speed, but man-made forest growing fast.

20. Pyracantha fortuneana (Maxim.) Li

Evergreen shrubs with a height of up to 3 meters; preferring strong sunshine, tolerant to drought, but not cold; planted in open air south of the Yellow River, but planted in pots, plastic sheds or low-temperature greenhouses in North China for wintering; tolerant to temperature as low as 0 degrees; having no stringent requirements on soil, preferring well-drained, wet and loose neutral or slightly acid soil.

20. Cercis chinensis Bunge

Leguminosae, deciduous trees or shrubs; originating in China; preferring sunshine and with certain cold resistance; preferring fertile and well-drained soil, not tolerant to flooding. Strong sprout tiller; tolerant to trimming;

21. Indigofera pseudotinctoria

Rosales, Leguminous semi-shrub plants; shorter plants with uniform height of 0.8-1.0 meters; feather-shaped compound leaves; leaflets 7-11, elliptic, racemose, axillary, pale red or purplish red corolla; mainly growing in streams, mud and shrubs.

22. Nerium indicum Mill

Evergreen vertical-stand large shrubs with a height of up to 5m; grey green twigs; shoots with prism and thin pubescence, which falls off in old age. Cultivated in all provinces in China, in particular in southern Chinese provinces, often in parks, scenic spots, roadside or riverside and lakeside areas; preferring warm and humid weathers, poor cold resistance and wetness resistance; intolerant to shade and fond of fertilizer; adaptable to wet and shaded environment.

23. Amorpha fruticosa Linn

Leguminous deciduous shrub with a height of 1 to 4 m; brown twigs covered with pubescence and later becoming glabrous; leaves alternate. Flowering and fruit period lasts from May to October. Amorpha fruiticosa Linn prefers dry and cold climate and grows the best in North China with an annual average temperature of 10℃ to 16℃ and an annual precipitation of 500 to 700mm.

Strong tolerance to cold weather and also drought; capable of growing in areas with an precipitation of 200mm; with certain tolerance to undulation and staying alive after undulated for 1 month; requiring adequate sunshine; no stringent requirement on soil.

24. Carya illinoinensis (Wangenh.) K. Koch

Large trees with a height of up to 50m and a DBH of up to 2m; broadly oval crown; developed root system, good tolerance to wetness; intolerance to shade; preferring warm and moist climate; with certain tolerance to cold; suitable to grow in loose, well-drained, thick and fertile sandy soil or alluvial soil; poor tolerance to drought; intolerance tree species; preferring warm and moist climate; with large adaptability to soil pH; growing well in slightly acid or slightly alkaline soil; poor tolerance to dry and barren soil; growing fast on alluvial plains or river plains with deep, loose and rich humus soil; deep root; strong suckering ability; medium growing speed and long life; suitable to be cultivated in riverside and lakeside areas.

25. Magnolia liliiflora Desr

Genus Magnolia of Magnoliaceae, deciduous shrubs with a height of up to 3m; often clustered, brown barks, green purple or light brown purple branches. Florescence in March and April and fruit period in August and September. Endemic to China, growing in the area 300 meters to 1600 meters above sea level, usually on the edge of hillside forest.

26. Ginkgo biloba

Trees with a height of up to 40m and a DBH of up to 4m; flowering in March and April and seed maturity in September and October; with a wide area of cultivation; intolerant tree species with deep root system; wide adaptability to climate and soil; capable of growing, but at slow speed or poor quality, in areas with high temperature and high precipitation as well as areas with little precipitation and cold winters; capable of growing in acid soil (with a pH value of 4.5), lime soil (with a pH value of 8) and neutral soil, but not tolerant to salinized soil and excessively wet soil. Best growing in areas with an altitude of less than 1000m (or 1500-2000m in Yunnan), a warm and humid climate and an annual precipitation of 700-1500mm and thick, fertile and well-drained soil; hardly able to survive or growing poorly in dry and barren soil, on rocky hill slopes and excessively wet areas.

27. Michelia alba DC.

A species of Magnolia with white flowers; deciduous trees with a height of 17m, widely expanded branches, broad umbrella-shaped crowns and a DBH of 30cm; grey barks; fragrant braches and leaves when rubbed; flowering in April to September; peak flowering in summer, usually not solid. Suitable to grow in warm and moist climate and fertile and loose soil; intolerant to shade; intolerant drought and waterlogging; dead after a root undulation of 2 to 3 days; sensitive and poor resistance to toxic gases such as SO_2 and chlorine.

28. Ilex micrococca Maxim.

Large deciduous trees with a height of up to 20m; first-year twigs with obvious

lenticels; flowering in May and June and fruiting in September and October; growing in evergreen mountainous broadleaved forests with an altitude of 500m to 1300m; distributed in China, Japan and Vietnam.

29. Machilus thunbergii Sieb. et Zucc

Secondary evergreen trees of the Genus Machilus of Lauraceae with a height of up to 20 meters; short and bulky trunk with a diameter of up to 4 m; flowering in February and fruiting in July; growing in broad-leaved mixed forest in moist areas on the low mountain slope in nature; often growing together with Fagaceae, Theaceae and Lauraceae, Magnoliaceae and other species; Mostly growing together with Castanopsis fargesii and Castanopsis sclerophylla in the mountainous forests with an altitude of less than 800m; pure forest rarely observed.

30. Phoebe sheareri (Hemsl.) Gamble var. sheareri

Large shrubs to trees of Lauraceae with a height ranging from 5m to 15m; grey white barks; growing in areas along and south of the Yangtze River Basin; mostly growing in the mountainous broadleaved forests with an altitude of less than 1000m; good tolerance to shade; preferring warm and moist climate and thick, fertile and moist and well-drained light acid and neutral soil; with certain cold tolerance; growing normally in Nanjing and Shanghai; deep root; strong germination; slow growth.

31. MaChilus leptophylla Hand.-Mazz.

Large and high trees with a height of up to 28m; hard papery leaves in an obviated lanceolate shape with a length of 12 to 22cm; with white powder and think and flat pubescence on the back and a cuneate and slightly arced base; ball-shaped fruit; flowering in April and May and fruiting in the months of June to September; originating from the shrub or bamboo forests on the shade slopes or in the valleys in Longchi Mountain and Mingling Mountain in Yixing; distributed in Zhejiang, Anhui, Jiangxi, Fujian, Hunan and northern Guangdong.

32. Machilus pauhoi kanehira

Trees with a height of 6.5m to 20m and a DBH of up to 30cm; grey brown barks with shallow cracks; originating in Zhejiang and Fujian; deep-rooted tree species with shade tolerance; preferring shade and moist conditions and growing slowly in young age; intolerant to shade and preferring wet conditions and growing fast in middle age; strong adaptability and capable of growing in thick yellow soils in the mountainous areas with an altitude of less than 800m, in particular at hill foot or by valleys with loose, moist, fertile and well-drained soil.

33. pinus elliottii

Fast-growing evergreen trees preferring wet soil with an altitude of 150 to 500m; with straight and beautiful posture and dense leaves; pinus elliottii is suitable to grow and cultivate in clusters or parcels on hill slopes or by streams and reservoirs and also suitable to be cultivated alone or in clusters in gardens and grasslands as shade and background trees. Pinus elliottii is an excellent

and universal gardening and landscaping tree species with excellent tolerance to drought, waterlogging and barren soil and also excellent adaptability and resilience.

34. Manglietia yuyuanensis Law

Trees of the genus of Manglietia under the category of Magnoliaceae, with a height of up to 8 meters and a DBH of 18 cm; gray brown barks and yellow brown branches; glabrous except the golden pubescence on the outer bud scales. Originating in Anhui (Mount Huangshan) and southern Zhejiang in China and growing in forests with an altitude of 700-1200 meters. Preferring warm and humid climate environment, tolerant to shade, in particular the samplings. Excellent natural regeneration; suitable to grow in thick, moist, fertile or moderate and well-drained acid yellow soil; naturally growing in valleys and terraces with an altitude of 1300 meters and the middle and lower parts of the hill slopes; often growing mixed with evergreen broadleaved forests including Machilus thunbergii Sieb. et Zucc, Elaeocarpus sylvestris (Lour.) Poir, Schima superba Gardn. et Champ. and Castanopsis, etc.

35. Michelia chapensis Dandy

Evergreen trees with a height of 15-30 meters and a DBH of 1 cm; gray to dark brown barks growing in evergreen broadleaved forests with an altitude of 500-1500 meters. Preferring warm and humid climate environment, suitable to grow at a temperature range of 15-32℃ and tolerant to high temperature up to 41℃ and also tolerant to cold. Tolerant to light, but preferring shade in seedling period; preferring thick, loose, fertile and well-drained acid to slightly alkaline soil; tolerant to environment with high ground water level, growing poorly in dry soil; usually found growing well in the middle and lower part of hill slope and on both sides of a valley, but poor on mountain ridges and hill slopes.

36. Castanopsis sclerophylla (Lindl.) Schott

Trees belonging to the genus of Castanopsis under the category of Fagaceae in the Fagales family; Class II national protected plants; 5-10 m tall and rarely up to 15 meters high; DMH: 30-50 cm, barks with shallow cracks and flaking, gray branches with scattered lenticels; new twigs of the current year are red brown and slightly ribbed; glabrous branches and leaves. Growing in the open or dense forests on low hills or hill slopes with an altitude of 200-1000 meters and often growing together with cedar and camphor and occasionally cultivated around villages or by the roads; preferring adequate sunshine; tolerant to drought.

37. Cyclobalanopsis glauca(Thunb) Oerst

Evergreen trees belonging to the genus of Cyclobalanopsis under the category of Fagaceae with a height of 20m and a DBH of up to 1m. Glabrous twigs; distributed in provinces of Shaanxi, Gansu and Zhejiang in China; being one of the species of Fagaceae most widely distributed in China. Growing on hill slopes or in valleys with an altitude of 60 to 2600m as a part of the evergreen broadleaved forests or mixed evergreen broadleaved and coniferous forest or broadleaved mixed forests. With strong adaptability, Cyclobalanopsis

glauca(Thunb) Oerst can grow on both acid and alkaline substrate and form a single dominant community in limestone mountainous areas. Strong natural regeneration and medium growing speed; good tolerance to cold weathers and to an extreme low temperature of -10 ℃; tolerant to shade and barren soil; deep roots; vertical root system; tolerant to drought; strong germination and capable of achieving sprout regeneration.

38. Sassafras tzumu (Hemsl.) Hemsl

Deciduous trees of the genus of Sassafras under the category of Lauraceae with a height of up to 35 meters and a DBH of 2.5 meters; smooth barks; large and oval apical bud and approximately round-shaped bud scales; flowering in March and April and fruiting in May to September; distributed in the provinces of Zhejiang, Jiangsu and Anhui; often growing in open or dense forests with an altitude of 150-1900m. preferring warm and humid climate with adequate rainfall and an annual average temperature of 12-20℃. Afforestation usually on sunny slope with an altitude of less than 800m; suitable to grow in thick, well-ventilated and well-drained acid soil; suitable to be cultivated in places with loose, thick, adequately moist and well-drained acid red soil or slightly acid yellow soil, such as red soil, yellow soil, sandy soil, black sandy soil and other types of filled soil.

39. Betula luminifera H. Winkl

Trees with a height of up to 20m and a DBH of up to 80cm; red brown or dark yellow grey, solid, dense and smooth barks; originating in Yunnan, Zhejiang, Guangdong and Guangxi and growing in miscellaneous forests on sunny slopes with an altitude of 500-2500m; preferring warm and wet climate and fertile acid and sandy soil; strong adaptability and good tolerance to dry and barren land; pioneer tree species for afforestation in mountainous areas.

40. Zelkova serrata (Thunb.) Makino

Class II national key protected plants; deciduous trees of the category of Zelkova schneideriana with a height of up to 30m and a DBH of up to 100cm; vertically distributed on mountainous areas and plains with an altitude of below 500m and, in Yunnan, up to 1000m; intolerant tree species preferring warm environment; tolerant to smoke and hazardous gases; suitable to grow in thick, fertile and moist soil and strong adaptability to soil; capable of growing in acid, neutral and alkaline soil and light salinized soil; deep root and expanded lateral root; strong wind resistance; intolerant to waterlogging and drought and barren land; slow growing and long life.

41. Diospyros kaki Thunb

Intolerant tree species preferring warm climate, but also tolerant to coldness and adaptable to areas with an annual average temperature of above 9℃and an absolute low temperature of less than -20℃; strong tolerance to drought and having no stringent requirements on soil; capable of growing in acid, neutral and lime soil; most suitable to grow in rich organics soil or clay soil, but not tolerant to sandy soil. Diospyros kaki Thunb has developed root system, strong germination and long life and is extremely widely distributed in the low hill areas in Zhejiang Province.

42. Liquidambar formosana Hance

Deciduous trees distributed in low hill forests with an altitude of below 700m and being one of the representative community species of the sub-tropical broadleaved forest; as an intolerant tree species, the young trees are slightly tolerant to shade; deep rooted and with strong shade tilling; preferring thick, fertile and moist acid and neutral soil; tolerant to dry and barren land and capable of growing in barren gravel soil and clayey yellow soil and also tolerant to short-term undulation; strong natural regeneration capability; strong resistance to wind, cold and fire; fast growing, but growing relatively slow in the first 10 years and fast in the 10^{th} to the 50^{th} year; long life; ancient trees often observed around villages; extremely commonly seen in low hill areas all over the province.

43. Schima superba Gardn. et Champ.

Family: Theaceae

Ecological habit: evergreen trees with straight trunks and being the most commonly seen constructive species of local evergreen broadleaved forest in Zhejiang Province; growing in the valleys of low to medium-height hills with an altitude of below 1600m; mesophilous to intolerant tree species; tolerant to shade in young age; preferring overhead sunshine; adult trees are intolerant; suitable to grow in acid soil; tolerant to dry and barren land, but intolerant to water and wetness; medium growing speed; with a fast growing stage of 30 years, with a maximum annual increment of around 15 years and a DBH of around 25 years; deep rooted tree species with extremely strong germination and fire resistance.

Geographical distribution: distributed in mountainous and semi-mountainous areas all over the Province and often cultivated for afforestation.

44. Cinnamomum chekiangense Nakai

Family: Lauraceae

Ecological habit: evergreen trees with straight trunks; one of the constructive species or associated species of local evergreen broadleaved forest; scattered growing in the broadleaved forests on both sides of the hill slopes and valleys with an altitude of 1100m; mesophilous tree species; tolerant to shade in young age; preferring lateral shade; adult trees are intolerant; most suitable to grow in warm and humid climate and thick, fertile and well-drained slightly acid soil; also distributed in lime soil; deep rooted tree species with extremely strong shade tilling; fast growing.

Geographical distribution: Hangzhou, Ningbo, Wenzhou, Quzhou, Zhoushan and Lishui;

45. Phoebe chekiangensis C.B. Shang

Family: Lauraceae

Ecological habit: evergreen trees growing in evergreen broadleaved forests by streams and on shady hill slopes; highly tolerant to shade, but requiring appropriate sunshine condition in middle age; deep rooted; strong wind

resistance and weak germination; requiring warm and humid climate and fertile, moist and loose soil;

Geographical distribution: Longwang Mountain of Anji and Xitianmu Mountain of Lin'an in Zhejiang Province.

46. Liriodendron chinense (Hamsl.) Sarg.

Deciduous trees, mostly growing in a scattered way in evergreen and deciduous broadleaved forests in mountains with an altitude of more than 500m and occasionally constructive species. Intolerant tree species and tolerant to shade in young age; suitable to grow in acid soil with a pH value of 4.5 to 6.5; preferring thick and loose, fertile and moist and well-drained soil and temperate and humid climate; tolerant to a low temperature of -20℃ and with equivalent wind resistance as Pinus taiwanensis; fast growing, with the first 20 years as the fast growing period, in particular the first 10 years; DMH growth in the first 10 years is slow and accelerates later on and even faster after 20 years till 100 years; distributed in some counties (cities, districts) of Hangzhou, Wenzhou, Huzhou, Quzhou and Lishui.

47. Albizzia kalkora (Roxb.) Prain

Deciduous trees growing in or on the verge of mountain or low hill forests in a scattered way or in small parcels; intolerant tree species with a wide ecological width; preferring warm and humid and sunny environment, having strong adaptability to climate and soil; suitable to grow in well-drained and fertile soil, but also tolerant to barren soil and dry climate, but not waterlogging; fast growing tree with strong wind resistance; distributed in all cities of the Province, commonly seen on sea islands in Zhejiang Province;

48. Sapindus mukorossi Gaertn.

Deciduous trees growing in and on the verge of forests on hill slopes and in valleys and around the plains with an elevation of below 900m; wide ecological amplitude and strong adaptability of soil; suitable to grow in acid soil, slightly alkaline soil and light salinized soil; strong wind resistance; commonly seen all over the province.

49. Manglietia yuyuanensis Law

Evergreen trees as one of the associated species of local evergreen broadleaved forests; growing in a scattered way in valley and hill slope forests in the humid mountainous areas with an altitude of below 1300m; mesophilous to intolerant tree species; tolerant to shade in young age; excellent natural regeneration; shallow root; the main root is not obvious and the lateral root is very developed; preferring warm and humid climate, but tolerant to a low temperature of -10℃; suitable to grow in thick, wet, fertile or moderate and well-drained acid soil; fast growing tree, strong germination; strong fire resistance. Originating in some counties of Hangzhou, Wenzhou, Shaoxing, Huzhou, Jinhua, Quzhou and Lishui.

50. Choerospondias axiliaris (Roxb.) Burtt et Hill

Deciduous trees scattered growing in and on the verge of broadleaved forests in valleys or on hill slopes in low-hill and mountainous areas with an altitude of

less than 900m; strong adaptability, able to grow in acid, neutral and alkaline soil; preferring thick and well-drained soil; able to grow in barren gravel soil; intolerant to cold and windy areas, waterlogged areas and saline and alkali soil; deep-rooted species with developed horizontal root system; strong germination and fast growing; distributed in Hangzhou, Wenzhou, Quzhou, and Lishui.

51. Pistacia chinensis Bunge

Deciduous trees growing on hill slopes, by the streams, on the plains in mountainous and low-hill areas of all ranges of altitudes; often observed in coastal areas; intolerant tree species with no tolerance to shade; having no stringent requirements on climate and soil; tolerant to dry and barren soil and light saline soil; deep roots, strong germination and wind-resistance; slow growth and long life; distributed in Hangzhou, Ningbo, Wenzhou, Quzhou, Lishui and Zhoushan.

52. Ormosia henryi Prain

Evergreen trees or small trees growing in the miscellaneous forests on hill slops and in valleys with an altitude of 100m to 1300m; often growing together with Cunninghamia lanceolata (Lamb.) Hook, Liquidambar formosana Hance, masson pine and Albizzia kalkora (Roxb.) Prain; preferring warm climate, tolerant to cold; flexible requirement of sunshine; able to grow in fully illuminated or shaded environment, but preferring bright scattered light; preferring moist soil, intolerant to dry soil; may be used for fire protection; distributed in the mountainous and semi-mountainous areas all over the province.

53. Pseudolarix amabilis (Nelson) Rehd

Deciduous trees scattered growing in the coniferous and broad-leaved forests in areas with an altitude of 100m to 1500m; fast-growing and often growing in warm and rainy mountainous areas with thick, fertile and well-drained acid soil; intolerant to shade, with slightly tolerance to shade in the early age, but having stronger demand for sunshine later on; distributed in Hangzhou, Huzhou, Shaoxing, Ningbo and Taizhou.

54. Cunninghamia lanceolata (Lamb.) Hook

Evergreen trees with a height of up to 30m and a DBH of up to 2.5 to 3m; intolerant to shade; preferring warm and moist and foggy and calm wind climatic environment; intolerant to severe cold and wet and hot weather; intolerant to wind, drought, salinized soil; preferring fertile, thick, wet and well-drained acid soil; shallow roots; with no obvious main root, but having developed lateral root and fibrous root; strong regeneration ability, but poor penetration ability; the most important fast-growing timber trees for the warm areas and generally cultivated in all provinces south of the Yangtze River.

55. Vernicia montana Lour

Deciduous trees often mixed growing with broad-leaved and coniferous trees; often developed into advantageous species in secondary broad-leaved trees or burned ground; intolerant; young trees slightly tolerant to shade; strong

sunshine required for adult age; tolerant to dry and barren land; growing very fast in warm and rainy places with thick and fertile soil; distributed in Hangzhou, Quzhou and Lishui.

56. Camellia oleifera Abel

Evergreen shrubs to small trees, preferring warm sunshine, required to be planted on gentle slope with weak erosion; having no strict soil requirements; generally suitable for deep acidic soil, but not for rocky and hard soil. Camellia oleifera Abel is one of the world's four largest woody oil tree species and is widely cultivated in areas spanning from the Yangtze River Valley to South China. As a nationally encouraged key woody oil tree species, it is cultivated in the mountainous areas in Hangzhou, Jinhua, Quzhou, Taizhou, Lishui and Wenzhou.

57. Myrica rubra (Lour.) S. et Zucc.

Evergreen trees, growing on hill slopes or in valleys with an elevation of 125 to 1500m; preferring acid soil, strong cold resistance, not particular about soil condition, good resistance to drought and poor soil, pioneer tree species for water and soil conservation, with its root stumps having the function of soil improvement; strong and easy to plant, Myrica rubra (Lour.) S. et Zucc. has a long economic life and its production cost is obviously longer than the other fruit trees and is therefore an important cash tree in Jiangnan area. It is planted in the mountainous areas all over the province.

Annex 4: Agriculture Pest Management Plan

Agriculture Pest Management Plan

Contents

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1. Foreword

1.1 PROJECT OVERVIEW

Located on the south wing of the Yangtze River Delta on the southeast coast of China facing the East China Sea to the east, Zhejiang Province borders on Fujian to its south, Jiangxi and Anhui to its west and Shanghai and Jiangsu to its north. Spanning a straight-line distance of around 450km east to west and also south to north, Zhejiang Province has a land area of 101,800 km^2.

Zhejiang Province is topographically complicated, with 70.4% of its land area being mountains and low hills, 23.2% plains and basins and 6.4% rivers and lakes while the arable land only amounts to 2,081,700 h.a, giving birth to the saying of "70% mountains, 10% water and 20% farmland". With a terrain inclining from southwest towards northeast, Zhejiang Province roughly comprises of six terrain zones, namely, the plains in northern Zhejiang, low hills in eastern and western Zhejiang, and Jinqu Basin in the middle, the mountainous areas in southern Zhejiang, the plains on the southeastern coast and the coastal islands. There are eight water systems in the Province, namely, Qiantang River, Ou River, Ling River, Tiaoxi River, Yong River, Feiyun River, Ao River and Beijing-Hangzhou Great Canal (Zhejiang Section).

Over the past decades, greater social and environmental challenges have been brought about by the fast growth of Chinese economy, in particular in terms of the increased water consumption and pollutant discharge as well as ecological degradation. The PRC government has included water resource management, environmental protection and ecological protection into its important political agenda and developed specific objectives in its 13th Five-year Plan (2016-2020) in order to reduce soil erosion, effectively treat urban wastewater, reduce agricultural pollution and improve river management and enhance water resource security.

As the largest fresh water lake in Zhejiang Province, Qiandao Lake plays an important role in the ecological and economic development of the Province. Fast economic growth, urbanization, intensive agricultural production and improving living environment and tourism development in China have resulted in increased environmental pressures upon Qiandao Lake. Having become aware of the risks in the face of Qiandao Lake, the National Development and Reform Commission (NDRC), in cooperation with multiple government departments, conducted a comprehensive study and developed a blueprint for sustainable development of the region. The resulting plan, named "Integrated Plan for Water Resources and Eco-Environmental Protection in the Basin of Qiandao Lake and its Upstream Xin'an River" was approved in December 2013 by the State Council.

In such a context, Zhejiang Provincial Government (ZPG) initiated a request

for support from the World Bank and the Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project emerged as time requires. The Project proposes to utilize an IBRD loan in an amount of US$150 million and a counterpart fund of US$150 million in integrated management of the entire basin in Chun'an County and Jiande City of Zhejiang Province to reduce pollution and improve forest ecological environment in Qiandao Lake Basin and serve as a demonstration for extended application of the experiences of effective integrated river basin management in the other basins so as to promote the effectiveness and sustainability of river management and ecological environment protection.

Agricultural NPS pollutants in the basin will be controlled to reduce utilization and pollution of chemical fertilizers and pesticides; integrated pest management practices will be implemented to control the hazards of pests and reduce pollution from pesticides.

In order to improve pest monitoring, forecasting and prevention work under the Project, the Agriculture Pest Management Plan has been developed based on the requirements of the World Bank Environment Assessment OP/BP 4.09 --- Pest Management and taking account of the status quo of pest incidents in the project area and new issues likely to arise from the project activities. The Agriculture Pest Management Plan aims to facilitate the use of biological control methods in pest control, reduce the dependence on chemical compounds, and reduce pest risks in the project area so as to assure effective pest control while minimize environmental pollution caused by chemical pesticides.

Based on the plant protection guideline where "prevention is given the top priority for the final purpose of integrated prevention and control" and adopting the concepts of "public plant protection" and "green plant protection", the Plan summarizes and proposes the approaches for prevention and control of frequent pest hazards to the key agricultural crops related to the Project. The Plan lays emphasis on the role of natural control on the premise of ecological environment protection and promotes the use of agricultural, physical and biological pest prevention and control techniques and coordinated use of appropriate chemical prevention technologies and measures so as to reduce dependence on chemical pesticides, control pest hazards below the permissible economic injury level (EIL) and acquire the best economic, social and ecological benefits.

1.2 OVERVIEW OF NATURAL CONDITIONS IN THE PROJECT AREA

1.2.1 Geographical location of the Project Area

The Project is located in Chun'an County and Jiande City in Zhejiang Province.

Located in the western part of Zhejiang Province at 29° 11′ ～30° 02′ north latitude and 118° 20′ ～119° 20′ east longitude, Chun'an County has Tonglu and Jiande on its east as its neighbors and connects Qujiang District and Changshan on the south and borders on Kaihua on the southwest, Xiuning and Shexian counties of Anhui Province on the west and Lin'an on its north. Spanning a length of 96.80km east-to-west and a width of 94.40km south-to-north, Chun'an County has a land area of 4427km^2, accounting for 4.35% of the total land area of Zhejiang Province as its largest county in terms of land area.

Jiande City, located in the western part of Zhejiang Province at the upper reaches of Qiantang River, borders on Pujiang County on the east, Lanxi City and Longyou County on the south, Qujiang District of Quzhou City on its southwest and Chun'an County and Tonglu County respectively on its northwest and northeast. Jiande City has a total area of 2,321 km^2.

1.2.2 Hydrological and meteorological conditions of the project area

Chun'an County is located in a transition zone from the middle subtropical zone to the northern subtropical zone and on the northern verge of the subtropical monsoon climate zone. Despite of the warm and moist weather, distinct seasons, abundant rainfall and adequate sunshine, Chun'an County is frequently affected by hazardous weathers and features obvious regional differences in terms of sunshine, temperature and water. The wind direction changes with the seasons. In winter, the dominant wind direction is northeast; in the second half of a year, southeast wind is more frequent; the perennial dominant wind direction is northeast. With an annual average temperature of 17 ℃, Chun'an can expect the lowest average temperature of 5.8 ℃ in the coldest month (January) and the highest average temperature of 28.9 ℃ in the hottest month (July). With an annual average frost-free period of 263 days and an average annual freezing period of 23.4 days, Chun'an has an average rainfall of 1430 mm and a total number of 155 rain days, with its average relative humidity amounting to 76% and its average annual sunshine amounting to 1951 hours. Chun'an's annual average wind speed is 2.1 m / s and its static wind frequency is 18%.

Jiande City belongs to the subtropical humid monsoon climate featuring in hot and rainy summers and cold winters with little snow as well as the concurrence of rain and heat and distinct four seasons. With an average annual temperature of 16.9 ℃ and an average annual total temperature of 6180 ℃, Jiande City has a frost-free period of 254 days with adequate heat and an average annual total sunshine of 1760 hours giving adequate sunshine. With an average annual precipitation of 1545mm that is unevenly distributed throughout a year, precipitation, affected by the monsoon climate in summer, is mainly concentrated in the period from mid-May to mid-July; the average

humidity is 78%.

1.3 SOCIOECONOMIC CONDITIONS IN THE PROJECT AREA

In 2015, Chun'an County achieved a GDP of CNY 20.742 billion and a per capita GDP of CNY 45170 based on the registered population. With a total agricultural output value of CNY 4.556 billion, Chun'an County produced in total 83,300 tons of grain, 4523 tons of tea, 3718 tons of cocoon, 12.29 tons of fruits and 12,500 tons of freshwater fish. With a total industrial output value of CNY 31.38 billion, Chun'an County achieved an industrial sales value of CNY 31.284 billion and an industrial product sales rate of 99.4%. The total fiscal revenue was CNY 2.509 billion (including CNY 1.714 billion as fiscal revenue within the local budget) while the total fiscal expenditure within the local budget was CNY 5.061 billion. The per capita disposable income of urban residents is CNY 33,432 while the per capita disposable income of rural residents is CNY 14,632.

In 2015, Jiande City achieved a GDP of CNY 32.036 billion, up by 8.9% over the previous year, including an added value of CNY 3.048 billion for the primary industry, CNY 16.773 billion for the second industry, CNY 12.214 billion for the tertiary industry, respectively up by 2.4%, 7.9% and 12%. The three0industry structure was adjusted from 9.6: 54.0: 36.4 in the previous year to 9.5: 52.4: 38.1 at present. Calculated based on the registered household population, Jiande City achieved a per capita GDP of CNY 62,980, representing an increase of 8.9%.

1.4 CROP PLANTING STRUCTURE IN THE PROJECT AREA

Agricultural crops planted in the project area fall into two categories. The first category is mainly food crops, such as rice, wheat, corn and potatoes, for the basic needs of people's livelihood and used as animal feedstuff; the second category mainly comprises of cash crops such as oil crops, vegetables, fruit trees, mulberry and tea.

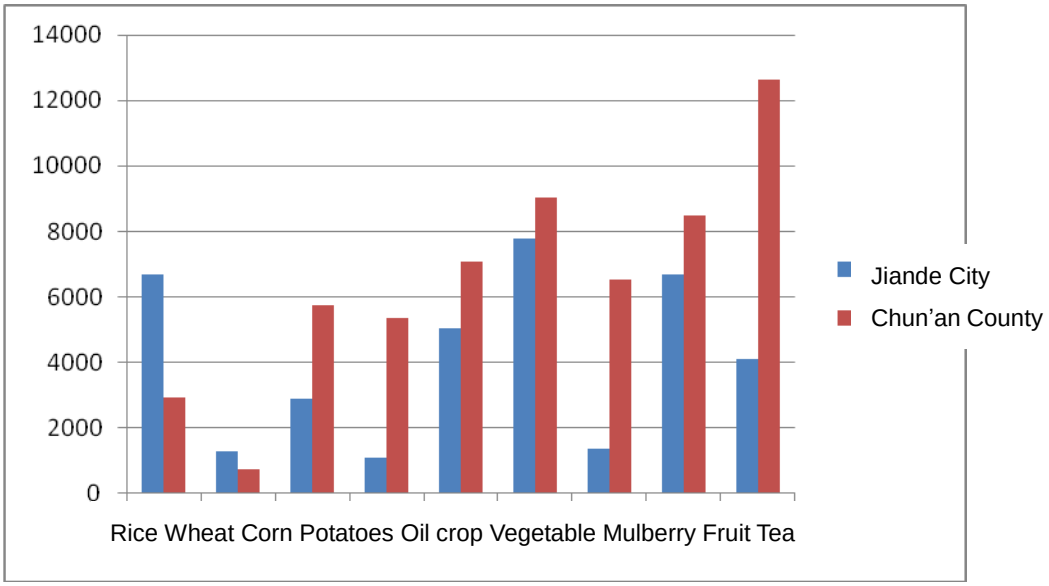
Mainly relying on farmers, the current production model features in inadequate arable land and occasional soil-borne diseases and underground pests. Chemical fertilizer, the major fertilizer in use, results in soil compaction, low organic matter content and year-on-year decrease of soil fertility.

Due to the shortage of labor force with the young rural population working away from home, field management is not well implemented in terms of pest management, with crop straws and debris treated in an unplanned manner; in addition, without knowledge of IPM, pest control main relies on chemical pesticides and has the phenomenon of inappropriate dosage, which does not only reduces the efficiency of pest prevention, but also leads to the drug resistance of the pests. Random increase of pesticide dosage violating the prescriptions leads to frequent pesticide injuries.

Table 1.4-1: Layout of main agricultural crops in the project area (Year 2015)

Unit: hectare

Category		Jiande City	Chun'an County
Food crops	Rice	6706	2932
	Wheat	1303	736
	Corn	2900	5737
	Potatoes	1113	5370
Cash crops	Oil crops	5038	7078
	Vegetable	7783	9017
	Mulberry	1367	6528
	Fruits	6688	8491
	Tea	4107	12619



1.5 INTEGRATED PEST MANAGEMENT CONCEPT

Integrated pest management (IPM) is a strategy of integrated management of harmful organisms and advocates coordinated application of agricultural, physical, biological and chemical prevention and control measures from the perspective of the agro-ecosystem as a whole and based on the interrelationship between the pests and the environment in order to fully exert the function of natural control in agro-ecology and control the agricultural pests below the permissible economic injury level (EIL). Prevention and control measures are enforced only when it is likely for the pest damage to lead to economic losses, i.e. allowing the crops to have a certain quantity of germs or pests provided that their population is not big enough to lead to economic injury. IPM attaches great importance to the application of integrated control technologies including resistant varieties, cultivation measures, biological natural enemies and chemical agents, in particular, the use of biological control

factors such as natural enemies to control pests and diseases while being cautious about the use of chemical pesticides.

IPM is also a method of systematic management that recognizes highly the participation of the planters and the promotion of the planters' qualifications and decision-making ability as well as the supports of relevant policies. In specific practices, fitness cultivation and natural enemy protection are promoted; periodical field ecological survey and analysis is organized to observe the growth of crops and the status of pests, natural enemies and other insects; the farmland ecological analysis results are used to replace the traditional experience threshold value so that an independent decision is made in the end. And the keynote of IMP has changed from pure pursuit of high yield to development of sustainable agriculture in order to realize the central goal of increased net revenue, reasonable utilization of limited resources and enhancement of the comprehensive qualifications of the producers. This approach is implemented in three closely interconnected steps: prevention, monitoring and intervention. With prevention taking a dominant position, use of chemical pesticides is minimized or cancelled so as to reduce pollution o the natural and ecological environment and create an environment not favorable to the growth of harmful organisms, but favorable to the growth and reproduction of crops and beneficial organisms.

The Project supports the application of integrated pest management (IPM), which involves the following aspects:

(1) Management of harmful organisms aiming to control them under the permissible EIL instead of try to eradicate the pests;

(2) Full exertion of the function of natural control factors so as to use non-chemical measures where possible to keep total pest at a low level;

(3) The varieties and methods of application as selected, when agricultural chemicals must be used, should minimize, where possible the adverse impacts on beneficial organisms, human being and the ecological environment.

1.6 OBJECTIVES OF PEST MANAGEMENT IN THE PROJECT AREA

Implementation of the Project will possibly change the amount and method of application of agricultural chemicals (chemical fertilizer and pesticides) at present. The Project will show concern on the potential negative impacts from change of the amount and method of application of agricultural chemicals and mitigate such negative impacts through introducing more efficient agricultural chemicals and application technology to the farmers. In addition, more environment-friendly integrated pest management techniques will be promoted to improve the production and quality of agricultural products, increase the farmers' income and reduce discharge of agricultural NPS pollutants.

The pest management plan of the Project will control pests through effortful promotion of the agricultural, physical and biological methods so as to reduce the level of dependence by agricultural production on agricultural chemicals, mitigate pollution on agricultural products and natural and ecological environment and gradually realize the sustainable development of agriculture.

2. Occurrence and control status of major pests and diseases in the project area

2.1 OCCURRENCE OF MAJOR AGRICULTURAL PESTS AND DISEASES IN THE PROJECT AREA

2.1.1 Overview of major food and oil crop pests and diseases in Jiande City in 2016

Jiande City has a rice planting area of about 100,000 mu, mainly single-season rice. The key rice varieties are Indica Japonica Hybrid and Indica Hybrid while the planting area of compact panicle rice such as the Yongyou series has decreased slightly. Late Japonica Hybrid Rice include Yongyou No. 9, No. 12, No. 15, No. 17, No. 538, and No. 1540 and Zheyou No. 18 and Chunyou No. 84; Late Indica Hybrid include Shenliangyou No. 5814, Zhongzheyou No. 8 and Longliangyouhuazhan etc, in addition to Xiushui No. 134 with a relatively smaller planting area.

Rice pests and diseases are in general at a high occurrence level, although not as high as in the past few years. In the early stage of rice growth, whitebacked planthoppers occur at a high level; in the middle stage of rice growth, cnaphalocrocis medinalis and Generation No. V(3) and VI(4) rice planthopper occur at a medium- to-high level; false smut at a medium level; rice blast at a low level; sheath blight at a high level; in the late stage of rice growth, ear rot caused by Helminthosporium oryzae brings about losses of a certain degree. Virus diseases occasionally occur.

The planting area of wheat is about 20,000mu and the pests and diseases involve a medium occurrence level, with Fusarium head blight at a high level while aphids at a medium level.

The planting area of corn is about 40,000mu and rust disease for autumn corn is found at a low level of occurrence.

The planting area of rape is about 70,000mu, all being Brassica napus L. The pests and diseases occurrence level in general is close to that in the past few years, with Sclerotinia sclerotiorum occurring at a high level and aphids at a medium level.

2.1.2 Overview of major crop pests and diseases in Chun’an County in 2016

Chun’an County is a single-season rice planting zone with a total planning area of 24,300mu. In Year 2016, the single-season pests and diseases in general involve a slightly lower occurrence level than the past two years. Single-season rice pests and diseases mainly include cnaphalocrocis medinalis, rice planthopper and sheath blight, with cnaphalocrocis medinalis and rice planthopper having a high occurrence level while sheath blight a low

occurrence level; S. inferens occurs locally but overall at a low occurrence level; (South China) black streaked dwarf virus occurs occasionally; rice blast occurs at a low level; Bacterial diseases such as bacterial blight and bacterial leaf streak also involve a low occurrence level.

(1) Borers

Occurrence level: Level 2 for S. inferens and Level 1 for Chilo suppressalis.

Area of occurrence: 2000 mu.

Characteristics and causes of occurrence: S. inferens is on a rising tendency in terms of occurrence level and mainly occur in the following two types of areas: 1) areas where S. inferens occurred in the previous year and the rice straws are discarded near the field; 2) areas where S. inferens occurred in the previous year and involving mixed cultivation with spring corn.

Prevention: Preventive measures have been implemented in a total area of 2000mu.

(2) cnaphalocrocis medinalis

Occurrence level: Level 4; Generation No. IV(2) and V(3) are the main hazard generations.

Area of occurrence: 70,000 mu; prevention measures implemented in a total area of 58,000mu.

Characteristics of occurrence: Generation No. III(1) involves no peak immigration, thus in a situation of low occurrence level; Generation IV(2) involves a large number of peak moth catches and heavy immigration and a high level of occurrence with significant inter-regional differences in the occurrence period; Generation No. V(3) mainly comprises of local insect sources with an excessively long period of moth emergence and large quantity of moths. However, affected by the continuous extreme high temperature, hazards only occurred in the late peak stage in most of the rice growing areas. In some individual rice growing areas where the temperature is relatively lower in mid-July, hazards occurred at the beginning and end of the peak stage while the hazard is light in the middle stage, but the occurrence level in general in these areas is slightly high; the occurrence level of Generation No. VI(4) is high in some individual rice-growing areas where the temperature is relatively low in mid-July, but low in most of the areas.

Status of prevention: Prevention measures were implemented in a total area of 58,000 mu in the whole county; the key pesticides applied in the comprehensive prevention and control area include Chlorantraniliprole, abamectin thiamethoxam, flutolanil, indoxacarb, with excellent effect of prevention.

Problems and recommendations: For the individual farmers, Abamectin avermectin single agent and acephate involve a relatively high rate of application, but the control effect is not ideal.

(1) Rice planthoppers

Level of occurrence: Level 4

Area of occurrence: 92,000mu; preventive measures are implemented in a total area of 76,000mu. In the pre-field stage, the main pest is whitebacked planthoppers with a relatively high level of occurrence and the main hazard generation is Generation No. IV; in the middle and late stage, the main pest is brown planthoppers and the main hazard generation is Generation No. VI with medium level of occurrence.

Characteristics of occurrence:

Whitebacked planthoppers: The main hazard generations are Generation No. III(1) and Generation No. IV(2). This year, the first day of emergence is May 10 for whitebacked planthoppers, earlier than the previous year and the average year. Immigration mainly occurred in mid-and-late June, featuring in multiple peak immigrations and significant inter-regional difference. The level of occurrence is high in general and extremely high in some individual fields. Due to the large interval between the peaks, the level of difficulty is increased in terms of pest management and some individual fields needed 2 rounds of prevention and control.

Brown planthoppers: The main hazard generation is Generation No. VI(4). This year, the first day of emergence is June 25 for brown planthoppers, 17 days later than the previous year and 21 days later than the average year. Immigration mainly occurred in early and middle stage, but the migration quantity is small. Generation IV(2) has a low level of occurrence while Generation V(3) is mainly from local insect sources with a medium level of occurrence. Generation VI(4) has a medium level of occurrence and also mainly originates from local insect sources; the level of occurrence is high and even extremely high in some individual fields that were not covered or not fully covered by the prevention and control measures. Immigration in the later stage is higher than the early and middle stage, but the quantity of reproduced insects takes a minor percentage compared with local insect sources.

Status of prevention: For prevention and control of whiteback planthoppers, imidacloprid and thiamethoxam are effective; pesticides for prevention and control of brown planthopper mainly include Pymetrozine and Pymetrozine - nitenpyram. Brown planthoppers have developed obvious resistance to Pymetrozine single agent, but the control effect of pyridine - ene Pymetrozine remains fine.

(2) Sheath blight

Level of occurrence: Level 3;

Area of occurrence: 30,000 mu.

Characteristics of occurrence: The first day of emergence is July 8, 10 days earlier than the previous two years. Affected by the extremely high temperature weather in a period of time in June, the speed of horizontal development of the sheath blight in the early stage is obviously slower than the same period in the past two years; in the middle stage, the speed of longitudinal development is faster; in the late stage, such development stopped at an early time. In general, the level of occurrence is medium.

Status of prevention: Preventive and control measures were implemented in a

total area of 30,000mu. In the comprehensive prevention and control area, the main pesticides are 75% Trifloxystrobin - tebuconazole, 10% Azole alcohol suspension and 240g/l Furosemide suspension and the effect of prevention and control is excellent. But the individual farmers continued using and the effect of prevention and control is average. However, sheath blight has been put under satisfactory control in general.

(3) Rice blast

Level of occurrence: Level 2 for leaf blast; Level 1 for neck blast.

Area of occurrence: 300 mu for leaf blast; 300mu for area of prevention.

Characteristics of occurrence: The continuous cloudy and rainy days in June and July this year led to leaf blast to a small number of low-resistance varieties. In the rupturing and heading periods, the temperature was relatively high and rainfall was relatively small. As a result, no neck blasts occurred this year in the field.

Status of prevention: Prevention and control measures were implemented in a total area of 300mu. The pesticide used in the comprehensive prevention and control area is mainly Trifloxystrobin – tebuconazole while that used by the individual farmers is mainly Tricyclic triazole. The effect of prevention and control in general is fine.

(4) Rice black-streaked dwarf viral disease (RBSDV)

Level of occurrence: Level 2

Area of occurrence: 2000mu; area of prevention: 3000mu.

Status of prevention: Thanks to the improvement of awareness in pest and disease control, pesticides such as imidacloprid, pymetrozine and thiamethoxam are generally used in the seedling stage for proper prevention and control of pests and diseases and the condition is well put under control.

(5) Field rat damages

Level of occurrence: Level 2.

Characteristics of occurrence: In the recent years, thanks to the zero application of extremely toxic rat poison in Chun’an County, the field ecosystem has gradually been restored. In many places, the ditches and canals were hardened and the habitats of rags are deteriorated. In addition, the continuous efforts of spring fertilization over the recent years also contributed to the stable decrease of community base of field rats. However, the local rat density remains high in residential areas where wastes are accumulated and geographical environment is complicated.

Status of prevention: In April, a comprehensive rural fertilization action was taken using 0.5% Bromadiolone as the rodenticide.

(6) False smut

Level of occurrence: Level 1.

Area of occurrence: 1000mu; area of prevention: 1500mu.

Characteristics of occurrence: occasional occurrence was noticed for varieties with low resistance, such as Yongyou No. 12, No. 15 and No. 538.

(7) Other pests and diseases

Rice bacterial diseases are noticed with low level of occurrence.

2.1.3 Key pest types

The project area is an area where agricultural crop pests and diseases occur extensively, manifested in the increasing types of frequent pests and diseases, increasing damages by outbreaks of pests and diseases, increasing risks of alien organisms, technical inadequacy of existing pest and disease control techniques and consequently the deteriorating damages from pests and diseases. A study tour in the project area reveals that the project area mainly involve the following types of agricultural crop pests and diseases and conventional prevention and control pesticides as described in the table below. (According to the WHO (World Health Organization) Classification for pesticide toxicity in Year 2009, there are 5 classes of pesticide toxicity, respectively being Class Ia for extremely hazardous, Class Ib for highly hazardous, Class II for moderately hazardous and Class III for slightly hazardous and Class U for unlikely to present acute hazard).

Table 2.1-1: Common pests and diseases and pesticides in the project area

Crops	Common pests	Common diseases	Common pesticides (WHO toxicity classification)
Rice	Sesamia inferens Rice leaf roller Rice planthopper Thrips oryzae	Sheath blight rice blast False smut Bakanae disease Virus disease	Benzamide (U) Avermectin (Ib, TC) Emamectin benzoate (II, TC) Acetamiprid (U) Pymetrozine (U) Validamycin A (U) Difenoconazole (II) Propiconazol (II) Tricyclazole (II)
Corn	Corn borer Aphid Cutworm	Large (small) leaf spot Rust disease	Carbendazim (U) Methyl sulfide (U) Dichlorvos (Ib) Chlorpyrifos (II)
Wheat	Aphid Wheat sawfly	Fusarium head blight Sheath blight Powdery mildew	Pymetrozine (U) Imidacloprid (II) Dimethoate (II) Carbendazim (U) Methyl sulfide (U) Validamycin A（U）
Potatoes	Aphid	Late blight	Phoxim (III)

	Henosepilachna vigintioctopunctata Underground pest	Early blight Ring rot	Permethrin (II) Deltamethrin (II) Metalaxyl (II) Mancozeb (U) Streptomycin (U) Thiodiazole copper (U)
Citrus	Tetranychid mite （Red spider，yellow spider） Phyllocoptruta oleivora Ashmead Scale insects Aphid Bud maggot Whitefly disease	Scab Anthrax Storage disease Sooty mould Resin disease Ulcer	Avermectin (Ib, TC) Pymetrozine (U) Imidacloprid (II) Propargyl (III) Potassium sulfide (III) Midazolam (II) Permethrin (II) Mancozeb (U) Carbendazim (U) Methyl sulfide (U) Lime sulfur (U)
Vegetables	Caterpillar Diamondback moth Diaeretiella Ground tiger noctuid moths bemisia tabaci Spider mite maruca vitrata liriomyza Snail Bowringi Flea beetle Thrips	Drooping disease Damping-off Gray mold Downy mildew Powdery mild Epidemic disease Anthracnose bacterial wilt Blight Virus disease Late blight Soft rot Leaf mold	Pyraclostrobin (U) Mycophenolate (III) Pythium (III) Acetamiprid (III) Carbendazim (U) Mancozeb (U) Chlorothalonil (U) Streptomycin (U) Mycophenolate (III) Deltamethrin (II) Fenvalerate (II) Imidacloprid (II) Acetamiprid (III) Tiotropium (U) Spirotetramat (U) Urea (III) Benzamide (U) Emamectin benzoate (II, TC) Avermectin (Ib, TC) Bacillus subtilis (III) Bacillus thuringiensis (III)
Rape	Aphid Diamondback moth Pierisrapae	Sclerotinia sclerotiorum downy mildew	Pymetrozine (U) Imidacloprid (II) Emamectin benzoate (II, TC) Sclerotium (III)

			Carbendazim (U) Methyl sulfide (U) Pythium (III)
Tea	Small green leafhopper Tea Looper Euproctis pseudoconspersa Toxoptera aurantii	Tea gall Anthracnose Tea leaf rot Red leaf spot	Imidacloprid (II) Bifenthrin (II) Furosemide (III) Matrine (U) Veratrine (U) Pymetrozine (U) Bacillus thuringiensis (III) Emamectin benzoate (II) Lime sulfur (U)
Mulberry	Snail Baris deplanata Germari mulberry thrips Diaphaniapyloalis mulberry gall-midge Phthonandria atrilineata	Cercospora leaf spot Purple Stripe Disease Virus disease	Methomyl (Ia) Malathion (II) Phoxim (III) Fenvalerate (II) Dichlorvos (I b) Trichlorfon (II) Carbendazim (U) Methyl sulfide (U) Lime sulfur (U)

2.1.4 Area of occurrence and loss rate of main pests and diseases

It can be seen from the tables and figures that the various agricultural crops suffered from significant losses of yield despite of the huge efforts of pest management made in each year in the project area. The magnitude of yield losses for the various crops in a descending order are: mulberry ＞ wheat ＞ potatoes ＞ rice ＞ rape ＞ tea ＞ corn ＞ vegetables ＞ mulberry ＞ citrus.

Table 2.1-2 Occurrence area ratio and loss rate of pests and diseases of crops in the project area

Crop	Occurrence area ratio (%)	Loss rate（%）
Rice	866.82	4.4
Wheat	462.79	9.64
Corn	351.34	3.26
Potatoes	330.26	5.19
Rape	331.03	4.02
Vegetables	411.55	2.55
Mulberry	855.97	11.98
Tea	626.32	3.87

Citrus	736.77	1.41

*Note: Occurrence area ratio is the sum of the occurrence area ratios of the different generations of different pests in one crop of the respective crop.

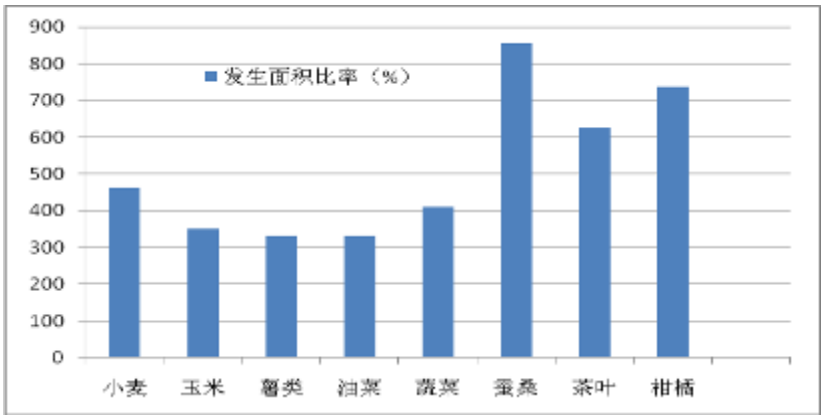


Figure 2.1-1 Pest occurrence area ratio in the project area

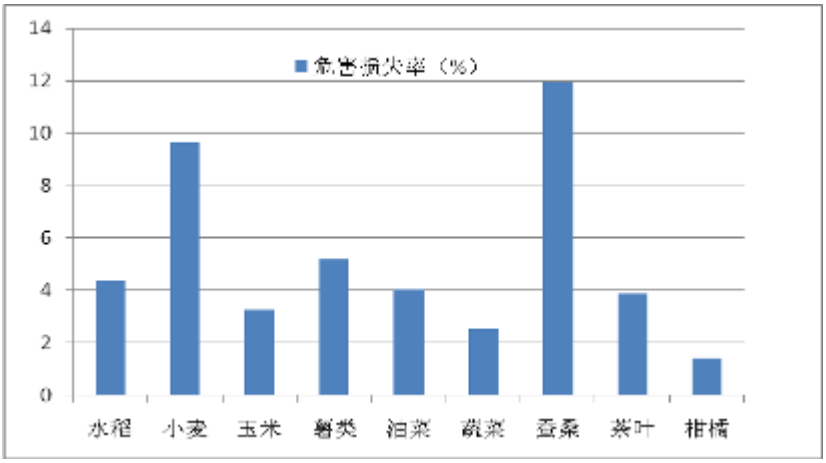


Figure 2.1-2 Pest loss rate in the project area

2.2 PEST AND DISEASE CONTROL MEASURES IN USE IN THE PROJECT AREA

2.2.1 Pest and disease control measures for key agricultural crops in the project area

The difference of natural conditions between Jiande City and Chun'an County is insignificant. Although the agricultural crops planted are slightly different, the measures and methods for prevention and control of pests and diseases are substantially the same, which, in summary, mainly include agricultural, physical and mechanical, biological, ecological and chemical prevention and control measures. Among these prevention and control measures, chemical prevention and control remains the dominant method for effective control of pests and diseases and takes a share of more than 80%, with agricultural prevention and control measures accounting for 10% and physical and mechanical prevention and control measures and biological prevention and control measures each accounting for around 5%.

Table 2.2-1 Key pest and disease prevention and control measures

currently enforced in the project area

	Prevention and control measures	Suitable crops
Agricultural measures	Selecting varieties and seedlings with disease and pest resistance	Suitable to all crops
	Plastic mulching	Suitable to all crops
	Crop rotation	Rice, rape, vegetables
	Clean garden	Fruit trees, vegetables
	Virus-free potatoes (seedlings)	Potatoes, vegetables
	Field irrigation and insect killing between crops	Rice, vegetables
Physical measures	Setting up insect-trapping lamp, sweet and sour liquid, yellow boards for insect trapping	Rice, citrus, tea, mulberry
	Seed sterilization by means of high temperature soaking; Heating up the greenhouse in summer using natural light	Rice, vegetables, wheat
Ecological measures	Adjusting greenhouse temperature and humidity	Vegetables
Biological measures	Releasing, protecting and utilizing natural enemies	Rice, fruit trees, vegetables and tea
	Integrating planting with livestock and poultry breeding and using birds, fish, frogs, etc. for pest management	Rice,fruit trees, tea and mulberry
	Using biological agents for disease and pest control	Rice, fruit trees, vegetable
Chemical measures	Seed dressing or coating	Rice, vegetables, wheat
	Applying pesticides or toxic soil in the seeding furrows or holes	Potatoes, vegetables, corn
	Applying mineral pesticides and closing the orchards during crop dormancy	fruit trees, tea and mulberry
	Using fabricated finished baits for pest trapping	fruit trees, vegetables and tea
	Killing pests with aerosols	Vegetables
	Surface spraying or underground root irrigation	Suitable to all crops

2.2.2 Use of chemical pesticides in the project area

An investigation was conducted over the use of chemical pesticides in the project area in order to assure proper use and management of chemical pesticides, in particular insecticides, as a part of the pest management work in the project area. See Table 2.2-2 for further details.

Table 2.2-2 Use of chemical pesticides in 2015 in the project area

Number of applications per crop season (number)	Volume of application (agents) per season (g/mu)		
	Bactericide	Insecticide	Herbicide
3.7	131	595	94.7

Here as follows are a few remarks on the data included in the table:

(1) Number of applications per crop season as indicated in the table is an

average of all crops (including herbicides). The actual circumstance is that spring crops such as wheat and rape usually receive up to 3 to 4 applications (including 2 to 3 applications of chemical herbicides); rice upon seeding receives seed treatment and then up to 4 to 5 applications during field growth (including 1 to 3 applications of chemical herbicides); leaf vegetables are significantly different in terms of application volume due to the difference in seeding season and length of growth period; cash crops such as fruit vegetables, fruit trees usually receive 4 to 5 applications and sometimes even 5 to 6 applications or even more for some individual plants.

(2) The volume of application in the project area is significantly different for different area of arable land and different types of crops. In areas where mainly vegetables and fruit trees are grown, the annual volume of application of chemical pesticides is noticeably larger; the usage of preparations is relatively large for pesticides for soil treatment which contain relatively low content of effective ingredients, only up to 1 to 3%.

(3) Chemical pesticides remain the dominant approach of pest and disease prevention and control in the project area and the application of agricultural biologicals only takes a percentage of less than 10%.

(4) Pesticides of high toxicity are still in use in some cases in the project area.

2.3 FARMER INTERVIEW

During the site visit in the project area, 30 farmers were interviewed on a random basis in Jiande City and Chun'an County and questionnaires were issued on the use of chemical pesticides. Contents included in the questionnaires include the education background of the interviewed farmers, area of arable land per household, types of crops planted, types of major pests and diseases occurred, how to select the right pesticide, how to determine the right dosage and time of application, points of attention during pesticide application, how to preserve pesticides, how to deal with bottles and packages of pesticides, training expectations of the farmers, etc. All interviewed farmers hope to receive training on knowledge about methods for identifying and controlling pests and diseases, reasonable use of pesticides and management of crop cultivation. It is reasonable to say that the results of farmer interview reflected the reality of pest and disease prevention and control in the project area.

We learned from the farmer interview that, apart from the guidance from the agricultural technology authority, most farmers rely on their own experiences to identify the approaches of pest and disease prevention and control; farmers seek advices from the local pesticide shops and dealers on purchase and selection of pesticides while rely on their own experiences and pesticide labels or instruction manuals to determine the number and dosage of pesticide application. We also learned that the farmers lack knowledge on usage of pesticides and usually mix two or more pesticides for immediate effect of control. Most farmers are not aware of the agricultural product pollution and environmental hazards generated from pesticides and have no concept of safe

intervals between two adjacent pesticide applications. During the site visit, we felt the strong expectations of farmers toward more workshops, site meetings or release or recommendation of latest technological information and pesticide products so that the various realistic problems they face in the daily agricultural production activities can be addressed.

Table 2.2-3: Contents of Farmer Interview in the Project Area

SN	Question	Question Design and Number of Respondents							
		1st choice	No. of persons	2nd choice	No. of persons	3rd choice	No. of persons	4th choice	No. of persons
1	Number of years for pesticide application	2-5 years	15	6-10 years	3	11-20 years	0	21-30 years	12
2	Whether aware of the three required licenses for pesticides	Yes	25	Not fully	5	/		/	
3	Source of purchase of pesticides	Pesticide shops	30	Pesticide manufacturers	0	Mobile vendors	0	/	
4	How to choose pesticides	Recommended by agricultural technicians	2	Recommended by dealers	24	Based on experience (or recommended by neighbors)	10	Based on product label (or advertisement)	0
5	How to determine time of application	Based on experience (or notice)	10	Guidance by agricultural technology	1	Fixed time of application	1	Based on product label	19

Table 2.2-3: Contents of Farmer Interview in the Project Area

SN	Question	Question Design and Number of Respondents							
		1st choice	No. of persons	2nd choice	No. of persons	3rd choice	No. of persons	4th choice	No. of persons
				authority					
6	Volume of pesticide application	Based on experience	9	Product label of pesticide	4	Guidance by agricultural technology authority	16	Advices from previous users	1
7	How to measure the volume of pesticide	Using bottle lids	12	Small package	1	Scale or known container	19	Random estimation	0
8	Actual dosage of application	Within the labeled dosage	19	Higher than the labeled dosage	9	Lower than the labeled dosage	2	/	
9	How to calculate dosage of application	g / mu	25	Based on dilution factor	5	/		/	
10	How to determine the frequency of pesticide application	Based on experience	7	Based on recommendation	23	Guidance by agricultural technicians	2	Based on own timing	0
11	Number of	1-2 times	27	3-4 times	1	5-6 times	0	/	

Table 2.2-3: Contents of Farmer Interview in the Project Area

SN	Question	Question Design and Number of Respondents							
		1st choice	No. of persons	2nd choice	No. of persons	3rd choice	No. of persons	4th choice	No. of persons
	pesticide applications per crop season								
12	Interval between two adjacent applications	More than 8 days	26	6-7 days	3	4-5 days	0	/	
13	Safe intervals between two adjacent pesticide applications	For reference	19	Not executed	2	No idea how to execute	5	Not clear	4
14	How to use the pesticides	One kind per application	18	Mixed application of two kinds of pesticides	8	Mixed application of several pesticides	3	Mixed application of many types of pesticides	0
15	Weather impacts on pesticide application	Rain	27	Strong wind	21	High temperature	0	/	

Table 2.2-3: Contents of Farmer Interview in the Project Area

SN	Question	Question Design and Number of Respondents							
		1st choice	No. of persons	2nd choice	No. of persons	3rd choice	No. of persons	4th choice	No. of persons
16	Whether protective measures are taken during pesticide application	Masks	21	Masks and protective clothing	28	Washing hands and changing clothes after pesticide application	24	Unnecessary	3
17	How to deal with pesticide toxication	Going to the hospital for first aid	22	Going to the hospital for first aid and carrying the product label	29	Self-aid based on label instructions	2	/	
18	Storage of residual pesticides	Classified storage	29	Random storage	0	Thrown away	1	/	
19	Handling of empty pesticide containers	Thrown away by the field	2	Burning or burying	23	Having never thought of this issue	5	/	
20	Local training on pesticide	None	29	1-2 times	0	3-5 times	0	More than 5	0

Table 2.2-3: Contents of Farmer Interview in the Project Area

SN	Question	Question Design and Number of Respondents							
		1st choice	No. of persons	2nd choice	No. of persons	3rd choice	No. of persons	4th choice	No. of persons
	knowledge								

Note: This questionnaire, in which totally 20 questions are designed, is issued in order to learn about the reality of use of chemical pesticides by farmers in the project area. For each question, there are 3 to 4 choices for the farmers to choose from based on their own actual situations.

2.4 STATUS QUO EVALUATION OF INTEGRATED PEST MANAGEMENT IN AGRICULTURE

It is observed based on the site visit, study tour and farmer interview carried out in the project area that the key crops subject to pest management in the project area are rice, vegetables, melons and fruits and tea and mulberry among other cash crops. In addition, chemical pesticides remain the major approach of pest control while some of the traditional and effective agricultural cultivation measures, physical methods and biological prevention and control technologies are rarely used. With regard to chemical prevention and control, most of the farmers are more reliant on their own experiences and recommendations by the pesticide dealers to address pest issues faced by them in addition to guidance by the agricultural technology authorities. With the heavy and year-long application of chemical pesticides, coupled with the lack of knowledge on pesticides, environment and health, farmers are exposed to extremely big risks in the course of pesticide application, the efficiency of pesticide application is extremely low and various damages are frequently caused on the various crops due to maloperation. Besides, there exist the following problems in the use of chemical pesticides:

1) Extremly high dependence on chemical pesticides, a particularly remarkable issue for vegetables, melons, fruits and cash crops with high commodity value and good economic return;

2) Incorrect use and management of chemical pesticides (bactericides, insecticides, herbicides) and use of high-toxicity pesticides.

3) The residual pesticides and waste packaging materials are not handled in a safe way by some farmers;

4) The promotion agencies, pesticide dealers and farmers are not adequately aware of IPM;

5) The traditional training mechanism is unable to address the specific production problems and some emerging problems faced by the individual farmers;

6) Lack of timely and adequate information and data on chemical pesticides.

3. Policy and supervision and management framework and institutional responsibilities

3.1 CHINESE POLICIES ON PLANT PROTECTION AND IPM

China put forward the concept of integrated pest management early back in the 1950s and launched the guidelines of plant protection at the national plant protection conference in 1975 advocating the principle where “prevention is given the top priority for the final purpose of integrated prevention and control”. Experiences and lessons learned over the past decades contributed to the recognition and reevaluation of the role of pesticides. The importance of maintaining the ecological and environmental balance has been highlighted and chemical control is the final choice of integrated pest management despite

of the efforts in integrated implementation of multiple methods so as to realize the economic, social and ecological benefits of pest management. The national and local governments have successively promulgated and implemented a series of laws, regulations, standards, methods, rules and guidelines, which facilitated the further promotion and application of Integrated Pest Management (IPM).

(1) Law of the People's Republic of China on Quality and Safety of Agricultural Products (NPCSC, April 2006);

(2) Regulations on the Administration of Agricultural Chemicals of the People's Republic of China (State Council Decree No. 677, June 2017);

(3) Measures for the Implementation of the Regulations on the Administration of Agricultural Chemicals (Decree No.9 of 2007 issued by the Ministry of Agriculture on December 8, 2007);

(4) Measures for the Management of Non-polluting Agricultural Products (Ministry of Agriculture and the State Administration of Quality Supervision, Inspection and Quarantine, April 2002);

(5) Pesticide Safety Standard (GB4285-1989) (State Environmental Protection Administration, September 1986);

(6) Standards on safe use of pesticides (GB8321.2-1987) (State Environmental Protection Agency, September 1986);

(7) Guidelines for the Use of Pesticides on Green Food (NY/T393-2000) (Ministry of Agriculture, March 2000);

(8) Maximum residue limits of pesticides in food (GB2763-2005);

(9) Determination of organophosphorus pesticide residues in food (GB / T 5009.20-2003);

(10) Guidelines for Reasonable Use of Pesticides (One to Eight) GB / TB8321.1 ~ 8321.8 (Ministry of Agriculture);

(11) Plant Quarantine Regulations (State Council, revised and released on May 13, 1992);

(12) Detailed Rules on Implementation of the Plant Quarantine Regulations (Agriculture) (Ministry of Agriculture, May 1995);

(13) Antitoxic Regulations on Storage and Sales, and Use of Pesticides (GB 12475-2006) (Ministry of Agriculture);

(14) Administrative Measures for Pesticide Registration (Ministry of Agriculture Order No. 2017, No. 3, August 2017);

(15) Measures for the Administration of Pesticide Production Licensing (Ministry of Agriculture Order No. 2017, No. 4, August 2017);

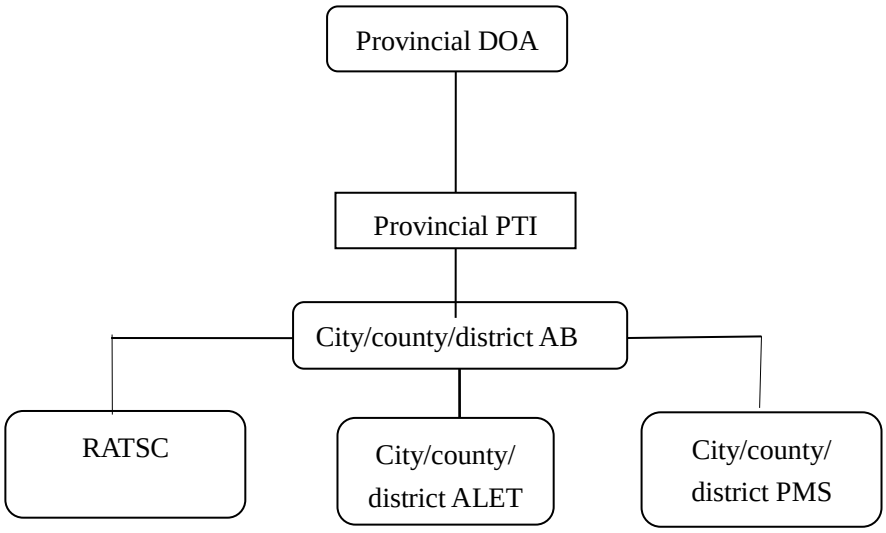
(16) Administrative Measures for Pesticide Business Permits (Ministry of Agriculture Order No. 2017, No. 5, August 2017);

(17) Regulations on Prevention and Control of Agricultural Crop Diseases and Pests in Zhejiang Province (November 2011);

(18) Methods for Issuance of Pesticide Business Licenses in Zhejiang Province (March 2011).

3.2 SUPERVISION AND MANAGEMENT FRAMEWORK AND INSTITUTIONAL RESPONSIBILITIES

3.2.1 Pesticide supervision and management agencies



Note:

DOA=Department of Agriculture; PTI = pesticide testing institute; AB = agriculture bureau; RATSC = Rural agricultural technology service center; ALET = Agriculture law enforcement team; PMS = pesticide management station

Figure 3.2-1: Schematic diagram of pesticide supervision and management agencies

Responsibilities of the various agencies:

Provincial DOA: responsible for developing local agriculture development plans, managing agriculture-related affairs and supervising and managing pesticides.

PTI: responsible for pesticide registration, application, use and supervision and management, developing or participating in the development of national or industrial standards on pesticide safety, pesticide product quality and pesticide

residue and other agriculture-related affairs.

Agriculture law enforcement body and pesticide management station: responsible for market and quality supervision and management of agricultural chemicals.

RATSC: Assisting and coordinating the relevant law enforcement and technology authorities in organizing local activities of technical promotion, training and guidance on pesticide management and IPM.

3.2.2 Crop disease and pest control and management agencies

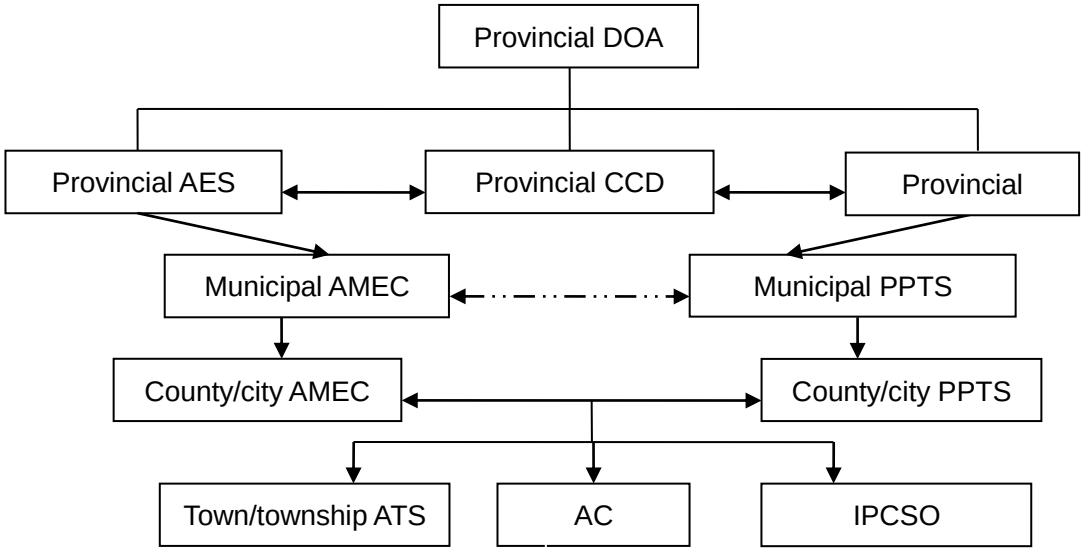


Figure 3.2-2: Schematic diagram of pest management agencies

Note:

DOA=Department of Agriculture; AES = agricultural extension station; CCD = cash crop division; PPTS = plant protection and test station; AMEC = Agricultural machinery extension center; ATS=agricultural technology station, AC = agricultural cooperatives; IPCSO = integrated prevention and control service organization

Responsibilities of the various agencies:

Provincial DOA: responsible for administration of agriculture and animal husbandry work of the whole province; responsible for organizing the agricultural management authorities at all levels in the province to implement the pest management work of agricultural crops.

Provincial PPTB: responsible for plant quarantine work, issuing long-term, mid-term and short-term agricultural crop pest and disease forecasts on a periodical basis, carrying out emergency prevention and control and long-term control of major pests and diseases of agricultural crops; promotion of new pesticides and instruments, safe use of pesticides; farmer education and

training on pest management technologies.

Provincial AMES: Assisting the Provincial DOA in carrying out the respective management work and responsible for technology extension.

Provincial CCD: Responsible for managing the planting plan and technology extension of cash crops such as vegetables, fruit trees, tea, etc. of the whole province.

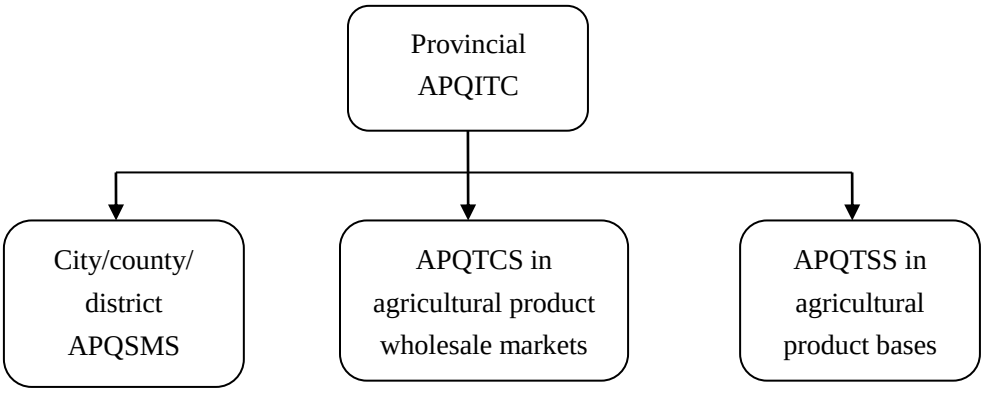
County/city ATEC: responsible for extension of agricultural technologies in the administrative area; responsible for organizing, planning, coordinating, supervising, making decisions on and developing work management regulations on prevention and control of pests and diseases of agricultural crops.

County/city PPTS: Responsible for organizing, managing, guiding and supervising the pest and disease prevention and control activities in the administrative area; assisting and coordinating the concerned law enforcement and technological authorities in implementing education and technical training and providing guidance on the local pesticide management and integrated pest management activities.

Town/township ATES: responsible for monitoring and forecasting and providing timely guidance on prevention and control of major pests and diseases in the administrative area.

Acs and IPCSO: organizing and carrying out local prevention and control of pests and diseases of agricultural crops.

3.2.3 Pesticide residue test agencies



Note:
APQITC = agricultural product quality inspection and test center; APQSMS = agricultural product quality safety monitoring station; APWM = agricultural product wholesale market; APQTCS = agricultural product quality test central station; APQTSS = agricultural product quality test sub-station

Figure 3.2-3: Schematic diagram of pesticide residue test agencies

Provincial APQITC: responsible for quality and safety supervision and management of agricultural products of the whole province and providing guidance on quality and safety supervision of agricultural products to the various cities and counties.

City/county agricultural product quality monitoring center (station): responsible for quality safety supervision and management work of local agricultural products.

APQTS in agricultural product wholesale markets and supermarkets: responsible for quality tests of agricultural products permitted to enter the market (supermarket).

APQTSS in agricultural product bases: responsible for quality tests of agricultural products permitted to leave the agricultural product bases.

3.3 PEST MANAGEMENT COMPETENCE ASSESSMENT AND DESCRIPTION

Huge efforts have been made over the recent years in extension and application of integrated pest management technology and gradual reduction of the usage of agricultural chemicals in order to promote the development of pollution-free agricultural products and green food. However, due to the limited professional competence and inadequate input in the agricultural technology promotion departments at all levels, non-chemical control technologies, such as physical control and biological control technologies, remain inadequately extended and further efforts are required to strengthen education and training and technological extension and application.

3.3.1 Key problems existing in pest management

(1) Awareness of pest prevention needs to be further promoted. With the concept of fitness cultivation of agricultural crops not integrated in the practices of prevention of harmful organisms for agricultural crops, no effective measures are in place to manage pests and diseases from the perspectives of eco-system and increase the resilience of agricultural crops.

(2) Pesticide market is not sufficiently supervised. The existing pesticide dealers of a large quantity, but small scale are known for their informal channels of procurement and generally low professional qualifications, implying that the pesticide market is not yet in a regulated order.

(3) The competence building system is not yet robust. Technical training in integrated control of harmful organisms for agricultural crops remains yet to be improved. Farmers mainly rely on guidance from pesticide dealers for pest prevention and control and there is not a sound mechanism for introduction, demonstrative application and training on advanced monitoring and prevention and control technologies. Since the hazards of harmful organisms for agriculture are not fully recognized, it is unlikely to achieve real-time monitoring and early warning of harmful agricultural organisms in the region.

3.3.2 Measures to be taken in pest management in the project area

Due to limited technical forces and input of the agricultural technology

extension bodies at all levels, non-chemical control technologies, such as physical control and biological control technologies, witness slow progress in extension. Therefore, with one single control method, the effect of pest and disease control has been far from ideal. In addition, with a small percentage in agricultural pest management, non-chemical control technologies require further and wider education and training and extensive application. During the implementation of the Project, stronger efforts should be made in the following aspects:

(1) Multiple measures should be taken to regulate the pesticide market in the project area. Pesticides entering the project area should be subject to archives management and annual training should be provided for the management personnel to strengthen their legal awareness and professional qualification. Full-process and comprehensive supervision should be carried out over the purchase, sale and storage of pesticides to supervise the pesticide purchase logbook and sales records established by pesticide dealers. Real name registration system for pesticide buyers should be implemented to make sure that the pesticide sales information is searchable and destination traceable.

(2) Training should be provided to agricultural technology extension staff at both the county and town levels to promote the level of control of harmful organisms;

(3) Training on basic knowledge of identification and prevention and control of harmful organisms should be organized based on local circumstances and farmer needs.

(4) Practical training textbooks should be developed and necessary video and audio devices provided.

(5) Stronger supports should be provided in research and demonstrative extension of technologies of integrated management of key agricultural pests and diseases.

3.3.3 Construction of pest prevention and control system in the project area

The plant protection stations in the project area are responsible for managing and implementing the work of prevention and control of harmful organisms of agriculture. A robust pest and disease monitoring and early warning system has been established in the project area to monitor the occurrence of pests and diseases in real time and provide data supports to integrated prevention and control. In addition, technical professionals are assigned to carry out the integrated prevention and control of agricultural pests and diseases.

Once any pests and diseases are discovered in the monitoring process, the monitoring personnel will notify the farmers via Internet, SMS or message boards to advise the farmers to carry out respective pest and disease prevention and control activities.

Currently, there are already professional cooperatives in the project area engaged in integrated prevention and control and the effectiveness of pest and

disease prevention and control is remarkably improved and the usage of pesticides reduced.

3.4 PESTICIDE MANAGEMENT AND ALLOCATION SYSTEM AND PESTICIDE USAGE

3.4.1 Pesticide management

According to the Regulations on the Administration of Agricultural Chemicals of the People's Republic of China, the provincial agricultural administrative authority is responsible for assisting the agricultural administrative authority of the State Council in registering the pesticides within its own administrative area and for supervision and administration of pesticides within its own administrative area. The agricultural administrative authorities of the respective cities and counties also have the responsibility of regulating the production, sale and safe use of pesticides in their own administrative areas.

3.4.2 Pesticide allocation system

Production and sales of pesticides in the project area shall be administered by the respective functional department of the local government in accordance with the national and local laws and regulations; farmers, as the pesticide users, shall purchase pesticides from the market on their own.

Pesticide manufacturers shall have its products registered according to the Regulations on the Administration of Agricultural Chemicals and comply with the conditions for safety, quality and environment and pollution control;

All pesticide dealers shall not be permitted to sell pesticides until they are licensed and shall be permitted to sell pesticide products with all three “certificates”. Pesticides explicitly prohibited by the national government shall not be sold on market.

Labels or instruction manuals must be attached to or included in the packaging of pesticide products to indicate the name of pesticides, manufacturer (zip code, address, telephone number), product batch number, the three pesticide certificates (registration certificate number, production license number, product standard reference number) as well as active ingredients, content, weight, formulation, product performance, toxicity, use, user instructions, production date, expiration date, flammable and toxic signs, poisoning rescue methods and precautions; pesticide products shall pass the quality test and be granted with a product quality test certificate before release.

3.4.3 Measures for reasonable usage of pesticides

The reasonable use of pesticides is based on full knowledge and scientific analysis of the characteristics of pesticide product and formulation, the biological characteristics of the objects of control and protection as well as the environmental conditions and realized through selection of pesticides of the appropriate category, formulation and dosage as well as the reasonable method and timing of pesticide application.

Table 3.4-1 Measures for reasonable use of pesticides in the project area

SN	Measures	Contents
1	Appropriate pesticide	Accurately identifying the types of pests and diseases and selecting pesticide varieties and formulations of the best cost-effectiveness and safety for the key objects of prevention and control to achieve scientific and targeted application of the right pesticide. For example, inhalation and contact insecticides are the best choice for prevention and control of piercing-sucking pests such as aphids, spider mites, planthoppers and scales while stomach-poisoning and contact insecticides are more suitable to chewing pests and fumigant and smoke agents have the best effect in airtight conditions such as greenhouses, etc. Pesticides of the same category but different formulations have significantly different effects of pest control. Normally, EC has the best effect, followed by WP, with powder performing the worst.
2	Appropriate timing	Pesticides should be applied based on the indicators of control in the critical period of prevention and control before any economic losses are caused. Under normal circumstances, the prevention and control of pests should be carried out at a young age while the prevention and treatment of diseases should respect the principle of protection before treatment.
3	Appropriate dosage	Small dosage should be selected where possible and within the scope of effective dosage of the respective pesticide provided that the required effect of prevention and control is assured. The frequency of pesticide application should be determined based on the time and quantity of occurrence of the pest and disease as well as the duration of effectiveness of the pesticide to realize effective control of pests and diseases and zero chemical hazard and environmental pollution.
4	Appropriate method	First of all, different methods of application should be adopted based on the formulation type of the pesticides. Emulsion and wettable powders are usually sprayed and poured; powdery pesticides are applied by means of powder-spraying; particulate pesticides are usually applied via spreading or in furrows; pesticides with strong absorption may be applied by means of power-spraying, mist-spraying, pouring or stem-coating. Secondly, different methods of application may be selected based on the position of disease, law of pest activity and different pesticide formulations.
5	Alternate application	Harmful organisms may become resistant under continuous and repeated action of the same pesticide with the same mechanism of action, resulting in reduced effect of prevention

Table 3.4-1 Measures for reasonable use of pesticides in the project area

SN	Measures	Contents
		and control. To mitigate and overcome resistance and increase the service life of pesticides, pesticide application should be carried out in an alternate way; inhalable bactericides tend to generate resistance extremely easily and should be applied in combination with protective bactericides as an alternate component; organophosphates, pyrethroids, carbonates, and organic nitrogen have different mechanisms of action and alternate application of these insecticides can achieve excellent insecticidal effect.
6	Mixed application	Crop pests and diseases often occur in a successive or simultaneous manner in a certain stage of growth. Reasonable mix of pesticides can achieve concurrent control of multiple pests and diseases in increased effect. However, mixed application must not be carried out in a random way. Normally, pesticides involving decomposition failure of alkaline substances must not be mixed with alkaline substances; mixed application is prohibited if chemical reactions such as flocculation, precipitation and stratification occur after mixing.
7	Weather-oriented application	Pesticides are generally applied in windless or breeze weathers instead of windy, cloudy or rainy days to avoid reduced efficacy due to liquid loss and rain runoff. The pesticide efficacy increases with the temperature in a certain temperature range and, therefore, application should generally be conducted at 10 am and 4 pm no matter whether the plants are cultivated in open field or in facilities. Application in strong sunlight or high temperature may easily lead to pesticide injury.
8	Safe application	In accordance with the national regulations on pesticide administration, the use of highly toxic pesticides are strictly controlled and pesticides with high residual and "three adverse effects" are resolutely banned. The codes of operation for safe application of pesticides and the crop safety intervals shall be strictly implemented to achieve safe application of pesticides, avoid environmental pollution and eliminate human and animal poisoning.

4. Methods recommended in the pest management plan of the project area

4.1 Principles of Integrated Pest Management

IPM is a pest and disease control approach modified by the UN Food and Agriculture Organization in 1972 on the basis of the integrated pest and disease control proposed in 1966. IPM is a science related to pests and diseases emphasizing natural control and organic coordination between natural control and other control measures. In the IPM approach, monitoring is first strengthened according to the different biological characteristics and habits of pests and quarantine, silvicultural, physical and mechanical methods and biological methods are considered with priority for prevention of pests and diseases. Chemical method and high-efficiency and low-toxicity chemical insecticides are used only when the above methods are unable to achieve effective control of pests and diseases.

Upon the development of a pest management approach, not only should the economic benefits be considered, but also ecological balance and social security. Based on this theory, the following pest management approach is developed for the project area. Plant protection work will be carried out under the guidance of the concept of scientific development and through thorough enforcement of the concepts of "public plant protection" and "green plant protection" and following the principle that "prevention is given the top priority for the final purpose of integrated prevention and control". We will adhere to the mechanism of territorial management, government guidance and departmental performance to promote sustainable development of pest and disease control system; the prevention and control activities will be implemented according to law and managed according to standards to enhance the level of scientific control. The pest and disease control factors in the nature will be fully utilized to create conditions unfavorable to the occurrence and growth of pests and diseases. Biological, physical and chemical approaches will be used in a reasonable, coordinated and supplementary way according to the specific circumstances to best avoid injury of natural enemies and pollution of natural environment and control the pests and diseases to a tolerable degree.

4.2 Strict Implementation of the World Health Organization (WHO) Pesticide Classification Guideline (2009) and Requirements

The pesticide hazard classification standard recommended by WHO was adopted at the 28th World Health Assembly in 1975. In order to meet the new environmental requirements, WHO revised this standard in 2009 (see Table 3). Classification of pesticide toxicity is mainly based on the acute oral and transcutaneous toxicity of rats, which has become a standard method for determining toxicity classification in toxicology. The WHO pesticide hazard classification standard is described detail in Table 3.2-1.

Table 3.2-1 WHO Criteria for Toxicity Classification of Pesticide by Hazard (2009)

Class	Classification description	Oral (mg/kg)	Dermal (mg/kg)
Ⅰa	Extremely hazardous	<5	<50
Ⅰb	Highly hazardous	5~50	50~200
Ⅱ	Moderately hazardous	50~2000	200~2000
Ⅲ	Slightly hazardous	>2000	>2000
U	Unlikely to present acute hazard	≥5000	≥5000

The requirements included in the WHO Guidelines to Pesticide Classification (2009) shall be strictly executed in pest management; Class I pesticides are prohibited; Class III and Class U are recommended with priority.

Pesticides used in the Project are Class III and Class U pesticides complying with the WHO requirements.

4.3 CONTENTS AND MEASURES OF INTEGRATED PEST MANAGEMENT

Integrated pest management will be carried out in strict accordance with the guidelines that “prevention shall be given the top priority and scientific and lawful actions of prevention and control shall be taken to create a healthy condition for crop growth”. The concept of pest management shall be incorporated in the true sense into the full process of agricultural production. First of all, pest-resistant crop varieties shall be selected and emphasis shall be laid on monitoring and forecasting of pest and diseases to provide a basis for decision-making on prevention and control; quarantine method, physical and mechanical method, biological method and chemical method shall be adopted in an integrated manner for pest and disease control. Physical and biological control measures should be selected with priority for pest and disease prevention and control; pesticides shall not be used until the other prevention and control methods become invalid and the monitoring results of pests and diseases indicate that the degree of hazards of such pests and diseases has exceeded the economic threshold. When pesticides are used, non-harmful pesticides shall be selected to mitigate pest resistance and avoid environmental pollution.

4.3.1 Monitoring and forecasting

Monitoring and forecasting is a technical approach to monitoring the occurrence of pests and diseases and forecasting the tendency of occurrence and trend of spreading and is a premise and assurance to scientific implementation of pest management. Pest monitoring and forecasting shall adhere to the principle of integrating public monitoring with professional

monitoring. Pest monitoring and reporting in the project area shall make full use of the existing plant protection agencies at all levels.

The plant protection agencies at the county level monitor and forecast pest occurrence and hazards of the Project by means of positioned monitoring and site survey and develop measures for prevention and control of pests and diseases based the monitoring and forecasting results.

4.3.2 Prevention and control methods

Non-chemical prevention and control technologies, such as agricultural, physical and biological measures for prevention and control of pests and diseases shall be applied in a demonstrative way to the maximum extent in the project area to reduce input of chemical pesticides, reduce environmental pollution and facilitate human-nature harmony.

1. Agricultural prevention and control methods

(1) Crop pest resistance should be improved through selection of excellent anti-pest and disease-resistant varieties, extensive application of formula fertilization technologies, rational irrigation, and increased application of organic fertilizers and implementation of fitness cultivation techniques.

(2) Soil-borne diseases should be prevented by means of crop rotation, field cleaning, and autumn furrowing and winter irrigation of dry farmland while pest habitat and concealment should be controlled and population base of winter and summer pests should be reduced by means of tillage of paddy fields and elimination of deep-water pupae.

(3) Fruit trees should be pruned in a reasonable way with buds cut and lower leaves reduced to improve ventilation and light penetration conditions of true bodies.

(4) Weeding should be conducted in a timely manner in the growth period to create environmental conditions unfavorable to development of pests and diseases;

(5) Soybean, sesame, vetiver and other crops may be planted on the ridges in an extensive manner in double-cropping rice growing areas and double-cropping and single-cropping rice mixed cultivation areas to protect natural enemies of pests, trap Chilo suppressalis and improve the index of biodiversity.

2. Physical prevention and control method

Physical prevention and control is a method that uses the taxix of pests to light, color and taste as well as their special reactions to heat, radiation, high-frequency current and ultrasonic waves to prevent and control pests. It mainly includes the following types of measures:

(1) Pest trapping using the phototaxis of pests. Frequency vibration lamp and black light lamps may be used to trap rice leaf roller, Chilo suppressalis, borer, Sesamia inferens, etc.

(2) Latent pathogens within the seed may be killed with heat, e.g. soaking

seeds in warm soup.

(3) Branches and leaves affected by pests and diseases may be cut off and pest eggs and yellow leaves at the lower part of the plants may be manually removed.

(4) Fruits affected by diseases and pests should be cleared to reduce wintering population base.

(5) Insulation: The habits of some pests may be utilized to prevent and control their hazards. For example, the tree trunks may be wrapped with plastic skirts to prevent and control pine caterpillars, willow moth and other pests having the habit of wintering off the trees or staying and causing hazards on the trees at night and staying off the trees for concealment in day.

(6) The chemotaxis of some pests may be used for pest trapping. For example, yellow boards may be used to trap aphids, whitefly, leaf miners and blue boards used to trap whitefly, thrips, leafhoppers, etc.

3. Biological prevention and control methods

Biological prevention and control is the method for prevention and control of harmful organisms using beneficial organisms, e.g. parasites, predatory organisms and pathogenic microorganisms, mainly including:

(1) Protecting and making use of natural enemies: Using insects to control pests, e.g. controlling aphids, mites, thrips and whitefly using their predatory natural enemies such as ladybird, Chrysopa, syrphids, vinchuca etc.; using A.cucumeris to predate red spiders, and rust mites; controlling rice leaf folder, stem borer and yellow rice borer, and Sesamia inferens using parasitoid Trichogramma.

(2) Using biological agents and products. At present the most widely used products are bacterial products including Bacillus thuringiensis (III) and Bacillus subtilis (U), fungi products such as Beauveria bassiana (U), Trichoderma (III), ear fungus (U); virus products, such as cotton bollworm nuclear polyhedrosis virus (III), cabbage moth karyotype polyhedrosis virus (III); antibiotic products such as streptomycin (U), clindamycin (U); sex pheromone such as sexual lure and botanical pesticides, such as 0.5% matrine (U) solution, 0.5% nimbin (III) emulsifiable concentrate, etc.

(3) Creating suitable habitats for and increasing the population of natural enemies;

4. Chemical prevention and control method

Chemical prevention and control is a method of preventing and controlling diseases, pests and weeds and other harmful organisms using chemical pesticides. Easy to use and with extensive objects of control and fast and high efficiency of prevention and control, the chemical pesticides are able to rapidly control the spread and hazard of pests and diseases and may be used as emergency response measures to get instant results in control of outbreak of pests and diseases. However, heavy use of chemical pesticides along does not only kill natural enemies, but also damages the eco-system of farmland, leads to outbreak of secondary pests and diseases and also generate a series

of side effects such as environmental pollution, human and animal poisoning and pesticide hazards. Long-term use of one single chemical pesticide will result in pesticide resistance of the object of control. Therefore, it is a critical part of this plan as to how to control the use of pesticides in chemical prevention and control and reduce environmental pollution and impacts on human health.

The following principles should be followed when chemical prevention and control methods are used in the project area:

(1) Demonstrative efforts should be made to assure the farmers in the project area that satisfactory effect of pest prevention and control can be achieved through reasonable and coordinated use of agricultural, physical and biological prevention and control methods assisted with necessary efforts of chemical prevention and control.

(2) When the required index of pest control is achieved, high-efficiency and low-toxicity pesticides should be used in time to achieve its best effect and control the pests within the financially permissible scope.

(3) In the event of a major plague of pests, professional plant protection and pest control forces should be organized and mobilized to carry out integrated prevention and control;

(4) Harmless prevention and control technologies should be promoted.

- High-toxicity pesticide in use at present should be eliminated. High-efficiency, low-toxicity and low-residual pesticides should be used. See Annex 1 for the catalogue of harmless pesticides recommended under the Project.
- In areas of pest origin with big pest population density and the central area of occurrence, high-efficiency and low-dosage pesticides should be used in time in the young age of pests to assure that the best effect can be achieved at each pesticide application. Use of pesticides with the power of killing natural enemies is prohibited in the post-peak period of pests.
- A safe interval should be assured between pesticide applications;
- Different types of pesticides should be used in alternate to avoid long-term and continuous use of one single pesticide.
- Safe application devices and methods should be used to increase pesticide utilization efficiency and pesticide prevention and control effect.
- Stronger efforts should be made in education and training on safe and reasonable use of pesticides and the respective requirements on pesticide usage should be strictly followed; serious attention should be paid to safety, including wearing the right protective clothing, having the common sense of first aid measures in case of pesticide poisoning.
- Safe storage of chemicals should be assured (e.g. far away from children and food, etc.)
- Waste pesticide and packaging materials should be subject to proper disposal and washing of pesticide application devices and tools in natural

water is prohibited. Waste pesticides and packaging materials in the same region should be recovered for centralized disposal.

4.4 SAFE USE OF PESTICIDES

In order to realize safe use of pesticides, biological agents, botanical insecticides, bionic agents and harmless chemical agents should be selected with priority. Pesticides tend to generate negative impacts on human and animal health and natural environment in the process of application. Therefore, effective measures should be taken to best avoid or reduce the health and environmental risks from pesticide application. Potential risks and measures for safe use of pesticides during the implementation of the Project are included in Table 4.4-1.

Table 4.4-1 Potential risks and measures for safe use of pesticides

Environmental risks	Health risks	Measures for safe use of pesticides
1. Pesticide residue leading to water quality deterioration and reduction of aquatic organisms; 2. Application pesticide in the adjacency of drinking water sources leading to polluted water sources. 3. High-toxicity pesticides generating impacts on non-target species (natural enemies, etc.); 4. Long-term and excessive application of pesticide leading to increased resistance; 5. Pesticide residue in soil leading to soil pollution.	1. Inhalation of pesticide mist during preparation of chemical agents; 2. Inhalation of fugitive gas during pesticide application without protective devices leading to physical discomfort; 3. Skin buns caused by pesticide spraying or leakage without wearing protective clothing; 4. Pollution of drinking water due to application or leakage of pesticides in the adjacency of drinking water sources; 5. Hazards to human health due to consumption of water, livestock and agricultural byproducts polluted by pesticide.	1. Strictly controlling the purchase, transportation and storage of pesticides; 2. Making sure that pesticides are used in the correct way and promoting pesticide application technologies with low toxicity to human, livestock and plants and minimum pollution to the environment; 3. Making stronger efforts in training on the use of pesticides and tools and promoting the awareness of personal protection of the pesticide application operators; 4. Highlighting the importance of protective clothing upon pesticide application (including suitable protective helmets, masks, gloves and shoes, etc.); 5. Strengthening the confirmation and management of pesticide application area and avoid pollution of water sources and ecological environment; 6. Strengthening technological cooperation to increase the efficiency of pesticide and tools and reduce the consumption of pesticide; 7. Developing standard procedures for management of pesticide and tools, e.g. prohibiting the reuse of waste chemicals and washing of used chemical containers and pesticide application tools in natural water bodies; selecting safe places for proper disposal (e.g. underground burning). Residual pesticides should be stored and handled in a reasonable and safe way.

4.5 PREVENTION AND CONTROL MEASURES AND RECOMMENDED PESTICIDES FOR THE MAJOR PESTS AND DISEASES IN THE PROJECT AREA

4.5.1 IPM measures for rice

Sheath blight, rice blast, false smut, Southern black streaked dwarf disease, striped rice borer, rice planthopper and rice leaf roller shall be identified as the key objects of control. Non-chemical prevention and control technologies including agricultural, ecological, biological and physical technologies shall be selected with priority to reduce the base number of pests and diseases. Pesticide application techniques such as seed treatment, pesticide-applied transplanting and spiking protection shall be promoted to control hazards with the supportive efforts in pesticide emergency prevention and control.

Crops with excellent resistance shall be introduced and balanced application and fitness cultivation technologies shall be adopted to reduce occurrence and epidemic of pests and diseases; Chilo suppressalis shall be trapped and controlled by means of deep water pupae killing and vetiver trapping.

Insect-attracting plants, such as the trapping plant of vetiver, may be planted on both sides of the tractor access roads in the rice fields with a spacing of 3 to 5 meters to attract the stem borers to lay eggs and reduce the amount of eggs laid by stem borers on rice. Flowering plants, such as sesame seeds, soybean or herbaceous flowers, may be planted on the ridges to provide food and habitat for natural enemies and protect and improve the hazard control ability of spiders, parasites and other natural enemies. Grasses on the ridges may be preserved to provide habitats for natural enemies.

Ecological prevention and control:

Biological prevention and control: The key measure for biological prevention and control is release of Trichogramma. Trichogramma japonicum or trichogrammachilonis is released in the adult stage of rice stem borer and rice leaf roller at a 5-day interval and a frequency of 2 to 3 releases per generation, depending on the pest situation, at 5 to 8 release sites with a spacing of 10 to 12m and a unit release of 10,000 insects per mu. The release height shall be set in such a way that the release card is located 5~20 cm over the plant of tilling stage and 5~10 cm below the top of the plant in the spiking stage.

Physical prevention and control: Physical barriers shall be set up to insulate the rice seedlings. In the seedling stage, 20 ~ 40 mesh insect-proof net or nonwoven cloth shall be used to cover the seedlings throughout the process to keep rice planthoppers away and prevent virus disease. Sex pheromone trapping of wintering Chilo suppressalis starts from the beginning of

emergence period of the wintering generation and sex pheromone for Chilo suppressalis shall be used in the full process to trap adult male. Such measure shall be adopted in a large and continuous area with 1 to 2 traps per mu on average and spaced at a distance of around 20m. The traps will be distributed in such a way that the density of distribution is greater on the periphery than the central area and traps are positioned along the ridges and around the paddy field at a height of 50 to 80cm higher than the ground. Long-lasting lures and dry moth trap with a validity of more than 2 months shall be selected; the lures shall be replaced once every 60 days.

Scientific application of pesticides: In the sowing stage, 10% imidacloprid (Ⅲ) shall be selected for seed dressing to effectively reduce the harm of rice planthopper and southern black-streaked dwarf disease and Pretilachlor (U), penoxsulam Fluroxypyr (U) and Cyhalofop-butyl (U) shall be used for controlling weeds in paddy field; in the rice growth stage, Clindamycin (U), 30% Benzopirone (III), Proprazole (U), and 40% Isoprothiolane shall be used for control of rice sheath blight, rice blast, rice false smut while pymetrozine (U), nitenpyram (U), 25% thiamethoxam (U) shall be used for prevention and control of rice planthoppers and chlorantraniliprole (U), tetrachloroxetine (U), flubendiamide (U), Bacillus thuringiensis (Ⅲ) shall be used for prevention and control of Chilo suppressalis, planthoppers, rice leaf roller. Pesticides containing pyrethroid are prohibited in paddy fields; high-toxicity and high-risk pesticides shall be strictly controlled; organic phosphorus pesticides shall be used with prudence. The importance of rotating and alternating application of different pesticides shall be highlighted, with each pesticide applied twice for each season to the maximum so as to delay the progress of pest and disease resistance.

4.5.2 IPM measures for corn

The key pests and diseases for prevention and control are corn borers, underground pests, sheath blight, big leaf blight, Cochliobolus heterostrophus and gray spot disease. Special attention should be paid to the 2nd and 3rd generation of armyworms.

1. Deep plowing in winter and stubbling before sowing helps destroying pest habitat and effectively reduces base population at pest sources.

2. Beauveria bassiana (U) sealing technology: Farmers should be organized to seal the stacks with Beauveria bassiana 15 days before the pupation of Ostrinia furnacalis.

3. Seed treatment: Insecticides and bactericides should be mixed at a reasonable mix for seed blending or seed dressing. Seed blending or seed dressing implemented with uniform technology, in a centralized area or a whole village and stronger efforts in quality supervision of seed dressing agent

can effectively improve the pest and disease prevention effect.

4. Adult pest trapping technology: In the adult emergence stage of Asian corn borers, farmers should be organized to use insecticidal light traps to trap each generation of adult pests and sex pheromone may be used concurrently to trap wintering pests.

5. Trichogramma release technology: 3 to 6 release sites are established per mu of land and farmers are organized to release Trichogramma japonicum in the spawning to full-egg stage of Asian corn borers for 2 to 3 times. The releasing card (releasing container) should be affixed to or hung on the leaf veins on the back of the middle leaves.

6. Pest control at the late stage of core leaves: In the bell stage of corn, farmers are organized to use Bt (U) and fill or spray Beauveria bassiana into the core leaves to control corn borer and Helicoverpa armigera, and use reasonably mixed compounds of insecticides and fungicides such as chlorantraniliprole (U), 30% benzoyl propiconazole (III), diniconazole (U) to control pests and diseases.

4.5.3 IPM measures for potatoes

The main pests and diseases for potatoes are late blight, pest cutworm, grubs and wireworms and diseases should be the major target of control in terms of the prevention and treatment strategies.

(1) Strengthening ecological regulation of agriculture through scientific crop rotation. Potatoes are suitable for crop rotation with Gramineae and Leguminous crops and suitable for paddy-upland rotation. Crop rotation is helpful to mitigating hazards caused by pests and diseases such as late blights and underground pests for potatoes.

(2) Sowing at the right time: Autumn potatoes should be cultivated when the temperature stabilizes at around 25℃. In the plain and low-hill areas with an altitude of below 500m, potatoes should be cultivated in late August to early September; in the plain and low-hill areas with an altitude of 500 to 1000m, potatoes should be cultivated in mid-August; in areas with an altitude of above 1000m, autumn potatoes are not suitable to grow.

(3) Careful selection and proper pre-treatment of potato seed: Virus-free potato seeds should be selected and desterilized and soaked before cultivation to effectively prevent the occurrence of late blights and other potato pests and diseases.

(4) Best land should be selected and scientific management of farm field should be strengthened. Fields with easy drainage and irrigation, soft and loose soil and thick cultivation layer should be selected for cultivation of

autumn potatoes; the potato fields should be covered with rice straw to reduce field humidity and mitigate pests and diseases; slag manure, animal manure and other farmyard manures should be used as the main fertilizer and mixed with nitrogenous fertilizer, phosphate fertilizer and potassic fertilizer among other inorganic chemical fertilizers to culture healthy and strong plants.

(5) Pesticides should be applied at the right time to assure yield increase. Prevention and control of late blight for potatoes: 53% fine metalaxyl, manganese zinc (U), acyl manganese zinc (U), chlorothalonil (U), etc., may be selected as the control agents and the pesticide application interval and frequency may be determined depending on the occurrence of disease, usually 3 to 5 times in a growth season. Underground pests: In adult emergence stage, light traps can be used to trap adults for centralized killing. high efficiency and low toxicity pesticides shall be used for prevention and control by means of poisonous soil spreading or root irrigation.

4.5.4 IPM measures for vegetables

There are diversified models of vegetable cultivation (e.g. facility vegetable, open field vegetable) and the occurrence of pests and diseases is even more complicated and diversified. Management of vegetable pests and diseases should focus on the entire ecological system and the agricultural, ecological, physical and chemical measures of prevention and control should be utilized in an integrated way to create an environmental condition unfavorable to pest and disease occurrence and favorable to multiplication of natural enemies so as to maintain the eco-system balance and biodiversity and reduce losses and damages caused by the various pests and diseases.

(1) Vegetable varieties with excellent pest and disease resistance should be selected. The vegetable farmers should buy their vegetable seeds at official and professional stores and high-quality and high-yield varieties with strong resistance to pests and diseases and suitable to grow locally should be selected and planted.

(2) Crop rotation: Methods including rational rotation, intercropping, relay cropping and crop variety replacement, foreign soil, construction of new sheds in a different location help to reduce the accumulation of pathogens and insect sources and prevent and control problems caused by years of continuous cropping. Crop rotation of the same family and same genus should be avoided. The peak hazard period of pests and diseases should be avoided by means of adjusting the cultivation or transplanting periods of vegetables to mitigate hazards of pests and diseases. Pests and diseases of tomatoes and Chinese cabbage can be mitigated by avoiding seedling in high temperature.

(3) Nurturing strong seedlings: The seedlings should be nurtured at a non-local or off-site nursery and nutrition bowls, plug tray, nutritive soil should be used to

protect the roots and nurture the seedlings; seedling management should be improved to increase the seedlings resistance to diseases and pests; weak seedlings should be discarded upon transplanting to assure that only strong seedling are planted in the end.

(4) Healthy and strong plants should be nurtured by means of fitness cultivation and management; Comprehensive measures shall be taken to strengthen temperature, light, water, fertilizer and air management and create a good vegetable-growing environment. For example, the measures of scientific formula fertilization, and addition of organic fertilizers and trace fertilizer can meet the growth needs of vegetables in time; the special environment in the protected areas may be used and measures of ventilation and shed closure may be taken to control temperature and humidity; measures of plastic membrane covering and better ventilation will help improve soil moisture and reduce air humidity; light control may be achieved by means of uncovering the shed according to different periods of crop growth so as to prevent and reduce the occurrence of various physiological diseases and increase the resistance to low temperature and frost.

(5) Disease prevention through grafting: Seedling grafting can effectively prevent soil-borne diseases, increase plant growth, and improve cold and drought resistance. Cucumber grafting with pumpkin as the rootstock, for example, can effectively prevent the occurrence of melon wilt disease.

(6) Physical prevention and control measures should be adopted. First, insect nets should be erected. Covering protective ground with insect net can keep the insects out of the shed and effectively control the hazards from aphids, hoppers, cabbage caterpillars, diamondback moth, beet armyworm, leaf blotch, and litura and greatly reduce the use of chemical pesticides. Second, seeds should be properly treated. Seed soaking in warm water or soaking liquid or seed dressing in pesticide agents can kill some pathogens and eggs. Third, soil disinfection should be carried out. Before vegetables are planted in the protected areas, wintering bacteria and eggs in the soil can be killed through sun exposure. Before vegetable planting or transplanting, soil treatment by means of pesticide spraying, watering, poisonous soil and fumigation among others can effectively control soil-borne diseases and underground pests. Fourth, the phototaxis, chemotaxis and taste tendency of pests can be utilized and black light, frequency vibration pest lamps can be installed in the open field or greenhouses to trap Lepidoptera pests; yellow (blue) boards can be used to trap whitefly, spot fly, aphid, and thrips.

(7) Stronger quarantine measures should be taken on vegetable seeds and seedlings in the project area to prevent alien and invading organisms such as western flower thrips and whiteflies via introduction and seed transfer.

(8) Biological agents should be considered with priority upon pesticide

selection. For example, Bt (Ⅲ), and Beauveria bassiana could be used for controlling lepidopteron pests such as diamondback moth, cabbage caterpillar, tobacco budworm, Helicoverpa armigera. Chlorantraniliproxide (U), indoxacarb (U) may be selected as the chemical pesticides.

4.5.5 IPM measures for rape

Rape Sclerotinia, downy mildew and aphids are the main objects of control. Brassica napus varieties with strong resistance and excellent overall performance shall be selected; rape and rice rotation shall be implemented and field management shall be strengthened to assure timely drainage and ventilation and removal of sick, old and yellow leaves out of the field for centralized treatment to reduce the sources of diseases. Flower pod fertilizers will be top-dressed and boron and phosphorus and potassium fertilizers will be applied before and after the peak flowering period to enhance the pest-resistance of plants. Pesticides shall be applied for preventive purposes when the percentage of leaves and stems affected by rape Sclerotinia reach 8% to 10% or the percentage of affected plants of stem disease reaches 1% in the initial and peak flowering periods. Second application is allowed in the peak flowering period if too much rain occurs in the flowering period. For prevention and treatment of aphids, 10% or 20% imidacloprid (Ⅲ), pymetrozine (U) and other agents may be selected; for control of downy mildew, metalaxyl, manganese and zinc (U), etc . may be selected; for prevention and control of Sclerotinia, 43% tebuconazole(U), 10% metronidazole (U), 30% metronidazole, propiconazole (Ⅲ) and 20% prochloraz (U) can be used; for the purpose of soil treatment and weeding (transplanting), glyphosate(U) and trifluralin (U) can be selected before sowing and acetochlor (Ⅲ) and 33% pendimethalin (Ⅲ) after sowing.

4.5.6 IPM measures for tea

Prevention shall be given the top priority for the final purpose of integrated prevention and control. Various prevention and control measures shall be utilized in a comprehensive manner from the perspective of the entire eco-system of the tea garden to create environmental conditions unfavorable to the reproduction of harmful organisms such as diseases, pests and weeds and favorable to the multiplication of various natural enemies, maintain the eco-system diversity and biodiversity of the tea garden and control the harmful organisms within the permitted threshold and reduce pesticide residue to the specified standard limit.

1. Ecological regulation

Shelter forests and sidewalk trees may be planted around the tea garden, tea-forest intercropping, tea-fruit intercropping, green manure can be planted

in young-age tea garden, grass can be laid between tea trees in summer and winter, shallow weeding can be performed once a year before spring tea and summer tea, deep furrowing and weeding once a year in autumn and a certain volume of weeds may be preserved around the tea garden. All such measures are helpful to improving the ecological environment of the tea garden to create a benign habitat and reproduction place for natural enemies and increase the capacity of natural regulation.

2. Agricultural prevention and control

(1) Local tea varieties with strong resistance to major pests and diseases shall be selected upon replanting, transplanting or development of new tea garden.

(2) Tea picking should be conducted in batches, in multiple operations and in a timely manner to restrict pests and diseases harmful to tea, such as small green leafhopper, tea mite, tea white scab.

(3) The tea trees should be controlled to a height of less than 80cm through pruning to mitigate hazards from pests such as gypsy moth, scale insect and black spiny whitefly and control the base wintering population of mites.

(4) In late autumn, deep furrowing may be conducted in the tea garden together with application of base fertilizer to reduce the population density of pests wintering in soil, such as Lepidoptera and weevil.

(5) Having leaves and top soil around the tree roots removed and buried deep between the trees can effectively prevent leaf diseases and pests wintering in the top soil.

(6) Tea garden management should be strengthened and formulated fertilization implemented to remove humidity hazard, prevent drought and frost hazard and improve ventilation and lighting in the tea garden, thus enhancing the disease resistance of tea trees.

2. Physical prevention and control

(1) Artificial trapping can reduce the hazards of pests such as tea caterpillar, silkworm, and Clania and myllocerinus aurolineatus.

(2) Light trapping, color board trapping and sexual trapping may be selected taking advantage of the taxis of pests. Light trapping may be used for control of adult pests of tea tree Lepidoptera, with one light trap installed per 40 to 50mu at a height of 1.5m above the ground. The lights should be turned on every evening and turned off the next morning from early April to late October. Color boards in tea gardens are mainly yellow green collar boards for prevention and control of pests such as spiniferus, leafhopper, aphids and thrips, with 20 to 25 color boards per mu and installed at a such a height that the bottom of the color board is close to the top of the tea tree.

(3) Weeding may be conducted artificially or mechanically.

3. Biological prevention and control

(1) In order to reduce artificial harms to natural enemies, attention should be paid to protection and utilization of beneficial organisms in the local tea garden, such as ladybugs, spiders, lacewings, predatory mites, and parasitic wasps .

(2) Biological pesticides (microbial pesticides and botanical pesticides) should be used. 0.6% matrine may be selected for prevention and control of tea aphid and mites; 0.5% veratridine for prevention and control of tea leafhopper, tea mite, and tea geometrid. When tea geometrid virus preparation is used, the first generation or the 1-year old and 2-year old pests of the 5^{th} generation and the 6^{th} generation should be selected for pesticide application. For prevention and control of tea caterpillar, the tea caterpillar virus preparation may be sprayed on the 1-year old and 2-year old larvae.

4. Chemical prevention and control

The 10% or 20% imidacloprid (III) and 25% thiamethoxam (U) shall be selected as pesticide for chemical control.

Chemical pesticides should be subject to strict control. Pesticide application is allowed for false eye green leafhoppers and mites when their population density reaches 6 per hundred leaves and 15 per hundred leaves or more respectively. The pesticide is applied in the initial expansion of young leaves, once per tea season. The different types of pesticides should be used alternatively. Pesticide spraying mainly focuses on the back of leaves, which should become wet and fully sprayed.

4.5.7 IPM measures for wheat

Wheat stripe rust, powdery mildew, full rot and aphid shall be the main objects of control and varieties with good resistance shall be introduced and utilized.

1. Agricultural prevention and control

(1) Quarantine inspections at the places of origin shall be strengthened to control pests and diseases at the source; the plant quarantine laws and regulations shall be followed when introducing from the seed production base. First, disease-free farm field shall be selected as the seed production base, which shall develop strict quarantine specifications for place of origins and carry out the quarantine work at places of origin. Introduction from disease-affecting areas is strictly prohibited.

(2) High-quality multi-resistance varieties shall be selected to enhance the resistance to pests and diseases of wheat.

(3) Regular rotation and quality-improvement cultivation techniques shall be

adopted; balanced fertilization and scientific irrigation aiming to promote smooth flow of irrigation, shall be implemented; farm fields shall be cleared and weeded to purify wheat field environment and reduce the parasitic sites of pests and diseases.

2. Physical prevention and control

(1) Pests shall be trapped taking advantage of the phototaxis of pests such as Toxoplasma gondii and using black light and vibrating trap light and other pest trapping technologies.

(2) Yellow sticky boards shall be installed to trap aphids taking advantage of the taxis of aphids to yellow color.

3. Chemical prevention and control

Upon cultivation, triazole fungicides, such as triadimefon (III), tebuconazole (III), hexaconazole (III), should be selected for seed dressing so as to effectively reduce the hazards of wheat stripe rust, powdery mildew, loose smut and full rot. In the growth season, neonicotinoid insecticides such as acetamiprid (III), imidacloprid (III), nitenpyram (U), thiamethoxam (U) and other high efficiency and low toxicity pesticides should be selected to control wheat aphids. This approach does not only reduce and control the direct hazards from aphids, but also effectively prevents the occurrence of wheat virus disease caused by the spread of aphids. Organic phosphorus and other highly toxic pesticides are prohibited to protect and take advantage of the natural enemies.

4.5.8 IPM measures for mulberry

Mulberry geometrid, wild silkworm, caterpillars, leaf worms, mulberry thrips, baris deplanata and plaster disease are the main objects of control.

1. Agricultural prevention and control

(1) Mulberry trees with resistance to diseases and pests shall be selected. Suitable varieties of mulberry should be selected targeting at the frequently observed diseases and pests in the region.

(2) Mulberry seedlings not affected by diseases and pests should be nurtured. Quarantine pest nurseries should be developed for disease-free wilt disease, root-knot nematode disease, mulberry mosquito, mulberry and any pests and diseases discovered shall be immediately burned or disinfected.

(3) Winter ploughing and summer planting: After the mulberry defoliation, winter ploughing should be conducted at a depth of 15cm to 25cm; summer planting should be conducted after summer felling with a depth of 10cm to 15cm so as to frost and expose the top soil pests.

(4) Fertilizer and irrigation management should be strengthened. Organic fertilizers should be increased to enhance the tree vigor and resistance to pests and diseases.

(5) Pruning and cutting should be conducted in a reasonable way. Summer cutting should be conducted using the method of fist form training immediately after the large-scale leaf picking in spring. Twigs and branches should be pruned and the dead trunks repaired in the period from mid-November to mid-December and the pest-affected branches, twigs and trunks shall be collected and burned in a centralized way.

2. Physical prevention and control

(1) Artificial trapping and picking

Artificial trapping of large pests or pests in fields failing to reach the specified indicators for prevention and control and picking larvae or eggs with flocking hazards.

(2) Bait or light trapping or killing

Using poisonous baits or light and a water-filled container underneath to trap and kill the mulberry pests taking advantage of their silotaxis, phototaxis and chemotaxis.

(3) Sexual trapping

Using heterosexual live or the immersion liquid at the end of their abdomen or synthetic sex pheromone to trap or attract insects and reduce the rate of fertilization of female adult.

3. Chemical prevention and control

Pesticide type and concentration should be selected according to the object of control and safety intervals for silkworm. The total number of pesticide application should be controlled at 4 times to 5 times in a whole year, i.e. Batocera lineolata control in March, fist-form control on the 3rd day after summer cutting and “final pest control” each in early June to early July, late July to early September depending on pest condition and in October.

Appropriately selected pesticide with the precise concentration should be applied over all the mulberry trees for a thorough control of pests depending on the different season. it is a requirement that the entire mulberry tree should be fully sprayed and wet for the sake of complete prevention and control. Pesticides available for selection include: 50% carbendazim (U) or 70% methyl Tobuzin (U) for control of Sclerotinia, mulberry blight of Botrytis cinerea; 20% (U) or streptomycin thiodiazole copper (III) for control of mulberry bacterial blight; chlorantraniliprole (U), tetrachloro amide(U), Flubendiamide(U), Bacillus thuringiensis(III), Pymetrozine(U), Nitenpyram(U), 25% thiazide (U) for control

of mulberry caterpillar, mulberry looper, mulberry thrips, etc.

Integrated prevention and control is an important approach to mulberry protection and a critical step for improving prevention efficiency. Such integrated prevention and control activities should be organized for uniform timing, uniform pesticide type, uniform preparation concentration and dosage and uniform pesticide application method, quality and progress.

4.5.9 IPM measures for fruit trees

Plant quarantine is the first step for integrated prevention and control of pests and diseases for fruit trees and conscientious efforts should be made to carry out the quarantine inspection of introduced seedlings. IPM measures for existing orchards include:

(1) First, the fundamental position of agricultural measures should be reinforced. A) Stronger efforts should be made in fertilizer and irrigation management to improve the pest and disease resistance of the fruit trees. High-quality organic fertilizers and phosphorus fertilizer should be applied as an additional measure to obviously mitigate the occurrence of rot, round rot, spot leaf blight and powdery mildew. The nutrition condition for the various sucking pests, such as spider mites, aphids and scale insects. B) Precise pruning, flower thinning, fruit thinning should be carried out to assign a reasonable load and increase tree vigor. C) Fruits should be bagged to improve fruit quality and prevent ring rot and hazards from multiple pests, such as moth and leaf roller. D) The orchards should be properly cleaned. Affected twigs and branches should be removed during pruning for centralized burning or deep burying to reduce the population base of pests.

(2) Second, biological prevention and control technologies should be adopted with an active attitude. A) Protection and utilization of natural enemies. First, usage of broad-spectrum chemical pesticides should be reduced and biological agents such as Bacillus thuringiensis (Ⅲ) should be used in an extensive way to control Lepidoptera and other pests; Second. the practices of planting leguminous forage and green manures in orchards should be promoted to provide the natural enemies with a breeding ground and enable them to play a role of pest control; Third, artificial release of natural enemies helps to increase the number of natural enemies in orchards. For example, Trichogramma may be releases to control apple leaf roller and oriental fruit moths; predatory mites may be released to prevent fruit pests and other pests. B). Sexual attractant may be used for trapping of peach small leaf rollers, pear small leaf rollers, small leaf roller moth, gold moth and other pests.

(3) Third, chemical pesticides should be used in a reasonable way. A) pesticide application should be controlled against the economic threshold. On the basis of proper monitoring, prevention and control of pests and diseases should be

carried out according to economic threshold to avoid blind use of drugs and reduce the amount and frequency of pesticide application. B) Chemical pesticides should be used in a scientific way. 1) Pesticides should be selected in a reasonable way so that pesticides safe to human and animals, harmless to natural enemies and causing no environmental pollution and having high efficiency in controlling the target pests should be selected where possible.

Insect growth regulators, such as urea (III), fipronil (III), etc.; Selective pesticides available for orchards include: biological agents, such as bacteria budworm (III), Bacillus thuringiensis (III) and polyoxin (III); selective acaricides, such as clofentezine (III), hexythiazox (III) etc.; selective aphid killing and scale killing agents, such as imidacloprid (III), etc.. Second, chemical pesticides should be reasonably used. In spring before the fruit tree sprouts when the orchard natural enemies are not yet out of hibernation, broad-spectrum insecticide can be sprayed to kill the eggs and pests of aphids and mites wintering on the tree; high-concentration eradicating fungicides can be sprayed to eradicate wintering bacteria on the trees causing rot, ring rot and altermaria leaf spots. It is preferable to use selective insecticides and acaricides in the growing season, such as diflubenzuron for controlling leaf moth (Ⅲ), imidacloprid (Ⅲ) for controlling aphids and avermectin for controlling spider mites. In addition, attention should be paid to improving application methods based on pest habits, e.g. ground spraying, trunk coating, etc., to reduce the damage on non-target organisms; pesticides should be used in rotation or through reasonable mixing to delay the emergence of pest resistance.

5. Pesticide use and management in the project area

5.1 PESTICIDES AND PESTICIDE APPLICATION TOOLS RECOMMENDED FOR THE PROJECT AREA

5.1.1 Recommended pesticides

In the implementation process of the Project, pesticides should be used in association with the agricultural, physical and biological measures so that the guideline of cost-effectiveness, safety and high-efficiency is respected. In accordance with the laws and regulations of China, the IPM approach and the principle of integrated management, the pesticides, additives and growth regulators shown in Annex 1 are recommended for the Project.

5.1.2 Pesticides prohibited and restricted in China

BHC, DDT, toxaphene, DBCP, Chlordimeform, 2-dibromoethane, nitrofen, aldrin, dieldrin, mercury, arsenic and lead preparation, dexon, Fluoroacetamide, gliftor, tetramine, Silatranes, sodium fluoroacetate, methyl parathion, parathion, monocrotophos, phosphorus amine, fenamiphos, fonofos, methyl sulfide, calcium phosphate, magnesium phosphide, zinc phosphide, Cadusafos, coumaphos, sulfotep, Terbufos, methamidophos, paraquat, three dicofol, sodium pentachlorophenate, 2, 4- butylate and Metsulfuron methyl, Ehtametsulfuron, asomate, Monzet, chlorsulfuron, octachlorodipropyl ether,

etc.

Pesticides including phorate, methyl isofenphos, G Budweiser, Isocarbophos, Do-win, endosulfan, Omethoate, methidathion, aldicarb and Ethoprophos, demeton, Sulfur phosphorus, Isazofos are prohibited for vegetables, fruit trees, tea and herbs.

Registration of chlorpyrifos and triazophos on vegetables was cancelled as of Dec. 31, 2016; application of chlorpyrifos and triazophos on vegetables is prohibited as of Dec. 31, 2016.

Registration of carbofuran, phorate and isofenphos-methyl on sugarcane crops is cancelled as of Sept. 7, 2016 and application of carbofuran, phorate and isofenphos-methyl on sugarcane crops is prohibited as of Oct. 1, 2018.

Application of fipronil is prohibited in areas other than for health purposes or as seed dressing for corn and other dry field crops.

Pesticide registration of florfenicol amide on rice is cancelled as of Sept. 7, 2016 and application of florfenicol amide on rice is prohibited as of Oct. 1, 2018. Application of daminozide on peanuts is prohibited.

The scope of registration and application and method of application of Methyl bromide and Trichloronitromethane are changed to soil fumigation and other registrations than soil fumigation are cancelled as of Oct. 1, 2015. Application of Methyl bromide and Trichloronitromethane should be carried out under professional guidance.

Pesticide registration certificate of products containing endosulfan is cancelled as of July 1, 2018 and application of products containing endosulfan is prohibited on agriculture.

The scope of registration and application of products containing Methyl bromide are changed to quarantine fumigation treatment and as of January 1, 2019. Application of product containing Methyl bromide is prohibited in agriculture.

As of August 1, 2017, pesticide registration of acephate, carbosulfan and dimethoate (including single agents and compound preparations containing effective ingredients of the aforesaid 3 types of pesticides, hereinafter the same) in vegetables, fruits and melons, tea, fungus and herbs is cancelled and request for registration of acephate, carbosulfan and dimethoate in vegetables, fruits and melons, tea, fungus and herbs is no longer accepted and approved. As of August 1, 2019, use of acephate, carbosulfan and dimethoate in vegetables, fruits and melons, tea, fungus and herbs is prohibited.

All pesticide products should be used within the scope of usage approved upon pesticide registration and are prohibited to use outside the approved scope.

5.2 TECHNICAL REQUIREMENTS ON PESTICIDE APPLICATION TOOLS TO BE USED IN THE PROJECT AREA

Pesticides constitute an indispensable production materials in agricultural

production. Excellent pesticide application tools and devices are required for the purpose of scientific, reasonable and safe use of pesticides. Selection or technical requirements on pest application tools generally cover the following aspects:

(1) Factors including objects of control, sites, types and growth condition of crops and, pesticide type, application method, control scope, etc., should be taken into account to determine the category of pesticide application tools. In the case of fruit trees, the age, height and spacing of trees as well as the suitability and passage capability of the selected tools during field operation should also be considered.

- Hand sprayers should be selected for small area application of pesticides.
- Knapsack mobile sprayers should be selected for large-area application of pesticides while air-blowing mist sprayer should be used for trees or orchards.
- Ultra long range gun sprayers should be selected for large-area application of pesticides.

(2) Suitable nozzles should be selected based on the needs of prevention and control of pests and other harmful organisms as well as the types of pesticide application tools; nozzles should be replaced on a regular basis.

- Sector nozzles, featuring in fan-shaped mists with uniform mist particle sizes and little drift, should be selected for application of herbicides and plant growth regulators.
- Hollow cone nozzles, featuring in fine mist particles that drift easily and contact the blades from different directions, should be selected for application of insecticides and bactericides.
- Mixed use of different types of nozzles on the spraying rod is prohibited.

(3) Pesticide application tools manufactured by licensed manufacturers and carrying quality inspection certificates should be selected. Upon purchase, inspections should be conducted according to the package list to determine whether the packaging condition is fine and the accompanying technical documents, accessories and spare parts are supplied.

(4) Mixed use of pesticide application tools is not permitted. Sprayers used for application of insecticides and bactericides should be washed before being used in application of other insecticides or bactericides; sprayers used for application of herbicides should, in general, not be used for application of other types of pesticides.

Pesticide application tools complying with the standards of FAO, ISO or China should be used for prevention and control of agricultural crop pests and diseases. Hand sprayers available to select include WS-16P, WS-16 and NS-15 made in China, BP-16 from Malaysia and MATABI series from Spain; knapsack mobile sprayers include 3WFB-18AC and 3WF-2.6; mobile jet sprayers include WSJ-36A and 3WZ-34.

5.3 USER CAPABILITY OF USING AND HANDLING CHEMICALS

The capability of pesticide dealers and farmers of handling pesticide products within the acceptable range of risks is inconsistent (e.g. safe storage, use of safe equipment, having protective clothing, safe treatment of waste chemicals or their packaging materials). The recommended training plan for farmers and chemical pesticide dealers will effectively address these issues. However, the local monitoring and evaluation plan will be used for regular monitoring of the capability of farmers and chemical dealers in safe use and handling of chemicals. Further training will be provided where the chemical operation methods are not safe.

5.4 ENVIRONMENTAL, OCCUPATIONAL / HEALTH RISKS

5.4.1 Environmental risks

(1) Major environmental risks involved in the process of pesticide application in the project area include:

- Insecticide residue results in deterioration of water quality and the potential risk is the reduction of the population of aquatic organisms (e.g. fish and aquatic insects);
- Application of insecticides or leakage of chemicals in the adjacency of drinking water sources leads to pollution of water source;
- Possible use of highly toxic insecticides brings impacts on non-target species (in particular, bees, birds, livestock and natural enemies of pests);
- Long-term and excessive use of some pesticides results in increased pesticide resistance of pests and rats;
- Residue of pesticides leads to soil pollution.
- Waste pesticide packaging materials may result in NPS pollution.

(2) Measures for mitigating the aforesaid risks include:

- Providing the farmers and chemical pesticide dealers with training on possible environmental impacts of the specific chemicals and recommending better spraying tools and methods;
- Regulating and monitoring, in cooperation with the governments and agricultural technology authorities in the project area, the behaviors of pesticide spraying to assure clean water sources;
- Recommending safe spraying tools certified by the national quality inspection authorities for the project implementation area;
- Selecting high-efficiency, low-toxicity and low-residue pesticides;
- Promoting the application of biological prevention and control measures and minimizing the usage of chemical pesticides;
- Taking a series of harmless prevention and control measures (agricultural, physical, biological and low-toxicity chemicals) to assure that the pesticide

resistance of pests will not increase.

- Setting up stations for centralized recovery of waste pesticide packaging materials.

5.4.2 Occupational / health risks

(1) The major occupational / health risks arising from pesticide application include:

- Harms to human body by fugitive gases in the process of pesticide preparation and spraying without any protective measures;
- Skin burns caused by pesticide spraying or leakage without any protective clothing;
- Drinking water pollution caused by spraying of pesticide or leakage of chemicals in the adjacency of drinking water sources.

(2) Measures for mitigating the aforesaid risks include:

- Providing farmers and pesticide dealers in the project area with knowledge training on safe use, transportation and storage of pesticides and treatment of wastes. The major contents include: occupational / health impacts that some specific pesticides may generate; recommended methods of operation and spraying; verified spraying tools and operation methods; wearing of safety clothing (long-sleeve clothing, masks, helmets, gloves, pants and footwear); weather conditions required for pesticide application; how to store chemical pesticides in a safe manner; how to carry out harmless treatment of waste chemical pesticides and their packaging materials, etc.;
- The execution status of the aforesaid measures should be monitored and evaluated and, if not properly executed, further education and training should be conducted.

6. Capacity building of pest management in the project area

6.1 POLICY ISSUES

6.1.1 Objectives of policy development and issuance of government documents

(1) National level: Making adjustments to the catalogue of prohibited pesticides according to the international standard; enacting laws and regulations on strict restriction of production and distribution of high-toxicity pesticides; supporting and facilitating the extension of IMP through project implementation.

(2) Local government level (project implementation area): Developing the catalogue of prohibited pesticides and strengthening monitoring and law enforcement management; helping farmers in registration of safe food,

harmless food and green food and enabling them to get market access and higher market prices.

(3) Farmers and service organization (project implementation area): Enabling farmers and service organizations to acquire IPM techniques through training and demonstration so as to enhance the awareness of environmental production and harmless pesticide.

6.1.2 The following stipulations shall be strictly respected.

(1) FAO Code of conduct for distribution and use of pesticides;

(2) FAO Code of conduct for packaging and storage of pesticides;

(3) FAO Code of conduct on labeling and packaging of pesticides;

(4) FAO Codes of conduct on disposal of pesticide residue on site and pesticide packaging and containers;

(5) Pollutant discharge standards for pesticides developed by the Ministry of Environmental Protection (MOEP) of the People's Republic of China;

(6) Pesticide Management Regulations enacted by the Ministry of Agriculture of the People's Republic of China.

6.2 MANAGEMENT OBJECTIVES

6.2.1 Enhancing the awareness of policy enforcement

Through implementation of the Project, the awareness of IMP execution will be enhanced in the following aspects:

(1) Routine usage and frequency of chemical insecticides in the project area are reduced;

(2) Unregistered pesticides are prohibited in the project area;

(3) High-toxicity pesticides (Class I pesticides according to WHO) are replaced with low-toxicity pesticides in the project area;

(4) FAO rules on restriction, distribution and application of pesticides and the Pesticide Management Regulations are enforced;

(5) FAO Codes of conduct on packaging and storage of pesticides and the Pesticide Management Regulations are executed;

(6) FAO Codes of conduct on labeling and application of pesticides and the Pesticide Management Regulations are executed;

(7) FAO guidelines on disposal of waste pesticides and packaging materials and the Environmental Protection Law of the People's Republic of China are enforced;

(8) Immediate preparations are made under the Project for implementation of the FAO guidelines in case China has no equivalent guidelines;

(9) The Pest Management Plan of the Project is executed.

In addition, the municipal, county and town and township governments are encouraged to promote and support the IMP methodology through discussions and project implementation (in particular long-term benefits).

6.2.2 Strengthening capacity building of plant protection at the grassroot levels

Through project implementation, the capacity of plant protection at the grassroots level is strengthened in the following aspects:

(1) Training is provided to county/city plant protection specialists, town and township agricultural technology extension personnel and grassroots farmer technicians and technology demonstration households.

(2) In the process of project execution, the plant protection personnel is familiar with and the local farmers acquires a certain knowledge of the IMP methodology.

(3) Through implementation of the Project, the county / city, town and village connections in terms of plant protection are strengthened to facilitate the implementation of the pest management plan.

6.3 MANAGEMENT CAPACITY, INSTITUTIONAL ARRANGEMENT AND PARTNERSHIP

The management capacity of plant protection under the Project will be strengthened by setting up full-time management bodies and personnel and close partnership with the pest prevention and quarantine departments at all levels so as to control the distribution and usage of pesticides. The Project will adopt the following methods:

(1) A full-time personnel will be appointed by the PMO to supervise the process of implementation of the Pest Management Plan;

(2) A pest monitoring and evaluation plan and methods will be developed to monitor and evaluate the pest management technologies adopted during the execution of the Project;

(3) The PMO will establish partnership with the crop pest prevention and quarantine authorities and pest research institutions at the national and provincial levels to update and enrich knowledge on pest prevention and control and enhance capacity of integrated pest management;

(4) The plant protection specialists at the provincial, municipal and county levels will made stronger efforts in technical training to the agricultural technology extension personnel and farmers in the counties, townships and towns in the project implementation area.

(5) Stronger efforts will be made in exchange of technologies and experiences in pest prevention and control between the cities, counties or towns (townships) in the project area for the final goal of outcome sharing.

6.4 TRAINING AND HUMAN RESOURCES DEVELOPMENT

Training and human resources development constitute an important work for capacity building of pest management. Based on the job assignments and staffing level of different departments concerned in this work, it is recommended that:

(1) Training is provided on a periodical basis to the industrial and commercial administration authorities, plant protection and agricultural technology extension personnel at the county, township (town) levels to assure that the various rules and regulations on operation, management and distribution of pesticides are effectively executed and supervised;

(2) Training on pest management methods is provided by the plant protection and agricultural technology extension staff at the county, town (and township) levels to farms in the form of field schools;

(3) The plant protection specialists at all levels may be interviewed and consulted or theme studies may be conducted by the respective research bodes regarding some new pests and diseases and technologies for their harmless control.

(4) Training textbooks should be compiled and necessary video and audio materials developed as early as possible based on the ecological characteristics of the project implementation area and the real circumstances of the occurrence of the key agricultural and forest crop pests and diseases.

6.5 TRAINING FOR FARMERS AND SERVICE ORGANIZATIONS

Farmers and service organizations are the subjects of project implementation. Training for farmers and service organizations is an important content of pest management and helps to improve their IPM knowledge and plant protection skills and enhance their awareness of environmental protection and active participation in IPM.

6.5.1 Training methods

Such training may be conducted in the form of participatory training and mobile training:

(1) Participatory training: Farmers' field schools should be set up in the project implementation and the trainers will mainly comprise of agricultural technology extension personnel at the town (township) level and farmer technicians with special training background and rich experiences in pest management. Upon such training, the field trainers will provide pertinent guidance and training to the farmers on how to identify and control pests in the field based on the actual occurrence of pests and diseases in the different growth stages of agricultural crops and trees so as to enrich the farmer trainees' technical knowledge and facilitate the training of the organization, exchange and management skill.

(2) Mobile training: The project team should organize the specialists from the agricultural science academies, colleges and universities and agriculture management and extension bodies to form a mobile training team to provide

training to local agricultural technology extension personnel, farmer technicians, farmers and pesticide dealers at the farmers' field schools or the towns (townships) and villages in the project implementation area. At such training, the latest IPM concepts, latest harmless pest control technologies and policies and laws and regulations on safe use of pesticides and management and distribution of pesticides.

6.5.2 Training contents

(1) Trainees: agricultural technology extension personnel and plant protection personnel at the county, town (or township) levels, farmer technicians, farmers, and practitioners of the integrated management service organizations and pesticide dealers, etc.

(2) Training contents:

- ✓ National and local laws and regulations;
- ✓ Pest management plan of the Project and the key contents of implementation;
- ✓ Technologies of identification, prevention and integrated management of the key pests and diseases in the project area;
- ✓ Morphological characteristics and identification of pests and diseases;
- ✓ Characteristics and losses of different pests and diseases;
- ✓ Law of occurrence of major pests and diseases;
- ✓ Identification of natural enemy insects;
- ✓ Methods for field sampling and estimation of occurrence density of pests and diseases;
- ✓ Pest and disease control thresholds;
- ✓ Pest and disease control measures, including agricultural, physical, biological and chemical prevention and control methods;
- ✓ Technologies for selection and safe use of pesticides;
- ✓ Knowledge and operating skills in purchase, transportation, safe use and storage of pesticides;
- ✓ Safe storage and disposal of agricultural chemicals and their packaging wastes.

6.6 TRAINING PLAN

The training work plan should include two parts, i.e. the trainer training plan and the farmers field school work plan. Here described as follows is the training plan:

Table 5.6-1 Training work plan and cost estimation

Training type	Training contents	Trainees	Project area		Number of trainees and days per training	Number of training per year	Training method	IA
Trainer training plan	Latest IPM concepts, the Project's PMP, latest technologies for harmless prevention and control of pests and diseases of the respective crops, technologies for safe use of pesticides and policies and laws and regulations on distribution of pesticides	Agricultural technology extension personnel and plant protection personnel of the town (township) level	Chun'an County		10 persons; 3 days per year for 5 years	2 centralized training per year on a periodical basis	Mobile training	PMO
			Jiande City		10 persons; 3 days per year for 5 years			
Farmers Field School	Measures for identification, prevention and control of key pests and diseases; technologies for safe use of pesticides and disposal of waste pesticides and packaging materials	Farmer technicians, farmers, practitioners of the integrated management service organizations and pesticide dealers	Chun'an County	Project towns and townships	50 persons for 5 years	In the months of April to September in the crop and forest growth period, 1 per month, totally 6 times a year	Participatory training	PMO
			Jiande City	Project towns and townships	30 persons for 5 years			

7. Project monitoring and reporting

7.1 CONTENTS OF PROJECT MONITORING

During the execution of the Project, it is necessary to conduct on-site monitoring of the implementation status of IPM, methods of pesticide usage, dynamic status of key pests and diseases and the natural enemy species in the project area as well as the environmental impacts after the project is implemented. The specific contents of monitoring are shown in the figure below:

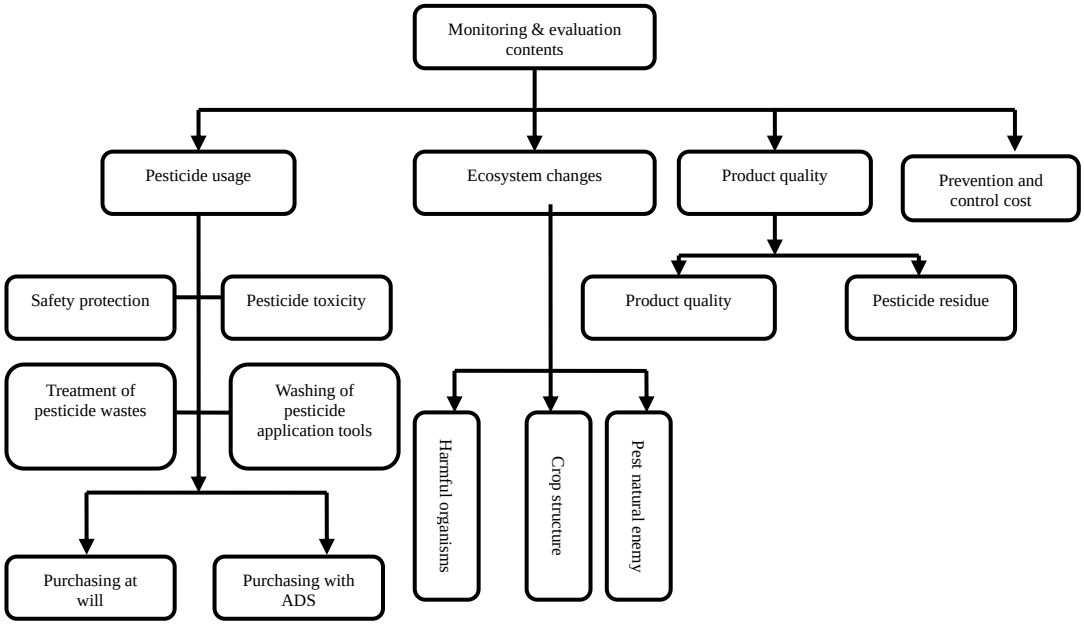


Figure 7.1-1: Schematic diagram of monitoring contents of the Project

7.2 CONTENTS OF PROJECT SUPERVISION AND MANAGEMENT

On-site monitoring is required for the following work activities during the implementation of the Project:

- Pesticide registration;
- Policy issuance;
- Assistance in fulfilling of the local monitoring procedure and analysis of outcomes.

7.3 MONITORING AND SUPERVISION PLAN

7.3.1 Pest management monitoring plan

7.3.1.1 Implementation of the monitoring plan

The monitoring work should be carried out together by the municipal and county-level agricultural technology extension service centers, the PMO and the project owner in each town and township on the project implementation

area. Once any pests or diseases are discovered, a timely report shall be submitted for timely actions. The World Bank delegates should provide assistance in setting up a suitable monitoring system and sampling procedure at the earliest possible date and provide training in implementation and analysis of the monitoring system.

7.3.1.2 Establishment of monitoring sites and methods of monitoring

Based on the crop structure and unique and advantageous crops grown in the project area, the key crops to be monitored include rice, vegetables, mulberry and tea gardens and 2 monitoring sites each will be set up in Chun'an County and Jiande City.

Method for monitoring of pesticide usage: in the harvesting period of the monitored crops, data and information on the types, usage and frequency of pesticides used for prevention and control of the respective crop(s) and the disposal of waste pesticides and packaging materials will be collected by means of questionnaires and surveys, with a statistical summary developed.

Methods for status monitoring of farmland ecosystem: 1 village will be selected at each monitoring site to investigate in the types of pests and occurrence of each type of pests as well as the type and quantities of their natural enemies once each in the seedling stage, adult stage, fruiting stage and harvesting stage, with 4 surveys per year for each type of crops;

Methods for monitoring of output and quality status: 1 representative village will be selected at each monitoring site and 3 representative sample fields will be selected for output monitoring upon harvesting of the monitored crops. In addition, samples will be taken of the agricultural products for testing of pesticide residue.

7.3.1.3 Monitoring and evaluation system

(1) Level of implementation of IPM measures

- ✓ Number of households participating in the implementation of IPM measures;
- ✓ Area of agricultural crops for which IPM measures are taken;
- ✓ Number of farmers capable of identifying key pests / natural enemies;
- ✓ Number of farmers participating in the training of IPM plan;
- ✓ Effects of control of key pests after the IPM measures are implemented.

(2) Level of safe use of pesticides

- ✓ Number of pesticide applications per year on key crops or fruit trees;
- ✓ Types and volume of pesticide applied on major crops per year per mu;
- ✓ Cost of pesticides used for pest prevention and control of key crops per year per mu;

- ✓ Number of farmers implementing safe use and disposal of pesticides (safe storage, use of labor protection devices, etc.);
- ✓ Number of rejections of agricultural products due to excessively high content of pesticide residue;
- ✓ Incidents of human and livestock poisoning caused by use of pesticides.

Table 7.3-1 Schedule of pest monitoring and evaluation for key crops planted in the project area

Description of monitoring sites	Key monitored crops	Pesticide usage				Farmland ecosystem condition				Output and quality status				Monitoring expenditure (CNY10000)
		Type	Frequency	Usage (kg)	Monitoring frequency	Incidence of diseases	Quantity of pests	Quantity of natural enemies	Monitoring frequency	Output	Output value	Pesticide residue monitoring indicator	Monitoring frequency	
Chun'an County	Mulberry				6				24			Propiconazole, imidacloprid, buprofezin, Carbendazim	18	21.6
	Tea				6				24				18	21.6
Jiande City	Rice				6				24				18	21.6
	Vegetables				6				24				18	21.6

Notes:

(1) Methods for monitoring of pesticide usage: in the harvesting period of the monitored crops, data and information on the types, usage and frequency of pesticides used for prevention and control of the respective crop(s) and the disposal of waste pesticides and packaging materials will be collected by means of questionnaires and surveys, with a statistical summary developed.

(2) Methods for status monitoring of farmland ecosystem: 1 village will be selected at each monitoring site to investigate in the types of pests and occurrence of each type of pests as well as the type and quantities of their natural enemies once each in the seedling stage, adult stage, fruiting stage and harvesting stage, with 4 surveys per year for each type of crops.

(3) Methods for monitoring of output and quality status: 1 representative village will be selected at each monitoring site and 3 representative sample fields will be selected for output monitoring upon harvesting of the monitored crops. In addition, samples will be taken of the agricultural products for testing of pesticide residue.

(4) Based on the 6-year project implementation period.

(3) Agricultural product output and quality status

- ✓ Output of key agricultural crops after IPM is implemented under the Project;
- ✓ Quality status of key agricultural crops after IPM is implemented under the Project;
- ✓ Output of key agricultural crops and level of profitability after IPM is implemented under the Project.

(4) Level of impacts on ecosystem

- ✓ Area of occurrence and degree of hazards of the key pests for the key crops;
- ✓ Changes of types and quantities of beneficial organisms (including predatory insects, parasite insects) in each unit specimen from the crops on which IPM plan is implemented;
- ✓ Level of impacts on wildlife, water, soil after IPM control measures are implemented.

(5) Other indicators

- ✓ Number of visits to the project area by the agricultural chemical product distribution personnel;
- ✓ Number of advertisements of the agricultural chemical products on public media (TV, radio and newspaper);
- ✓ Number of emergence of the brands of agricultural pesticide products via the retail channel in the project area;
- ✓ Number of acceptable agricultural product exhibitions.

7.3.2 Supervision plan

7.3.2.1 Execution of the supervision plan

The PMOs at all levels should be responsible for assuring normal implementation of the periodical supervision activities. The PMOs and agricultural technology extension centers at all levels should supervise and inspect the implementation status of the pest management plan in the peak period of pest occurrence and assist the World Bank supervision mission in project supervision and inspection. The World Bank supervision mission should comprise of specialists with experiences in pest prevention and control and carry out the supervision and inspection activities 1 to 2 times a year, usually in the peak period of pest occurrence each year.

7.3.2.2 Specific contents of supervision and inspection

(1) Usage of pesticides

- ✓ Checking whether pesticides distributed by the pesticide dealers and used by farmers in the project area are registered pesticides recommended in the pest management plan;
- ✓ Checking whether Class I pesticides are sold / used in the project area;
- ✓ Checking the pesticide registration list to verify the registration status of new pesticides;
- ✓ Checking whether protective measures are taken by the farmers during pesticide application;
- ✓ Checking the farmers' practices of disposal of waste pesticides and packaging materials;

(2) Policy issues

- ✓ Government subsidies (if any) on pesticide application;
- ✓ Implementation of policies and stipulations on pesticide application and extension of IPM technologies by the local governments;

(3) Execution of site monitoring plan

- ✓ Evaluating the status of execution of on-site monitoring plan inspected by the World Bank supervision mission;
- ✓ Helping staff of the project county to solve any problems generated from execution of on-site monitoring plan;
- ✓ Providing timely training to concerned staff of the project county on on-site monitoring process, data analysis and result interpretation and making adjustments to areas requiring improvement in pest and disease management.

7.3.3 Responsibilities

Agricultural technology extension centers at all levels shall be responsible for providing the integrated pest management techniques and fulfill the obligations of guidance, supervision, monitoring and training. The PMOs at all levels and the stakeholders have the responsibilities and obligations of promptly identifying and reporting pest occurrences and fulfilling the requests consistent with the pest management plan.

7.3.4 Professional and technical requests

The agricultural technology extension service centers at all levels shall be responsible for providing the IPM technologies and methods.

7.4 PROJECT REPORTS

The PMOs at all levels and the plant protection departments at the county level should report to the relevant departments of the World Bank on the status of implementation of the Project on a half-year basis and twice a year. The report shall include information on the main crops and the area of cultiviation, the

forest area in the project area and occurrence and prevention of pests, use of pesticides, changes of ecosystem, quality of agricultural products, and cost of prevention and control and use of project funds, etc.

8. Cost estimate

The pest management plan is an important component of the Project. In order to assure effective implementation of the plan, the budgetary fund should be included in the total management cost of the PMO and the agricultural department and also the special fund for technical training, advertisement, safe and reasonable use of pesticides, pest monitoring, forecasting and early warning, supervision and monitoring, theme study and overhead. The total budget amounts to CNY 1,535,000. Details of the cost estimate are shown as follows:

Table 8-1: Budget Schedule for Training on Pest Management Plan in the Project Area (2018-2023)

Type of training	Trainee	Project area		Number of trainees	Training time (day)	Training method and frequency	Year of training	Training cost (CNY/day-time)	Total cost (CNY 10000)	IA
Trainer training plan	Town (township) agricultural technology extension personnel, plant protection personnel	Chun'an County		10 persons	3	2 periodical centralized training per year	2018 to 2023, totally 5 years	200.0	3	PMO
		Jiande City		10 persons					3	
Farmers field school	Farmer technician, farmers, integrated management service organization practitioners, pesticide dealers	Chun'an County	Project towns / townships	50 persons	1	1 training in June to September in the growth period of agricultural crops and forest, totally 6 trainings a year	2018 to 2023, totally 5 years	150.0	22.5	PMO
		Jiande City	Project towns / townships	30 persons					13.5	

Table 8-2 Budgetary Estimate for Seminars, Training Specialists, Textbooks, Supervision, Test and Management (2018-2023)

Budget item	Subject	Time/place/frequency/duration/number of person	Cost (CNY)	Total (CNY 10000)	IA	Supervision agency
Project inception workshop	World Bank officer, provincial, municipal and count PMOs, specialists, agricultural department personnel	Upon project inception at the place of PMO, 1 day with 40 persons	4.0	4.0	Provincial PMO	World Bank
Summer workshop for IPM Strategy and Action Plan in the project area	Personnel from municipal, county (district), town (township) PMOs and plant protection departments, and representatives of farmer technicians and pesticide dealers	At the end of each year; 1 summary workshop per project area for 1 day with 50 participants	CNY 35000 * 5 years	17.5		
Technical consultancy from experts	Famous specialists and professors from agriculture research institutions home and abroad in the disciplines of plant protection, agricultural pesticides and ecology	In the crop growth period; 2 time a year; 3 – 4 specialists to be invited to visit each project area for on-site guidance or mobile training for 7 to 10 days per visit	2 times * CNY 30000 * 5years	30.0		

Table 8-2 Budgetary Estimate for Seminars, Training Specialists, Textbooks, Supervision, Test and Management (2018-2023)

Budget item	Subject	Time/place/frequency/duration/number of person	Cost (CNY)	Total (CNY 10000)	IA	Supervision agency
Service charge for trainers	Trainers participating in the training for farmer technicians, farmers, pesticide dealers in the project area	According to the training plan, 80 persons are trained per year in the project area with 6 training sessions per year with a duration of 1 day per training; totally, 30 training sessions for 5 years involving a subsidy of CNY 200 per person.	80 persons * 6 times * 1 day * 5 years * CNY 200 per day per time	48.0		
Pest monitoring, survey and evaluation and pesticide supervision and management in the project area	Fixed monitoring personnel assigned by the agricultural technology extension and plant protection departments in the project area	2 persons per town/township in 4 towns/townships; 7 surveys a year with a unit cost of CNY 200 per person. See Table 7.3-1 for details of the other monitoring activities.	4 * 2 person * 7 times * CNY200 per person-time * 5 years; CNY 864,000 for monitoring and evaluation	87.52	County (district) PMO	World Bank and Provincial PMO
Total				187.02		

9. Catalogue of recommended pesticides and additives

Crop	Object of control	Recommended pesticide	WHO toxicity classification
Rice	Rice blast	Proprazole (10% , 20% , suspending agent)	U
		Isoprothiolane (40% , EC AND wettable powder)	III
		azoxystrobin (25% or higher, EC)	U
		Thiazole zinc (40% or higher, suspending agent)	U
	Sheath blight	Azole alcohol (10% , suspending agent and water dispersible granule)	U
		tebuconazole (43% , suspending agent)	U
		Thifluzamide(24% or higher, suspending agent)	U
		azoxystrobin (25% or higher, EC)	U
		Clindamycin (20% or higher, water soluble powder)	U
		Clindamycin-wax bud bacteria (12.5% or higher, suspending agent)	U
		Oxime·tebuconazole (75% or higher, water dispersible granule)	U
	False smut	Fluoro triazole (12.5% or higher, suspending agent)	U
		tebuconazole (43% , suspending agent)	U
		Propiconazole (25% , EC)	U
		Benzoyl·Propiconazole (30% , water dispersible granule, EC)	III
		Clindamycin-wax bud bacteria (12.5% or higher, suspending agent)	U
		Oxime·tebuconazole (75% or higher, water dispersible granule)	U
	Rice planthopper	pymetrozine (25% or higher, suspending agent, wettable powder and water dispersible granule)	U
		Buprofezin (25% , suspending agent and wettable powder)	U
		Thiamethoxam (25% , water dispersible granule)	U
		Imidacloprid (10% , 20% , wettable powder, water dispersible granule, suspending agent, Microemulsion, Seed dressing agent)	III
		Acetamiprid (10% , suspending agent)	U
		dinotefuran (25% or higher, wettable powder)	U
		pymetrozine ·Nitenpyram (80% or higher, water dispersible granule)	U
	Chilo suppressalis, Borer	chlorantraniliprole (20% or higher, suspending agent)	U
		Florfenicol amide (20% or higher, suspending agent)	U
		B multi-methoxy insects (34% , suspending agent)	U

Crop	Object of control	Recommended pesticide	WHO toxicity classification
		Tetrachlorfenamide (10% or higher, suspending agent)	U
	Herbicide	Pretilachlor (30% or higher, containing safety agent, EC, water emulsion)	U
		Bensulfuron-methyl (10% or higher, wettable powder)	U
		Penoxsulam (2.5% or higher, oil-based suspending agent)	U
		Cyhalofop-butyl (10% or higher, EC and water emulsion)	U
		Bensulfuron·Pretilachlor (20% , wettable powder)	U
		Acetochlor (10% or higher, EC AND oil-based suspending agent)	U
		Promethazine methyl ethyl ester (10% or higher, suspending agent and oil-based suspending agent)	U
		bentazone (45% , liquid agent)	III
		Bispyribac-sodium (10% or higher, suspending agent and oil-based suspending agent)	U
Corn	Corn borer, aphid	chlorantraniliprole (20% or higher, suspending agent)	U
		Florfenicol amide (20% or higher, suspending agent)	U
		Thiamethoxam (25% , water dispersible granule)	U
		Bacillus thuringiensis 2000IU/microliter suspending agent	III
	Large (small) leaf spot, rust disease	Carbendazim (25% , 50% wettable powder)	U
		Methylthiophanate (80% wettable powder)	U
		Mancozeb (80% wettable powder)	U
		Clindamycin (20% or higher, water soluble powder)	U
		diniconazole (12.5% wettable powder)	U
Wheat	Aphid, wheat sawfly	chlorantraniliprole (20% or higher, suspending agent)	U
		Florfenicol amide (20% or higher, suspending agent)	U
		pymetrozine (25% or higher, suspending agent, wettable powder and water dispersible granule)	U
		Imidacloprid (10% , 20% , wettable powder, water dispersible granule, suspending agent, Microemulsion, Seed dressing agent)	III
		acetamiprid (20% soluble powder, soluble concentrate)	III
		Thiamethoxam (25% , water dispersible granule)	U
		Acetamiprid (10% , suspending agent)	U
	Fusarium head blight, Sheath blight, powdery mildew	Carbendazim (25% , 50% wettable powder)	U
		Methylthiophanate (80% wettable powder)	U
		Mancozeb (80% wettable powder)	U
		Clindamycin (20% or higher, water soluble powder)	U
		tebuconazole (43% , suspending agent)	U
		Propiconazole (25% , EC)	U
Potato	Aphid, 28 star	chlorantraniliprole (20% or higher, suspending agent)	U

Crop	Object of control	Recommended pesticide	WHO toxicity classification
es	ladybug	Florfenicol amide (20% or higher, suspending agent)	U
		pymetrozine (25% or higher, suspending agent, wettable powder and water dispersible granule)	U
		Imidacloprid (10% , 20% , wettable powder, water dispersible granule, suspending agent, Microemulsion, Seed dressing agent)	III
		acetamiprid (20% soluble powder, soluble concentrate)	III
		Thiamethoxam (25% , water dispersible granule)	U
		Acetamiprid (10% , suspending agent)	U
	Late blight, early blight, ring rot	thiodiazole-copper (20% suspending agent)	U
		Mancozeb (80% wettable powder)	U
		streptomycin (72% soluble powder)	U
		Chlorothalonil (560g/L suspending agent)	U
		Oxime·tebuconazole (75% or higher, water dispersible granule)	U
		Metalaxyl·Mn-Zn (68% water dispersible granule)	U
		Enoyl·Mn-Zn (69% wettable powder)	U
Citrus	Scab	Mancozeb (80% or higher, wettable powder)	U
		thiodiazole-copper (20% , suspending agent)	U
		Chlorothalonil (75% or higher, wettable powder)	U
		azoxystrobin (25% or higher, suspending agent)	U
		Albendazole (10% , water dispersible granule)	U
	Ulcer	Zn thiazole (20% or higher, suspending agent)	U
		thiodiazole-copper (20% , suspending agent)	U
		Cupric hydroxide (46% , wettable powder and water dispersible granule)	III
		copper abietate (20% , wettable powder)	U
		Calcium copper sulfate (77% , wettable powder)	III
	Anthrax	propineb (70% or higher, wettable powder)	U
		thiophonate-methyl (70% or higher, wettable powder)	U
		Bromothalonil (25% , EC)	III
		prochloraz (20% , EC and water emulsion)	U
		azoxystrobin (25% or higher, suspending agent)	U
		Chlorothalonil (75% or higher, wettable powder)	U
	Resin disease	Captan (80% or higher, water dispersible granule)	U
		prochloraz (20% , EC and water emulsion)	U
		Mancozeb (80% or higher, wettable powder)	U
	Large (small) fruit fly	0.1% Avermectin bait	U
	Red spider	spirodiclofen (24% , suspending agent)	U

Crop	Object of control	Recommended pesticide	WHO toxicity classification
		Propargite (73% or higher, EC)	III
		Acitretin·Propargite (40% , EC)	III
		Acitretin·pyridaben (10.5% , Micro-EC and EC)	III
	Phyllocoptruta oleivora Ashmead	fenproxymate (5% , EC)	U
		spirodiclofen (24% , suspending agent)	U
		Acitretin·Propargite (40% , EC)	III
	Scale insects	Buprofezin (25% , wettable powder)	U
		Imidacloprid·Buprofezin (18% , suspending agent)	U
		Engine oil (94% , EC)	III
	Phyllocnistis citrella	chlorbenzuron (25% or higher, suspending agent)	U
		Carbamide peroxide (25% , wettable powder)	U
		chlorfluazuron (5% or higher, EC)	U
Rape	Sclerotinia sclerotiorum	Carbendazim (80% or higher, wettable powder)	U
		Sclerotium (40% , wettable powder)	U
		prochloraz (25% , EC)	U
Vegetables	Root knot nematode disease	bacillus cereus (100 billion cfu/ml suspending agent)	U
		fluopyram (41.7% suspending agent)	U
	Bacterial diseases of vegetables (soft rot, angular leaf spot, etc.)	Thiamin copper (20% , 30% suspending agent)	U
		thiodiazole-copper (20% suspending agent)	U
		Zn thiazole (20% , 30% suspending agent)	U
		Cupric hydroxide (6% , 53.8% , 57.6% water dispersible granule, 77% wettable powder)	U
		Agricultural streptomycin (72% soluble powder)	U
		Bacillus polymyxa (1 billion CFU/g wettable powder)	U
	Tomato leaf mold	Fluorosilzole (10% water emulsion)	III
		polyxins (10% wettable powder)	III
		Fluoride bacteria·Oxime ester(43% suspending agent)	U
		azoxystrobin (250g/L suspending agent)	U
	Strawberry powdery mildew	Ketogenic ester (50% water dispersible granule, 50% wettable powder, 30% wettable powder)	U
		Tetrafluoroether (4% , 12.5% water emulsion)	III
		Ether bacteria ·Bifidobacterium (300g/L suspending agent)	U
		Triflumizole (30% wettable powder)	III
	Strawberry gray mold	Boscalid (50% water dispersible granule)	U
		Bacillus subtilis (1 trillion/g)	U
		Oxazole ether·Bifidobacterium (38% water dispersible granule)	U
	Vegetable gray mold, Sclerotinia sclerotiorum,	Iprodione (50% wettable powder, 500g/L suspending agent)	III
		Boscalid(50% water dispersible granule)	U
		Fluoride bacteria·Oxime ester(43% suspending agent)	U

Crop	Object of control	Recommended pesticide	WHO toxicity classification
	Tomato early blight	picoxystrobin (22.5% suspending agent)	U
	Melon and fruit Mycosphaerella melonis	picoxystrobin (22.5% suspending agent)	U
		Azoxystrobin. Chlorothalonil (560g/L suspending agent)	U
		azoxystrobin (250g/L suspending agent)	U
		Fluoride bacteria•tebuconazole (35% suspending agent)	U
		Fluoride bacteria·Oxime ester(43% suspending agent)	U
	Downy mildew, Phytophthora Blight and late blight of fruits and vegetables	Fluoride bacteria•propamocarb(687.5g/L suspending agent)	III
		Dimethomorph(50% suspending agent, 50% water dispersible granule)	III
		Urea cream •Mn-Zn (72% wettable powder)	U
		Oxone•Cyclocarbamide(52.5% water dispersible granule)	III
		Metalaxyl·Mn-Zn (68% water dispersible granule)	U
		Mandipropamid (23.4% suspending agent)	U
	Powdery mildew of fruits and vegetables	Naphthalene·azoxystrobin (29% suspending agent)	U
		Fluoride bacteria•tebuconazole (35% suspending agent)	U
		Bupropion sulfonate(25% Microemulsion)	III
		Ethin (25% suspending agent)	U
		Triflumizole (30% wettable powder)	U
		Tetrafluoroether (4% water emulsion)	III
	Anthracnose of melon and fruit	picoxystrobin (22.5% suspending agent)	U
		prochloraz (250g/L , 25% EC)	U
		pyraclostrobin (250g/L EC)	U
		azoxystrobin (250g/L suspending agent)	U
		Oxime•tebuconazole (75% water dispersible granule)	U
		Albendazole (10% , 60% water dispersible granule)	U
		Benzoyl•azoxystrobin (325g/L suspending agent, 48% suspending agent)	U
		Fluoride bacteria·Oxime ester(43% suspending agent)	U
	Vegetable thrips	Azithromycin (25g/L suspending agent)	U
		spinetoram (60g/L suspending agent)	III
		acetamiprid (20% soluble powder, soluble concentrate 40% , 70% water dispersible granule)	III
	Underground pests of fruits and vegetables (grub, black cutworm, Mayflies, maggot)	Chlorantraniliprole·Thiamethoxam (300g/L suspending agent)	U
		Biphenyl - Tiotropium (1% granules)	U
	Vegetable Lepidoptera pests	chlorantraniliprole (5% suspending agent)	U
		Azithromycin (25g/L suspending agent)	U

Crop	Object of control	Recommended pesticide	WHO toxicity classification
	(Plutella xylostella, Pieris rapae, Spodoptera litura, beet armyworm)	diafenthiuron (50% wettable powder, suspending agent)	III
		indoxacarb (150g/L suspending agent, water dispersible granule)	III
Mulberry	Cercospora leaf spot, Purple Stripe Disease, Mulberry anthracnose	Albendazole (10% water dispersible granule)	U
		pyraclostrobin (250g/L EC)	U
		Sclerotium (40% , wettable powder)	U
		Methylthiophanate (80% wettable powder)	U
		Mancozeb (80% wettable powder)	U
	Baris deplanata, Germari, mulberry thrips, Diaphaniapyloalis, mulberry gall-midge, Mulberry looper	EPNPV-BT (Euproctis pseudoconspersa nuclear polyhedrosis virus 10000 PIB/microliter , Bacillus thuringiensis 2000IU/microliter suspending agent)	U
		Matrine (0.6% liquid agent)	U
		Imidacloprid-hydrochlorothiazide (18% , suspending agent)	U
		Imidacloprid (10% , 20% , wettable powder, water dispersible granule, suspending agent, Microemulsion, Seed dressing agent)	III
		Thiamethoxam (25% , water dispersible granule)	U
		Acetamiprid (10% , suspending agent)	U
		chlorantraniliprole (20% or higher, suspending agent)	U
Tea	Tea looper	EPNPV-BT (Euproctis pseudoconspersa nuclear polyhedrosis virus 10000PIB/microliter , Bacillus thuringiensis 2000IU/microliter suspending agent)	U
		Matrine (0.6% liquid agent)	U
		Celastrus angulatus (1% water emulsion)	III
		Biphenyl benzoate (5.3% Microemulsion)	III
	Empoasca pirisuga Matsumura	Tea saponin (30% liquid agent)	U
		High chlorine fluoride (22% Microcapsule suspension—suspending agent)	U
		indoxacarb (150g/L EC)	III
		Azadirachtin (0.5% soluble concentrate)	U
		Amatrine veratrine (0.6% liquid agent)	U
	Acaphylla theae	Lime-sulfur (45% crystalline powder)	U
		Mineral oil (99% EC)	U
	Euproctis pseudoconspersa	Bacillus thuringiensis (2000-8000IU/microliter suspending agent, 8000-16000IU/microliter suspending agent)	III
		EPNPV-BT (Euproctis pseudoconspersa nuclear polyhedrosis virus 10000 PIB/microliter , Bacillus thuringiensis 2000IU/microliter suspending agent)	III
		Azadirachtin (0.3% liquid agent)	U

Crop	Object of control	Recommended pesticide	WHO toxicity classification
		Matrine (0.5% liquid agent)	U
	Exobasidium vexans Massee	polyxins (1.5% , 3% wettable powder)	III
	tea anthracnose	dithane Z-78 (80% wettable powder)	III
		pyraclostrobin (250g/L EC)	U
		Albendazole (10% water dispersible granule)	U

10. Questionnaire on Pesticide Usage

Basic Information of Questionnaire

Respondent

Name:_____

Gender:_____

Age: _____

Education background:_____

Family population:_____

Area of arable land (mu):_____

Address:_____Village_____Town/District

_____County/City_____Province

Date of survey: (DD) (MM) (YYYY)

Pest Usage Questionnaire

1. Please list 1 to 5 crops that you planted this year in a descending sequence based on the area of plantation.

Crop					
Area (mu)					

2. Area of plantation in last year: mu.
3. Please indicate the area of each field and names of crops planted per season in the table below.

Crops planted per season / Field No.		Spring	Summer	Autumn	Winter
1	(mu)				
2	(mu)				
3	(mu)				
4	(mu)				
5	(mu)				

Please choose your answer by placing a tick " √ " in the brackets.

4. Have you ever used pesticides?
   (1) Yes（ ） (2) No（ ）
5. For how many years have you been using pesticides?
   (1) Less than 1 year（ ） (2) 2～5 years（ ） (3) 6～10 years（ ）
   (4) 11～20 years（ ） (5) 21～30 years（ ） (6) More than 30 years（ ）
6. Do you know about the three certificates required for pesticides? Which ones of the following are the three certificates for pesticides?
   (1) Pesticide registration certificate（ ） (2) Quality certificate（ ）
   (3) Production certificate（ ） (4) Pesticide transportation certificate（ ）
   (5) Business license（ ）(6) Product standard（ ）
7. Where do you usually buy your pesticides?
   (1) Pesticide shops（ ） (2) Manufacturer（ ）
   (3) Mobile vendors（ ） (4) Other channel, please specify:_____
8. How do you choose pesticides?
   (1) Based on recommendation by agricultural technology personnel（ ）
   (2) Based on recommendation by pesticide dealer（ ）
   (3) Based on my own experience（ ）
   (4) Trial use after reading the label（ ）
   (5) Based on recommendation by relatives and neighbors（ ）
   (6) Based advertisements on publications, newspapers（ ）

9. How do you determine the time of pesticide usage?
(1) Based on my own experience（ ）
(2) As noticed by the village（ ）
(3) Based on guidance by agricultural technology department（ ）
(4) At planned intervals（ ）
(5) As instructed on pesticide label（ ）
(6) Others, please specify_____.

10. How do you usually determine the pesticide dosage?
(1) Based on my own experience and estimation（ ）
(2) As instructed on the pesticide label and user manual（ ）
(3) Based on guidance by agricultural technology department（ ）
(4) Based on advice by other users （ ）

11. How do you measure the dosage when preparing pesticide?
(1) Using containers with unknown volume（ ）
(2) Using scale or containers with known volume（ ）
(3) Using small packs（ ）
(4) Using pesticide bottle lids（ ）
(5) Directly filling the sprayer based on experience（ ）
(6) Others, please specify _____

12. Which of the following cases best describes the dosage of pesticide you usually determine?
(1) Lower than the labeled dosage（ ）
(2) Within the scope of the labeled dosage（ ）
(3) Slightly higher than the labeled dosage（ ）
(4) 2 times higher than the labeled dosage（ ）

13. How do you calculate the pesticide dosage?
(1) Based on “g/mu” for preparation dosage（ ）
(2) Based on “multiple”（ ）
(3) Based on “g/mu” for preparation dosage for wheat and rice（ ）
(4) Based on “multiple” for fruit trees and vegetables（ ）
(5) Based on “g/mu” for preparation dosage for wheat, rice and vegetables（ ）
(6) Based on “multiple” for wheat, rice, fruit trees and vegetables（ ）
(7) Others, please specify_____

14. How do you determine the frequency of pesticide application?
(1) Based on my own experience（ ）
(2) Based on instructions on pesticide label（ ）
(3) Based on guidance by agricultural technology department（ ）
(4) One application every 2 - 3 days or whenever having free time in order to assure effectiveness （ ）
(5) Others, please specify_____

15. How frequently do you apply pesticide in the growing season of each crop?
(1)1-2 applications（ ） (2) 3-4 applications（ ）
(3) 5-6 applications（ ） (4) 7 –8 applications or more（ ）

16. How long is the interval between two adjacent pesticide applications?

(1) 2-3 days（ ） (2) 4-5 days（ ）
(2) 6-7 days（ ） (4) 8 days or more（ ）

17. Do you have any knowledge of the concept of safe intervals for pesticide application?
(1) Yes, I do and the concept is well executed;（ ）
(2) Yes, I do, but the concept is not executed;（ ）
(3) Yes, I do, but I don't know how to execute;（ ）
(4) No, I have no idea.（ ）

18. How do you use the pesticide?
(1) One type of pesticide per application;（ ）
(2) Two types of pesticides are used together;（ ）
(3) A few types of pesticides are used together;（ ）
(4) One or more types of insecticides are used together with fungicide;（ ）
(5) One or more types of insecticides and fungicides are used together with herbicide;（ ）
(6) Others, please specify_____

19. Do you consider weather condition upon pesticide application?
(1) No, never.（ ） (2) Yes, occasionally;（ ）
(3) Yes, but sometimes（ ） (4) Yes, I do.（ ）

20. Which ones of the following weather conditions will affect pesticide application?
(1) Rain（ ） (2) Strong wind（ ）
(3) High temperature（ ）(4) Others, please specify_____

21. How do you prevent and control rice pests and diseases?
(1) Seed dressing with insecticide and bactericide（ ）
(2) Spreading or root application of insecticide; spraying application of bactericide（ ）
(3) Spraying of insecticide and bactericide（ ）
(4) Others, please specify_____

22. What, in your opinion, are the main causes of crop pesticide hazard, if any?
(1) Pesticide quality problems（ ）
(2) Inappropriate instructions or inadequate information on the pesticide labels（ ）
(3) Inadequate guidance from agricultural technology department（ ）
(4) Weather conditions（ ）
(5) Operating problem（ ）
{excessively large dosage（ ） incorrect stage （ ）
Inappropriate crop（ ）mixed use of multiple pesticides（ ）**}**

23. Do you know whether any local training on pesticide has been organized over the past 3 years?
(1) No, not any.（ ） (2) 1～2 times（ ） (3) 3～5 times（ ）
(4) More than 5 times（ ） (5) I don't know.（ ）

24. How many pesticide-related trainings do you participate in on average each year?
(1) None（ ） (2)1～2 times（ ）

(3) 3～5 times（ ） (4) More than 5 times（ ）

25. Which one(s) of the following types of pesticide training have you ever participated in?

(1) Agricultural technology training（ ）

(2) Township, village, group training（ ）

(3) Field tutoring（ ）

(4) Farmers field school（ ）

(5) Night school（ ）

(6) Agriculture broadcasting and TV school（ ）

(7) Others, please specify_____

26. What's your attitude toward participating in training on safe and scientific use of pesticides held by farmers field schools?

(1) Very willing（ ） (2) Depending on whether other people do（ ）

(3) Indifferent（ ） (4) Not necessary（ ）

27. What's your attitude toward safety protection measures in the process of pesticide application?

(1) not necessary（ ） (2) Never thought of（ ）

(3) Masks are essential（ ） (4) Masks and protective clothing（ ）

(5) Able to wash hands and change cloths immediately after pesticide application（ ）

28. What actions should be taken in your opinion in case of any human poisoning in the process of pesticide application?

(1) Taking action based on label instructions;（ ）

(2) Consulting pesticide manufacturer by telephone（ ）

(3) Consulting expert by telephone（ ）

(4) Directly delivered to hospital for first aid （ ）

(5) Carrying the pesticide label and seek aid from hospital（ ）

29. What do you usually do when the prevention and control effect is not good after one type of pesticide is applied?

(1) Increasing the dosage（ ）

(2) Seeking recommendation from pesticide dealers and buying other pesticides（ ）

(3) Deciding based on own inquiry of relevant documentations（ ）

(4) Seeking advice from plant protection professionals（ ）

(5) No particular good method（ ）

30. How do you handle the unused pesticide?

(1) Storing by classification（ ）

(2) Casting away （ ）

(3) Storing at a random place for future use（ ）

(4) Giving the unused pesticide to the other farmers（ ）

31. What's your opinion about the storage life and validity period marked on the pesticide label?

(1) Never noticed（ ）

(2) Pesticide beyond the storage life and validity period can still be used. It doesn't matter.（ ）

(3) Avoiding buying expired pesticide by paying close attention to validity

period as indicated（ ）

32. How do you handle the waste pesticide packaging material?

(1) Directly dumped by the field（ ）

(2) Never thought of this issue（ ）

(3) Collected and thrown into the garbage bins（ ）

(4) Collected and burned（ ）

(5) Collected and buried under the ground（ ）

(6) Recovered by pesticide dealers or distributors（ ）

33. Have you ever received any service of IPM organized by government?

(1) Yes（ ） (2) No（ ）

34. What's your attitude to the idea that the government organizes integrated pest management?

(1) Very supportive（ ）

(2) Never considered（ ）

(3) Not supportive（ ）

35. What is the cost of pesticide acceptable to you per mu if integrated pest management is organized by the government?

(1) CNY 100 and less（ ） (2) CNY 100-150（ ） (3) CNY 150-200（ ）

(4) CNY 200-250（ ） (5) More than CNY 250（ ）

36. What's your attitude toward the idea that some pesticides are purchased by the government and then redistributed to farmers?

(1) Very supportive（ ）

(2) Never considered（ ）

(3) Not supportive（ ）

Annex 5: Forestry Pest Management Plan

Forestry Pest Management Plan

Contents

Introduction

Located on the south wing of the Yangtze River Delta on the southeast coast of China facing the East China Sea to the east, Zhejiang Province borders on Fujian to its south, Jiangxi and Anhui to its west and Shanghai and Jiangsu to its north. Spanning a straight-line distance of around 450km east to west and also south to north, Zhejiang Province has a land area of 101,800 km^2, accounting for 1.06% of the land area of the nation as a whole and being the smallest province of China in terms of land area. By the end of Year 2011, Zhejiang Province had achieved an urbanization rate of 62.3%, greater than the national average of 51.27% by approximately 11 per cents.

Zhejiang is an eastern coastal province located in the south of Yangtze River Delta. Zhejiang is bordered by the Fujian province to the south, the Jiangxi province and Anhui province to the west, the Jiangsu province and the Shanghai municipality to the north.

Zhejiang Province is topographically complicated, with 70.4% of its land area being mountains and low hills, 23.2% plains and basins and 6.4% rivers and lakes while the arable land only amounts to 2,081,700 h.a, giving birth to the saying of “70% mountains, 10% water and 20% farmland”. With a terrain inclining from southwest towards northeast, Zhejiang Province roughly comprises of six terrain zones, namely, the plains in northern Zhejiang, low hills in eastern and western Zhejiang, and Jinqu Basin in the middle, the mountainous areas in southern Zhejiang, the plains on the southeastern coast and the coastal islands. There are eight water systems in the Province, namely, Qiantang River, Ou River, Ling River, Tiaoxi River, Yong River, Feiyun River, Ao River and Beijing-Hangzhou Great Canal (Zhejiang Section).

Over the past decades, greater social and environmental challenges have been brought about by the fast growth of Chinese economy, in particular in terms of the increased water consumption and pollutant discharge as well as ecological degradation. The PRC government has included water resource management, environmental protection and ecological protection into its important political agenda and developed specific objectives in its 13th Five-year Plan (2016-2020) in order to reduce soil erosion, effectively treat urban wastewater, reduce agricultural pollution and improve river management and enhance water resource security.

As the largest fresh water lake in Zhejiang Province, Qiandao Lake plays an important role in the ecological and economic development of the Province. Fast economic growth, urbanization, intensive agricultural production and improving living environment and tourism development in China have resulted in increased environmental pressures upon Qiandao Lake. Having become aware of the risks in the face of Qiandao Lake, the National Development and Reform Commission (NDRC), in cooperation with multiple government departments, conducted a

comprehensive study and developed a blueprint for sustainable development of the region. The resulting plan, named “Integrated Plan for Water Resources and Eco-Environmental Protection in the Basin of Qiandao Lake and its Upstream Xin’an River” was approved in December 2013 by the State Council.

In such a context, Zhejiang Provincial Government (ZPG) initiated a request for support from the World Bank and the Zhejiang Qiandao Lake and Xin’an River Basin Water Resources and Ecological Environment Protection Project emerged as time requires. The Project proposes to utilize an IBRD loan in an amount of US$150 million and a counterpart fund of US$150 million in integrated management of the entire basin in Chun’an County and Jiande City of Zhejiang Province to reduce pollution and improve forest ecological environment in Qiandao Lake Basin and serve as a demonstration for extended application of the experiences of effective integrated river basin management in the other basins so as to promote the effectiveness and sustainability of river management and ecological environment protection.

Forest eco-restoration system aims to address the ecological problems and improve the ecological functions of forests in strategic water source areas, and improve the tolerance to catastrophic climates and adaptability to climate changes of forest ecosystem, reduce soil erosion and realize sustainable development of forestry resources through eco-restoration of the low efficiency pure coniferous forests and sparse shrubs in the mountainous areas.

In order to improve pest monitoring, forecasting and prevention work under the Project, the Agriculture Pest Management Plan has been developed based on the requirements of the World Bank Environment Assessment OP/BP 4.09 --- Pest Management and taking account of the status quo of pest incidents in the project area and new issues likely to arise from the project activities. The Agriculture Pest Management Plan aims to facilitate the use of biological control methods in pest control, reduce the dependence on chemical compounds, and reduce pest risks in the project area so as to assure effective pest control while minimize environmental pollution caused by chemical pesticides.

Adhering to the principle that “pest management shall be carried out in a scientific and lawful manner with prevention given the top priority for the final goal of promoting health”, this Plan identifies the methods for prevention and control of key pests and diseases likely to arise in the Project, recommended pesticides, institutional arrangement, training plan and monitoring and evaluation among other contents.

1. Policy, Regulatory Framework and Institutional Responsibilities

1.1 Policies on Plant Protection and Integrated Pest Management of PRC

China has put forward the concept of integrated pest management (IPM) as early as the 1950s and formulated the guidelines that “prevention is given the top priority for the final purpose of integrated prevention and control” on the National Plant Protection Working Conference in 1975. Based on the experiences and lessons learned in the past few decades, the role of pesticides has been re-recognized and evaluated. The importance of maintaining the ecological balance of the environment has been highlighted. Chemical control should be the final choice of integrated pest management. Various methods should be considered as far as possible to ensure economic, social and ecological benefits. The national and local governments have successively promulgated and implemented a series of laws, regulations, standards, procedures, rules and guidelines. Through the implementation of these laws and regulations, the concept of Integrated Pest Management (IPM) has been further promoted.

Forest pest management shall follow the “manager-manages-pest” principle, according to which, the owner is responsible for pest management of the commercial forest and economic fruit trees. The forest pest management authorities may provide supervisory and technical guidance. The local governments are responsible for pest management for public forest and the Forest Pest Control and Quarantine Station (hereinafter referred to as “forest protection stations”) is responsible for carrying out specific pest management tasks. The national government enacts and enforces subsidy policies for the major forest pest management campaigns and provides operational subsidies for the national monitoring and forecasting centers.

1) Law of the People's Republic of China on Quality and Safety of Agricultural Products (NPCSC, April 2006);
2) Pesticide Management Regulations of the People's Republic of China (State Council Decree No. 677, June 2017);
3) Measures for the Implementation of the Pesticide Management Regulations (Decree No.9 of 2007 issued by the Ministry of Agriculture on December 8, 2007);
4) Standard on Safe Use of Pesticides GB4285-1989 (State Environmental Protection Agency, September 1986);
5) Management Measures for Pesticide Registration (Ministry of Agriculture Order No. 2017, No. 3, August 2017);
6) Measures for the Administration of Pesticide Production Licensing (Ministry of Agriculture Order No. 2017, No. 4, August 2017);
7) Measures for the Administration of Pesticide Business Permits (Ministry of Agriculture Order No. 2017, No. 5, August 2017);

8) Guidelines for Proper Use of Pesticides (One to Eight) GB / TB8321.1-8321.8 (Ministry of Agriculture);
9) Plant Quarantine Regulation (State Council, revised on May 13, 1992 release);
10) Implementing Regulation of the Plant Quarantine Ordinance (Agriculture) (Ministry of Agriculture, May 1995);
11) Pollution Prevention, Storage and Sales, and Use of Pesticides (GB 12475-2006) (Ministry of Agriculture);
12) Forest Law of the People's Republic of China (April 1998);
13) Regulation on Prevention and Control of Forest Pests and Diseases (December 1989);
14) Technical Regulation on Forest Phytosanitary (May 1998);
15) Measures for the Implementation of Forest Pest and Disease Control in Zhejiang Province (November 2005);
16) Implementing Measures on Plant Quarantine of Zhejiang Province (November 2005);
17) Measures for the Protection of Wild Plants in Zhejiang Province (September 2010);
18) Prevention and Control of Crop Diseases and Pests in Zhejiang Province (November 2011);
19) Administration of Pesticide Business License in Zhejiang Province (March 2011).

REGULATORY FRAMEWORK AND INSTITUTIONAL RESPONSIBILITIES

1.2.1 Agencies related to pesticide supervision and management

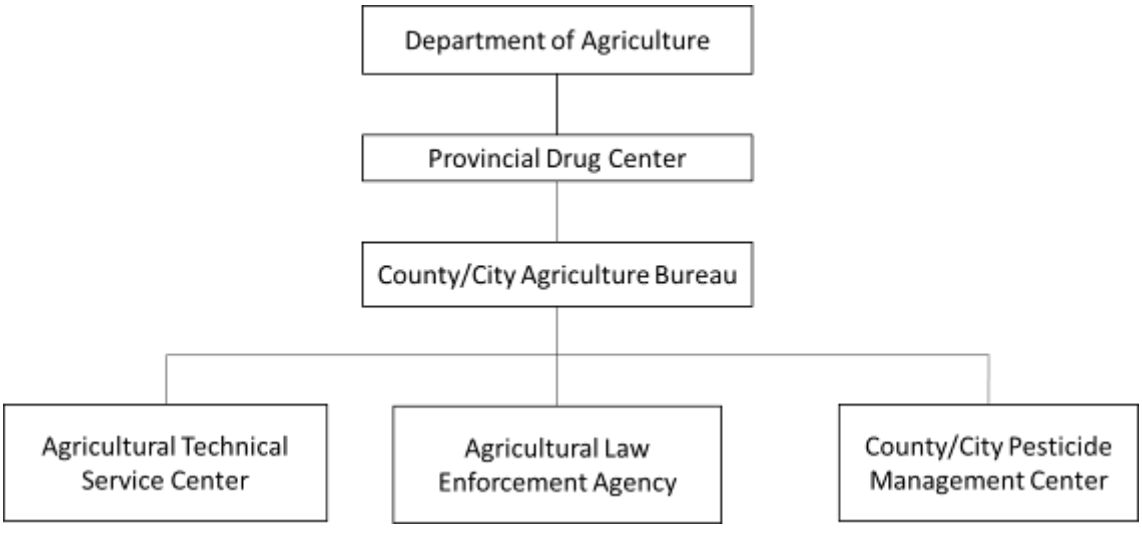


Figure 1.2-1: Pesticide Supervision and Management

Institutional responsibilities:

- ✓ Provincial Department of Agriculture is responsible for agricultural development planning; administration of agriculture related affairs; supervision and management of pesticides.
- ✓ Pesticide test center is responsible for administration of pesticide registration, application and supervision; formulating or participating in the formulation of national or sectorial standards on safe use of pesticides, pesticide product quality and pesticide residues, and other affairs related to agriculture.
- ✓ Agricultural law enforcement agency and pesticide management station are responsible for supervision and management of agricultural chemicals market.
- ✓ Agricultural Technical Service Center at township level is responsible for assisting and coordinating relevant law enforcement departments and technical departments to conduct pesticide management and pest management propaganda and training activities.

1.2.2 Forestry Pest Management Agencies

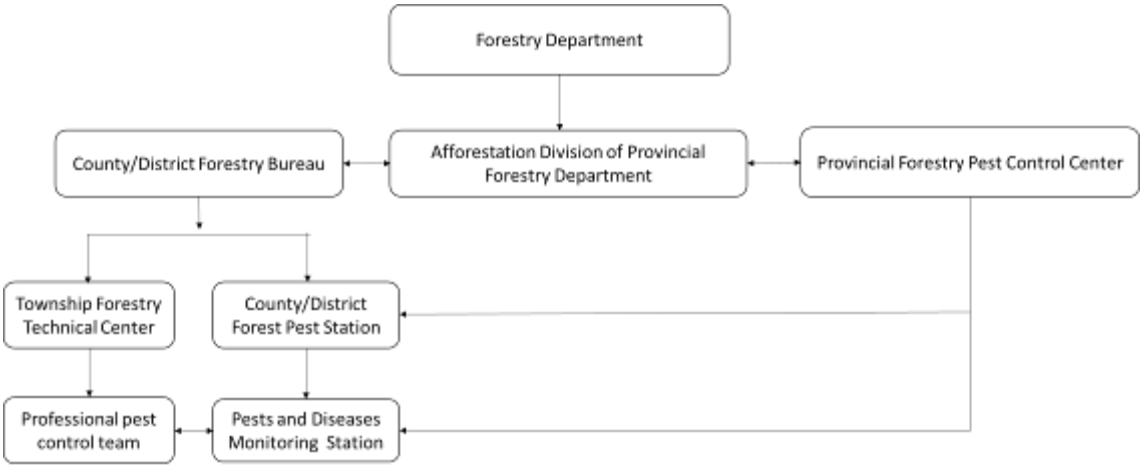


Figure 1.2-2 Diagram of Forestry Pest Management

Institutional Responsibilities:

- ✓ Provincial Forestry Department is in charge of the province's forestry work and responsible for the supervision and management of the province's forestry and ecological construction.
- ✓ Afforestation Division of Provincial Forestry Department technical guidance on afforestation.
- ✓ Zhejiang Provincial Forestry Pest Control and Quarantine Bureau and Forestry Pest Control Center are responsible for organizing pest management and provision of technical guidance.
- ✓ Municipal and county (district) Forestry Bureau is responsible for the administration of forestry works in its jurisdiction;

organizing/planning/coordinating/supervising forestry pest management activities and decision making; formulating working rules.

- ✓ Municipal and county (district) forestry pest management station is responsible for organizing and supervising pest control in its jurisdiction and providing guidance; supporting and coordinating relevant law enforcement agencies and technical departments to conduct training and propaganda activities on pesticide management and integrated pest management.
- ✓ Pest and disease monitoring station is responsible for investigation of the pest occurrence trends and monitoring in its jurisdiction; regularly publishing long-term, medium-term and short-term forecasts of forestry pests and diseases.
- ✓ Professional pest control team is responsible for timely removal of pests and diseases within its jurisdiction.

PESTICIDE MANAGEMENT, DISTRIBUTION AND APPLICATION

1.3.1 Pesticide Management

According to the Pesticide Administration Regulation of People's Republic of China, the provincial agricultural administrative department shall assist the agricultural administrative department of the State Council in pesticide registration within its jurisdiction and shall be responsible for the supervision and administration of pesticide within its jurisdiction. The corresponding administrative departments of agriculture under the jurisdiction of cities and counties also have the responsibility of regulating the production, sale and safe use of pesticides in their own administrative areas.

1.3.2 Pesticide Distribution System

The production and sales of pesticides in the project area shall be managed by the corresponding functional departments of local governments in accordance with the national and local laws and regulations. The farmers can purchase pesticides in the market.

Pesticide producers must register their products in accordance with the Pesticide Management Regulations and meet with the safety and quality control conditions and pollution control conditions

All pesticide distributors must obtain the business license before selling pesticides. Only the pesticides with "three permits" are allowed to be distributed. The pesticides on the banned list shall not be sold.

Pesticide product packaging must be affixed with label or instruction, indicating the name of pesticide, business name (zip code, address, telephone number), batch number, three permits (registration number, production license number, product number), as well as the active ingredients, content, weight, dosage form, product performance, toxicity, usage, instruction for use, production date, expiration date, flammable and toxic signs, poisoning rescue methods and precautions. All products shall pass the strict quality inspection for certification before allowed to leave the factory.

1.3.3 Proper Application of Pesticides

The properties and dosage form of pesticides, biological characteristics of the objects of prevention and protection and the environmental conditions shall be thoroughly identified and scientifically analyzed so that the appropriate pesticide type and dosage are selected and reasonable method and time of pesticide application are determined to realize reasonable usage of pesticides.

Table 1.3-2 Measures to ensure proper application of pesticides

SN	Measures	Details
1	Right pesticide	Identify the types of pests and diseases and then determine the pesticide variety and dosage form. The most economical, effective and safe pesticide targeting at the specific pest and disease for control should be selected. For the insect pests with piercing sucking mouthparts, such as aphids, spider mites, planthoppers, and scale insects, systemic insecticide and contact insecticide are the best choice. Stomach poison and contact insecticide are more suitable for the chewing mouthparts insects. Fumigation agent and smoke agent are better to be used in greenhouse or other closed place. The dosage form will also affect the effectiveness even the same pesticide type. Generally, the cream has best performance, followed by wettable powder. The powder is the worst.
2	Right timing	The disease can be controlled before the economic loss is caused if using pesticide at the critical time according to the pest prevention indicators. In general, the pests should be controlled at larvae stage. The principle of “protection first and treatment second”.
3	Right dosage	The dosage should be minimized provided that it is in the effective range and performance is guaranteed. The frequency of application should be determined considering the occurrence period, amount of occurrence and duration of pesticides, so as to effectively control pests and diseases without causing toxicity and environment pollution.
4	Right method	Different application methods can be used depending on the dosage form. In general, spraying and pouring are usually used for wet powder. Dusting is mainly used for powder; Granules are usually spread or put in the ditch; Spraying, dusting, pouring or coated stems are suitable for the agent with strong absorption capacity. Secondly, the location of disease, pest activity and dosage forms should be considered when determining application method.
5	Alternating pesticide	If continuously use one pesticide, the pests will have resistance so that the effectiveness of this pesticide will get poor. In this case,

Table 1.3-2 Measures to ensure proper application of pesticides

SN	Measures	Details
		rotating the pesticides can delay or overcome the emergence of resistance, and improve duration of the pesticide. Systemic insecticide tends to generate antibiotic resistance and should be used in rotation with protective bactericides. Organic phosphorus, pyrethroids, carbonates, organic nitrogen, etc. have their own different mechanisms of action and alternation can achieve good insecticidal effect.
6	Mixing pesticides	Various pests and diseases often occur in succession or in a particular growth stage simultaneously. A proper mix of pesticides can be more effective. However, pesticides cannot be mixed freely. In general, agents decomposed in alkaline circumstance cannot be mixed with alkaline substances. Flocculation, sedimentation, stratification and other chemical reactions often imply that the respective pesticides are not suitable for mixed use.
7	Weather condition	Pesticides generally should be applied in windless or breeze day. Windy, cloudy or rainy days should be avoided as the pesticides will be blown away by wind or flushed by rain. In a certain temperature range, the efficacy increases with increasing temperature. Whether in open field or greenhouse, the best time for application is at 10 am and 4 pm or so. The plants might be hurt if applied under strong sunlight or high temperature.
8	Safe use	In accordance with the national pesticide management regulations, the use of highly toxic pesticides should be strictly controlled. Pesticides with high residual and mutagenesis, carcinogenesis or teratoeenesis are resolutely banned. The regulations on safe use of pesticides and safety intervals should be strictly followed to avoid environmental pollution and poisoning.

2. Occurrence and Control Status of Main Pest Diseases in Project Area

2.1 Occurrence Status of Major Forestry Pest Diseases in Project Area

1. General Situation of Entire Province

According to the statistics of the occurrence of forestry pest in Zhejiang Province, the major forestry pests with an occurrence area of more than 1 million mu include pine wilt disease, monochamus alternatus, dendrolimus punctatus, dendrolimus houi lajonquiere, otidognathus davidis fairmair, hippotiscus dorsalis, bamboo snout moth, pantana phyllostachyae chao, hickory bud maggot and hickory dry-rot disease.

(1) Diseases and pests of pine and fir forest

The main diseases and pests of pine and fir forest are pine wilt disease, monochamus alternatus, dendrolimus punctatus, dendrolimus punctatus, dendrolimus kikuchii matsumura, matsucoccus matsumurae and so on. The total area of occurrence is 1.4047 million mu.

According to the daily monitoring survey statistics of the province, the area of occurrence of pine wilt diseases was 0.1555 million mu. There were 185,800 dead pine trees in 33 counties (cities and districts) in nine cities including Hangzhou, Ningbo, Wenzhou, Jiaxing, Huzhou, Shaoxing, Zhoushan, Taizhou and Lishui. The area of occurrence of monochamus alternatus was 1.1747 million mu distributed in all the cities in the province, mainly in Taizhou, Shaoxing, Wenzhou among others.

The area of occurrence of defoliating pest of pine and fir forest in the province is 72,900mu. Dendrolimus punctatus mainly occurred in Jinhua, Lishui and Hangzhou. The area of occurrence in former cities of high occurrence (such as Hangzhou and Wenzhou) has greatly reduced. The occurrence of other pests (such as dendrolimus kikuchii matsumura and dendrolimus punctatus) was relatively stable.

(2) Diseases and Pests of Bamboo Forest

The area of occurrence of diseases and pests of bamboo forest was 0.1638 million mu. The common bamboo pests are otidognathus weevil, hippotiscus dorsalis, bamboo snout moth, pantana phyllostachysae chao and ceracris kiangsu tsai, which are mainly distributed in Quzhou, Huzhou, Lishui and Ningbo. After years of comprehensive management, the occurrence of some common bamboo pests, such as otidognathus weevil, bamboo snout moth, hippotiscus dorsalis and bamboo wasp, tend to be stable.

(3) Diseases and Pests of Economic Forest

The area of occurrence of diseases and pests of economic forest was 77,000 mu in the province. The major economic forests include chestnut, hickory, torreya grandis and other dry fruits.

The area of occurrence of diseases and pests of chestnut was 23,200 mu in the province, which was mainly happened in Quzhou, Shaoxing, Lishui, Jinhua and other places. The diseases and pests of the hickory were mainly happened in Lin’an, Jiande, Tonglu and Chun’an with areas of 49,500 mu. Among them, the area of occurrence of hickory bud maggot, hickory dry-rot disease and kurisakia sinocarye zheng were 15,400 mu, 29,800 mu and 4,300 mu respectively.

In addition, the area of occurrence of diseases and pests of other economic forests were 4,400 mu, mainly camellia oleifera, torreya grandis and other fruit trees, such as sooty mould of camellia oleifera (1,300 mu), euproctis pseudoconspersa (400 mu) and macrolygus torreyae (300 mu).

(4) Diseases and Pests of Landscaping Nursery and Others

The area of occurrence of diseases and pests of landscaping nursery, corridor forest and others were 64,900 mu, on a declining trend in general. The areas of occurrence of orthaga achatina butler and termite were 5,300 mu and 2,500 mu respectively, mainly happened in green belt on both sides of highways and roads, nursery and camphor forest of urban street. The area of occurrence of diaphania perspectalis were 6,700 mu, mainly in Xiaoshan, Tonglu, Fuyang and other places.

2. Occurrence and control of forestry diseases and pests in Jiande City

In recent years, the main forestry pests to be prevented and controlled are dendrolimus punctatus walker, monochamus alternatus, bursaphelenchus xylophilus matsucoccus matsumurae, other occasional pests (diprion pini, dasychira axutha collenette, hyssia adusta), and pests on phyllostachys edulis (e.g. bamboo snout moth).

The main prevention and treatment measures are spraying, trunk injection, clean-up dead pine, forest transformation, which are listed as below:

(1) Spray biological pesticides and apply beauveria bassiana on leafy insects, such as dendrolimus punctatus walker, dendrolimus kikuchii matsumura, diprion pini, and hyssia adusta and bamboo snout moth.

(2) Monochamus alternatus, as the trunk-boring pest, can directly damage pine trees and carry bursaphelenchus xylophilus, which is the main reason for the pine tree to death. Therefore, the main prevention and control measures of bursaphelenchus xylophilus is to spray thiacloprid two times in June and July, and promote the method of perforating on trunk (such as use of immunity injection of bursaphelenchus xylophilus) for old and famous trees and pine forest in key scenic areas. From September to end of next March, it needs to complete the clean-up dead pine caused by monochamus alternatus, transfer the harvested dead pine to the designated sites for pest control.

(3) Pine forests along highways and around key scenic spots and forest parks should be subject to broadleaved-forest transformation.

3. Occurrence and Control of Forestry Diseases and Pests in Chun'an County

In 2016, Chun'an County completed 12 monitoring surveys of 8 pests and diseases (dry rot of hickory, kurisakia sinocarye zheng, hickory contarinia citri barnes, bamboo oval-shaped stinkbug, bamboo snout moth, dendrolimus punctatus walker, monochamus alternatus and bursaphelenchus xylophilus), covering a total area of 3,929,400 mu in comparison with an occurrence area of 56,770 mu and a pest control area of 174,466 mu.

The survey showed that: (1) The survey area of hickory was 21,120 mu, with cumulative damage of 10,527 mu, of which 2,511 mu of kurisakia sinocarye zheng, 3,964 mu of dry rot and 4,052 mu of contarinia citri barnes. The harm of diseases and pests of hickory is common. (2) In 2016, the outbreak of dendrolimus punctatus walker was seriously endangered. The main towns along the lakes and the state-owned forest farms had different level of harm. The area of occurrence was 46,243 mu in monitoring area.

In response to the characteristics and actual situation of forestry pests in 2016, active efforts were made to organize and guide the forest farmers to carry out effective prevention and control of pests and diseases.

(1) Actively guide pest control of hickory diseases. As early as possible to detect and investigate, timely publish insect notification, and actively carry out technology training on prevention and treatment. According to the characteristics occurred of pests and diseases of hickory in recent years, the training focus to Jiangjia, Jinfeng and other non-producing areas of hickory, actively carry out prevention and control of technical guidance, improve the management of forest hickory technology. During the year, 27 training courses on pest control of hickory were held and 1,687 forestry farmers were trained. It undertook hickory pest control

operation for area of 40,172 mu.

(2) Actively organize the prevention and control of dendrolimus punctatus walker. In response to the actual situation of outbreak of dendrolimus punctatus walker in Chun'an County in 2016, it actively organized the prevention and control of dendrolimus punctatus walker with operation area of 134,294 mu. Combination of county condition, different regions undertook different preventive measures. Weiping, Jiangjia, Fenkou and other key sericulture township used insecticidal lamps and the release of Trichogramma dendrolimi to prevent and control, of which Trichogramma control area of 16011 mu, insecticidal lamp control area of 55133 mu; the urban area and scenic tourist areas of Qiandao Lake used biological pesticides Avi BT (III) to spray for prevention and control, with operation area of 63,150 mu. During the prevention and treatment, forest protection stations provided on-site guidance and supervision to ensure that the prevention and control were in place, timely organized the assessment of control effect afterwards, and achieved the desired goal to ensure that the hazards are minimized for the pine tree in city and scenic.

(3) Undertake prevention and control of hickory. 28 units in 7 townships were organized to carry out the prevention and control of diseases and pests of hickory. The project application area was 20,250 mu, which was mainly for prevention and treatment of hickory contarinia citri barnes. Some units also carried out the prevention and treatment of dry rot (4715 mu), and the control operation area was 31,945 mu. It took the unified pharmacy procurement, organized the operation of prevention and control by agroforestry, and completed three time of spraying prevention and treatment for hickory contarinia citri barnes and dry rot. For dry rot, it mainly adopted oxine-copper (III) and oxazole alcohol (U) for prevention and treatment. For contarinia citri barnes, it mainly adopted imidacloprid (III) and chlorpyrifos (II) for prevention and treatment. For aphid, it mainly adopted imidacloprid for prevention and treatment.

(4) Diseases and Pests for Bamboo Forest

The main diseases and pests for bamboo forest are pantana phyllostachysae chao, which is used avermectin (III) and bacillus thuringiensis (U) for prevention and treatment.

CURRENT SITUATION OF INTEGRATED PEST MANAGEMENT FOR FORESTRY

Zhejiang Forestry Pests Control and Quarantine Bureau is responsible for the organizational management and guidance and supervision for prevention and control of forestry diseases and pests throughout the province, and responsible for technology promotion.

forest protection stations is set up by the county/city forestry bureaus in Zhejiang Province responsible for the organizational management, guidance and supervision of pest management in their respective areas.

At present, the pest detection, prevention and quarantine networks have taken shape in the province. The forest protection stations in the project area is responsible for the management and implementation of local forest pest control.

Chun'an County has established 18 detection and forecasting sites for diseases and pests and the key objects of pest detection are pine tree, camellia, hickory and

bamboo. The detection and forecasting sites are located across the whole county, including Lishan Forest Area, Pingshan Forest Area, Maozhuyuan Forest Area, Tuanyuan Forest Area, Hejiawu Forest Area, Yuanguanchu Forest Area, Xiaojinshan Forest Farm, Yeqi Forest Farm, Jinzhupai Forest Farm, Qianwu Village of Qiandaohu Town, Yunlin Village of Fenkou Town, Jiangjia Village of Jieshou Township, Linqi Town, Yaoshan Township, Bifeng Village of Weiping Town, Huaping Village of Wangfu Township, Ludongshan Village of Fengshuling Town and so on.

During 1983 - 1990, Jiande City set up 15 detection and forecasting sites of dendrolimus punctatus walker at Tancun Village and the towns / townships of Hangtou, Sanhe and Xiaya and Jiande Forest Farm, Shouchang Forest Farm, Xin'anjiang Forest Farm, 5 detection and forecasting sites of hyssia adusta at Datong, Sanhe, Xiaya and other townships (towns) and Jiande Forest Farm and Xin'anjiang Forest Farm, 4 detection and forecasting sites of bamboo snout moth at Shangma, Lijia and other townships (towns) and Shouchang Forest Farm, and 4 detection centers of matsucoccus matsumurae at Gantan, Yangcunqiao Town and Jiande Forest Farm, and 3 detection and forecasting sites of diseases and pests for torreya grandis at Yaocun Village, Fenghuang, Chenjia, Dengjia, Tancun, Yangcunqiao and other villages (towns). The city as a whole has 37 detection and forecasting sites and 41 full-time or part-time staff. In 2002, the State Forestry Administration determined that Jiande City was a national-level forest diseases and pests monitoring center, and the main subjects were matsucoccus matsumurae, dendrolimus punctatus walker and bursaphelenchus xylophilus.

Currently the project counties (cities) have set up a relatively complete monitoring and early warning system for diseases and pests for timely monitoring of the occurrence of diseases and pests and have provided adequate technicians and professionals for comprehensive prevention and treatment of diseases and pests.

A relatively robust forest protection system covering all levels has been established in the project area with adequate technical and professional resources to meet the basic needs and using conventional prediction and control methods. In recent years, the IPM principles were followed in the project area in terms of integrated management of pests and diseases which is mainly realized using biological, physical and harmless methods of chemical control. The pest management competence of the existing forest protection departments at all levels can basically meet the needs of the Project on pest management.

Currently great progress has been made in pest prevention and control in the project area mainly in the following aspects:

1. Comprehensively strengthening of monitoring and forecasting activities. Actions were taken to give full play to the radiation and leading roles of the detection and forecasting sites of national forestry pest center, use the national, provincial, municipal and county-level detection and forecasting networks and the town/township forestry work stations to comprehensively improve the monitoring coverage, detect disasters in time and issue forecast and control notices and require relevant responsible person to take proper actions of prevention and control.

2. Well-designed actions are taken to assure proper prevention and control of dangerous forest pests (e.g. monochamus alternatus, dendrolimus punctatus walker, dendrolimus houi lajonquiere, dasychira axutha collenette, dioryctria splendidella and

poplar leaf pests) causing serious damage to forest resources, high public concern and big international influence. According to the 'Forest Pest Control Regulations', comprehensive measures of forest management, such as silvicultural and biological, physical and chemical prevention and control measures, are taken to reduce the damages and losses, cut area of occurrence and achieve sustainable control of forest pests. The relevant requirements of WHO are strictly followed, in particular regarding the use of chemical pesticides, to make sure that Class III and Class U pesticides are selected.

3. The laws and regulations on quarantine should be strictly enforced. The requirements in the "Plant Quarantine Regulations" should be conscientiously enforced by strengthening inspection and quarantine to prevent the spread of quarantine pests. Scientific risk assessment should be carried out over exotic forest pests and strict procedures should be fulfilled for review and approval and quarantine supervision of species introduction, focusing on quarantine at the places of origin and on the transportation route to strictly prevent the introduction of exotic harmful pests.

4. Focused efforts are made in the development of the emergency response mechanism against unexpected forestry pest disasters. Actions were taken according to the requirements of 'Incident Handling Approach on Unexpected Forestry Pest Disasters' and 'Emergency Plan on Major Exotic Forestry Pest Disasters' to make organizational, technical, financial and physical preparations, develop emergency response plans, and reinforce the infrastructure construction and material reserves for responses to any emergency incidents.

5. Continuous actions are taken to improve the technical level. In order to tackle the difficulties encountered in pest prevention and control, conscientious efforts are made in studying and summarizing the advanced technologies home and abroad, strengthening international cooperation and interdepartmental coordination, improving application technology and promoting the extension of advanced, environment-friendly and applicable technologies of pest prevention and control at the earliest possible date.

6. For the major diseases and pests occurred in the project area, physical and biological control measures are taken and pesticides recommended by the national government and complying with the WHO requirements are used with priority.

7. Efforts were made in integrated prevention and control of hickory diseases and pests in the project area to effectively improve the control effects and reduce amount of pesticide.

8. Waste pesticide packaging materials are required to be collected and recovered in a uniform manner.

MAJOR PROBLEMS AND RECOMMENDED IMPROVEMENTS IN PEST MANAGEMENT IN PROJECT AREA

2.3.1 Major Problems

(1) The concept of prevention needs to be improved. The idea of forest health care is not yet incorporated into the practice of forestry pest management and no effective measures are developed for managing pests and increasing forestry resilience from the perspective of ecosystem.

(2) The forecast and prediction method needs to be improved. Forestry pest monitoring at the current stage mainly uses the traditional ground survey method which requires a lot of labors and time. The advanced monitoring techniques need to be introduced and applied in a wider scope.

(3) There is not a sound capacity building system. Training on forestry IPM technology needs to be strengthened. Further improvements should be made to the introduction, demonstration and promotion and training organization of advanced monitoring and control technologies. Pest risks are not highly recognized and real-time monitoring and early warning of pests in the region is not yet realized.

(4) High dependence on chemical pesticides: In the event of large-scale occurrence of pests and diseases in the project area, chemical pesticides are still the key approach to pest prevention and control and there are no effective measures in some forest areas for control of pests and diseases.

2.3.2 Improvements and Suggestions

To effectively prevent diseases and pests and tackle the existing problems in the project area, the forest protection authorities at all levels need to establish an IMP system and minimize the use of chemical pesticides. During the implementation of this project, actions should be taken to strengthen the following aspects:

(1) Providing training to forest protection experts and forest professionals at the county and township levels, implementing IPM principles of integrated pest management, improving the governance level of harmless organisms and enhance the concept of forest health care;

(2) Strengthening management, supervision and training on the use of chemical pesticides. The PMO and forest protection stations are responsible for purchasing, supervising and providing guidance on safe use of pesticides to ensure that WHO Class U and Class III pesticides are purchased and the codes of operation are followed in use of pesticides.

(3) Strengthening supports to comprehensive research and demonstration and extension of IPM;

(4) Improving forecast and prediction methods and promoting the advanced monitoring and early warning technologies;

(5) Changing the habits of chemical pesticide application and strengthening the promotion of biological and physical pest management methods.

Pest Management Methods in the Project Area

3.1 Principles of Integrated Pest Management (IPM)

IPM is a pest and disease control approach modified by the UN Food and Agriculture Organization in 1972 on the basis of the integrated pest and disease control proposed in 1966. IPM is a science related to pests and diseases emphasizing natural control and organic coordination between natural control and other control measures. In the IPM approach, monitoring is first strengthened according to the different biological characteristics and habits of pests and quarantine, silvicultural, physical and mechanical methods and biological methods are considered with priority for prevention of pests and diseases. Chemical method and high-efficiency and low-toxicity chemical insecticides are used only when the above methods are unable to achieve effective control of pests and diseases.

Upon the development of a pest management approach, not only should the economic benefits be considered, but also ecological balance and social security. Based on this theory, the following pest management approach is developed for the project area. Plant protection work will be carried out under the guidance of the concept of scientific development and through thorough enforcement of the concepts of "public plant protection" and "green plant protection" and following the principle that "prevention is given the top priority for the final purpose of integrated prevention and control". We will adhere to the mechanism of territorial management, government guidance and departmental performance to promote sustainable development of pest and disease control system; the prevention and control activities will be implemented according to law and managed according to standards to enhance the level of scientific control. On the basis of the silvicultural measures, the pest and disease control factors in the nature will be fully utilized to create conditions unfavorable to the occurrence and growth of pests and diseases. Biological, physical and chemical approaches will be used in a reasonable, coordinated and supplementary way according to the specific circumstances to best avoid injury of natural enemies and pollution of natural environment and control the pests and diseases to a tolerable degree.

3.2 Strict Implementation of the World Health Organization (WHO) Pesticide Classification Guideline (2009) and Requirements

The pesticide hazard classification standard recommended by WHO was adopted at the 28th World Health Assembly in 1975. In order to meet the new environmental requirements, WHO revised this standard in 2009 (see Table 3). Classification of pesticide toxicity is mainly based on the acute oral and transcutaneous toxicity of rats, which has become a standard method for determining toxicity classification in toxicology. The WHO pesticide hazard classification standard is described detail in Table 3.2-1.

Table 3.2-1 WHO Criteria for Toxicity Classification of Pesticide by Hazard (2009)

Class	Classification description	Oral (mg/kg)	Dermal (mg/kg)
Ⅰa	Extremely hazardous	<5	<50
Ⅰb	Highly hazardous	5~50	50~200
Ⅱ	Moderately hazardous	50~2000	200~2000
Ⅲ	Slightly hazardous	>2000	>2000
U	Unlikely to present acute hazard	≥5000	≥5000

The requirements included in the WHO Guidelines to Pesticide Classification (2009) shall be strictly executed in pest management; Class I pesticides are prohibited; Class III and Class U are recommended with priority.

3.3 IPM CONTENTS AND MEASURES

Integrated pest management will be carried out in strict accordance with the guidelines that “prevention shall be given the top priority and scientific and lawful actions of prevention and control shall be taken to create a healthy condition for crop growth”. The concept of pest management shall be incorporated in the true sense into the full process of forestry production. First of all, pest-resistant tree varieties shall be selected; stronger efforts should be made in inspection and quarantine of seedlings to eliminate transportation and planting of pest-affected seedlings; effective measures for afforestation control should be taken to strengthen the pest resistance of trees and keep the forests in a healthy condition; emphasis shall be laid on monitoring and forecasting of pest and diseases to provide a basis for decision-making on prevention and control; quarantine method, silvicultural and physical and mechanical method, biological method and chemical method shall be adopted in an integrated manner for pest and disease control. Physical and biological control measures should be selected with priority for pest and disease prevention and control; pesticides shall not be used until the other prevention and control methods become invalid and the monitoring results of pests and diseases indicate that the degree of hazards of such pests and diseases has exceeded the economic threshold. When pesticides are used, non-harmful pesticides shall be selected to mitigate pest resistance and avoid environmental pollution.

The principle of “Prevention first, scientific prevention, law governance and promotion of health” will be thoroughly implemented. The pest and disease

control works will go through the whole process of forestry production. First, seedlings resistant to pests and diseases will be selected for afforestation and nursery; strengthen the inspection and quarantine of tree seedlings to avoid seedlings with diseases and pests; take effective silvicultural measures to enhance resistance to pests and disease so as to maintain the healthy state of forests; conduct pest monitoring and forecast to provide basis for pest control; use quarantine, silvicultural measures, and mechanical, biological and chemical methods for pest control. Physical and biological control measures should be the first choice. Pesticides are allowed only when other measures are ineffective, and the pest surveillance results show the damages caused by pests and disease exceed the economic thresholds. When using pesticides, it needs to choose the non-polluting pesticides to reduce resistance of pests and disease and avoid causing pollution to the environment.

3.3.1 Monitoring and forecasting

Monitoring and forecasting is a technical approach to monitoring the occurrence of pests and diseases and forecasting the tendency of occurrence and trend of spreading and is a premise and assurance to scientific implementation of pest management. Pest monitoring and forecasting shall adhere to the principle of integrating public monitoring with professional monitoring. Pest monitoring and reporting in the project area shall make full use of the existing forest protection agencies at all levels.

The forest protection agencies at the county level should monitor and forecast pest occurrence and hazards of the Project by means of positioned monitoring and site survey and develop measures for prevention and control of pests and diseases based the monitoring and forecasting results

3.3.2 Prevention and Control Methods

During the implementation of this plan, various effective measures should be taken to reduce the dependence on chemical pesticides, such as silvicultural, physical and mechanical measures, biological measures and chemical control measures.

1. Plant Quarantine

Plant quarantine is conducted by the statutory body (forest protection stations at all levels) to inspect the risks of pests and control pests and disease during the circulation process from the original place, transportation, to the new planting place.

Plant quarantine in the afforestation area of the project should be strengthened. The origin quarantine, dispatching quarantine and re-inspection system should be strictly implemented to assure actualization of effective pest removal. It is prohibited to transfer seeds and species from areas with quarantine objects and pest outbreaks. The seed registration certificate system will be implemented. The systems of “seedling production permit’, ‘seedling quality inspection certificate’ and “nursery stock production permit” to regulate seedling production and sales behavior. The quarantine inspection on

the import of wood and wood products will be strengthened. If quarantine objects are detected, destroy them on site to prevent the disease from the project area.

2. Silvicultural Measures

Silvicultural measures, such as forest management and cultivation will be strengthened to enhance pest resistance and control the occurrence and spread of pests and diseases. Silvicultural measures mainly include:

-Select resistant tree species to improve the resistance to pests and diseases;

-Mixed forest: proper arrangement of tree species to reduce damages;

-Consider the local conditions: select the tree species suitable for local environmental conditions;

-Planting at the right timing: planting trees at the proper season;

-Cultivate strong seedlings: cultivate high-quality seedlings and remove the unhealthy seedlings;

-Proper use of fertilizers: apply adequate compost; limited use of nitrogen and phosphate fertilizer and increase the utilization of calcium.

-Clean the woodland: plow soil to expose the pest in extreme weather and remove infected plants and leaves;

-Reasonable thinning: reasonable thinning will promote tree growth and improve the resistance capability to pests.

3. Physical and Mechanical Measures

Physical and mechanical measures refer to the artificial, physical and mechanical methods of preventing and controlling pests and diseases based on their occurrence regularity and habits and making use of the weak parts of their infiltration cycles or life history, mainly including:

(1) Artificial and mechanical pest control, including artificial capture and removal of the larvae and eggs of some insect pests; killing larvae and adult insects through suspended animation; digging overwintering pests or pests' pupation; artificial pruning of infected leaves.

(2) Trapping. Some pests will be attracted by certain colors or odors. For example, black light can be used to trap moths, beetles and straight-winged insects. Sweet and sour solution can be used to trap moths.

(3) Barrier. Some pests can be prevented by making use of some of their habits. For example, the plastic skirt installed on the trunk can be used to control the pine caterpillars, willow months and other pests that like staying under the trees in winter or daytime but causing damages in nighttime.

These measures are simple, easy, cost-effective and environmental friendly but take long time and are only effective to certain pests. Therefore, they should be used as supplementarymethods.

4. Biological Measures

Biocontrol is the use of beneficial organisms to inhibit harmful organisms, such as the use of parasitic organisms, predatory organisms and pathogenic microorganisms to control harmful organisms, which mainly include:

(1) Natural enemies, such as Trichogramma, swollen leg bees, flat belly bees, woodpeckers and so on.

(2) Biological agents and products.

(3) Create suitable environment for natural enemies to increase the number of natural enemies.

5. Non-chemical Measures

Such measures mainly include:

(1) Using matrine preparations to control spider mites and stink bug;

(2) Coating limestone on the trunk to prevent disease intrusion or pest spawning and physiological diseases;

(3) Using certain color and light to trap pests at early stage;

(4) Spraying lime, sulfur and copper sulfate, Bordeaux mixture to prevent disease.

6. Chemical Measures

Chemical measures are to use chemical pesticides to control pests and other harmful organisms. Chemical pesticides are convenient, high efficient and effective, and can control the spread of pests quickly, especially for outbreaks of pests. It is an emergency measure and can work immediately. Therefore, how to control the use of chemical pesticides and minimize pollution and harms to human health are critical.

3.4 SAFE USE OF PESTICIDES

For safety consideration, priority should be given to biological agents, botanical agents, biomimetic agents and non-polluting chemicals. Pesticides tend to have adverse effects on the health of human and livestock as well as ecological environment. Therefore, effective measures should be taken to avoid or minimize the health and environmental risks brought by the use of pesticides. During the implementation of the project, potential risks and corresponding mitigation measures are shown in Table 3.4-1.

Table 3.4-1 Potential Risks of Pesticide and Mitigation Measures

Environmental risks	Health risks	Measures of safe use
1. Pesticide residues will cause deterioration of water quality and decrease of aquatic organisms. 2. Spraying pesticides near the sources of drinking water will cause pollution to water sources. 3. Highly toxic pesticides will affect the non-target species (natural enemies, etc.) 4. Over use for long time will lead to increased drug resistance. 5. Pesticide residues in the soil will cause soil contamination.	1. Inhalation of pesticide smoke during preparation; 2. Discomfort caused by inhalation of pesticide gas when spraying pesticide in the absence of protective equipment. 3. Skin burns due to pesticide spraying or spilling without protective clothing. 4. Pollution to the drinking water source due to applying pesticides or spills near the water source. 5. Harm to human health due to consumption of water, livestock and agricultural products polluted by pesticides.	1. Strictly control the purchase, transportation and storage of pesticides. 2. Proper use pesticide and spray correctly. Promote the application of pesticide that have low toxicity to humans, livestock and plants and less environmental pollution. 3. Strengthen training on use of pesticide and equipment; improve awareness of personal protection. 4. Emphasize the importance of wearing protective equipment (including protective clothing, mask, gloves and shoes, etc.) when using pesticides. 5. Strengthen the management of areas applied pesticides to avoid pollution to water source and environment. 6. Strengthen technical cooperation to improve the efficiency of pesticide and reduce dosage. 7. Formulate standard pesticide and equipment management regulation. The used chemicals and containers should not be washed in natural waters and should be disposed in a safe place (e.g. deep burial). The remaining pesticides should be stored properly.

3.5 RECOMMENDED PEST MANAGEMENT MEASURES AND PESTICIDES IN THE PROJECT AREA

The major pests and disease control measures and recommended pesticides in the project area are shown in Table 3.5-1.

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
Masson pine	Blight Pine needle rust	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Chemical measures: use of low toxicity and high efficiency and low residues fungicides at proper time.	Carbendazim	Chlorothalonil Methyl triadimefon Thiophanate	U Ⅲ U
	Dendrolimus punctatus, D·argentata Buller , Bupalus piniarius	1. Silvicultural measures: mixed forests, improved site conditions; 2. Mechanical and physical prevention: sex attractant, pesticides, etc. 3. Biological control: Trichogramma, BT, beauveria bassiana, etc. 4. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Matrine Nicotine BT Smpv	Chlorbenzuron Diflubenzuron Triflumuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Fir	Disease of anthracnose and leaf blight	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Strengthen quarantine; 3. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Carbendazim	Chlorothalonil Methyl thiophanate Triadimefon	U U Ⅲ
	Polychrosis cunninhamiacola	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Biological control: Release wasps; 3. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Fenoxycarb	Ⅲ Ⅲ U
Sassafras	Stem rot	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Chemical measures: use of low toxicity and high efficiency and low residues fungicides at	Carbendazim	Chlorothalonil Clear Triadimefon Thiophanate	U Ⅲ U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		proper time.			
	Aulacaspis sassafris Chen	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Chemical measures: use of low toxicity and high efficiency and low residues fungicides at proper time.	Matrine Azadirachtin Nicotine	Chlorbenzuron Diflubenzuron Triflumuron.	Ⅲ Ⅲ Ⅲ
Sweet gum	Powdery Mildew	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Chemical measures: use of low toxicity and high efficiency and low residues fungicides at proper time.	Carbendazim	Chlorothalonil Clear Triadimefon Thiophanate	U Ⅲ U
	Horned beetle	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Biological control: release wasps; 3. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine	Chlorbenzuron Diflubenzuron Fenoxycarb	Ⅲ Ⅲ U
Phoebe	Very few diseases, weevil, beetle	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Biological control: release wasps; 3. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine	Chlorbenzuron Diflubenzuron Fenoxycarb	Ⅲ Ⅲ U
Ilex micrococca	Scutate scale, blight	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Biological control: release wasps; 3. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Clear Triadimefon Thiophanate	U Ⅲ U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
Schima	Brown blotch	1. Silvicultural measures: mixed forests; improve site conditions; clearing of diseased foliage; 2. Chemical measures: use of low toxicity and high efficiency and low residues fungicides at proper time.	Carbendazim	Chlorothalonil Clear Triadimefon Thiophanate Dimethachlon	U Ⅲ U Ⅲ
	Cutworm	1. Silvicultural measures: mixed forests; improve site conditions; 2. Mechanical and physical prevention: sex attractant, insecticide lamps, etc. 3. Biological control: Encyrtidae; 4. Chemical control: spraying of pollution-free chemicals timely.	Matrine Azadirachtin Nicotine BT	Diflubenzuron Triflumuron. Fenoxycarb	Ⅲ Ⅲ U
Beech	Clania vartegata Snellen Thorn moth, Alternatus	1. Silvicultural measures: mixed forests, improved site conditions; clearing of diseased foliage; 2. Biological control: release wasps; 3. Chemical control: spraying of pollution-free chemicals timely.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Diflubenzuron fenoxycarb	Ⅲ Ⅲ U
Zhejiang Persimmon	Scab, round spot disease, angular spot disease, powdery mildew	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Chemical control: use of low toxicity and high efficiency and low residues fungicides.	Carbendazim	Chlorothalonil Clear Triadimefon Thiophanate	U Ⅲ U
	Persimmon mealybug, persimmon insect and persimmon leafhopper	1. Silvicultural measures: mixed forests, improved site conditions; 2. Mechanical and physical prevention: sex attractant, insecticide lamps, etc. 3. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin	Chlorbenzuron Diflubenzuron Triflumuron.	Ⅲ Ⅲ Ⅲ
Zhejiang camphor	Black spot disease	1. Silvicultural measures: mixed forests;	Carbendazim	Methyl thiophanate	U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
(camphor)		strengthen the tending and cut off the dead shoots; 2. Chemical: use of low toxicity and high efficiency and low residues fungicides at proper time.		Chlorothalonil Triadimefon	U Ⅲ
	Aulacaspis sassafris Chen	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine	Chlorbenzuron Diflubenzuron Triflumuron	Ⅲ Ⅲ Ⅲ
Robinia pseudoacacia	Purple root rot	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Chemical: use of low toxicity and high efficiency and low residues fungicides.	Carbendazim	Chlorothalonil Clear Triadimefon Methyl thiophanate	U Ⅲ U
	Robinia pseudo acacia, small bee	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Biological control: release wasps; 3. Chemical control: timely spraying of pollution-free chemicals.	Matrine Nicotine	Chlorbenzuron Triflumuron. Sendebao Fenoxycarb	Ⅲ Ⅲ U U
Cyclobalanopsis	Botrytis cinerea	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Clear Triadimefon Thiophanate	U Ⅲ U
	Borers, jewel beetle	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Strengthen quarantine; 3. Chemical control: spray pesticide with low	Azadirachtin BT SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Diflubenzuron	Ⅲ Ⅲ U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		toxicity and high efficiency and low residues.			Ⅲ
Cedar	Leaf blight	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Strengthen quarantine; 3. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Carbendazim	Chlorothalonil Clear Thiophanate Triadimefon	U U Ⅲ
	Caterpillars, aphids, Caterpillar canes	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Strengthen quarantine; 3. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Matrine Azadirachtin Nicotine BT SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Diflubenzuron	Ⅲ Ⅲ U Ⅲ
Pinus elliottii	Leaf blight Brown blotch	1. Silvicultural measures: mixed forests, improved site conditions, clearing of diseased foliage; 2. Strengthen quarantine; 3. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Carbendazim	Chlorothalonil Clear Thiophanate Triadimefon	U U Ⅲ
	Dendrolimus punctatus, pine-shoot borer, mealybug	1. Silvicultural measures: mixed forests; strengthen the tending and cut off the dead shoots; 2. Biological control: release wasps; 3. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Sen.	Ⅲ Ⅲ U U
	Dryocosmus bee, beetle, leaf moth	1. Silvicultural measures: mixed forests; improve site conditions;	Matrine Azadirachtin	Chlorbenzuron Triflumuron.	Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		2. Mechanical and physical prevention: sex attractant, insecticide lamps, etc. 3. Biological control: Encyrtidae; 4. Chemical control: spraying of pollution-free chemicals timely.	Nicotine BT SNPV	Fenoxycarb Sendebao	Ⅲ U U
Walnut	Brown spot, anthrax, twig blight, rot disease.	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Methyl thiophanate Triadimefon	U U Ⅲ
	Moth, borer, thorn moth	1. Silvicultural measures: improved site conditions, clearing of diseased foliage and fruit; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Fenoxycarb Diflubenzuron	Ⅲ Ⅲ U Ⅲ
Thin shell walnut	Leaf blight, brown spot and root rot	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.			
	Aphid Locust	1. Silvicultural measures: improved site conditions, clearing of diseased foliage and fruit; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Matrine Azadirachtin BT	Chlorbenzuron Triflumuron Fenoxycarb	Ⅲ Ⅲ U
Chestnut	Blight, fruit anthracnose and root rot disease	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Beetle, red spider, big black aphid	1. Silvicultural measures: improved site conditions, clearing of diseased foliage and fruit; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: spray pesticide with low toxicity and high efficiency and low residues.	Matrine Azadirachtin Nicotine BT SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao	Ⅲ Ⅲ U U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
Bamboo	Wilt disease	1. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 2. Strengthen quarantine; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate	U U
	Ceracris kiangsu Tsai, Oligia vulgaris Pegomyia phyllostachys Fan, Loudonta dispar Kiriakoff	1. Silvicultural measures: improve site conditions, remove and burn dead litter (strains); 2. Mechanical and physical control: digging egg, insecticidal lamps, etc. 3. Biological control: Trichogramma; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao	Ⅲ Ⅲ U U
Acer	Powdery mildew, brown spot	1. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 2. Strengthen quarantine; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Moth Alternatus	1. Silvicultural measures: mixed forests, improved site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: Trichogramma; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin n Nicotine BT	Chlorbenzuron Triflumuron Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Leucaena	Acacia wilt disease	1. Silvicultural measures: mixed forest.	Carbendazim	Chlorothalonil Clear	U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
	and canker	Improve site conditions, clearing of diseased foliage and fruit; 2. Strengthen quarantine; 3. Chemical control: use pesticide with low toxicity and high efficiency and low residues.		Thiophanate	U
	Rose borer, Bruchidius terrens	1. Silvicultural measures: mixed forest, improve site conditions; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Biological control: Trichogramma; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Oak	Freeze-dry stem	1. Silvicultural measures: mixed forests, improved site conditions, cleaning leaves; 2. Strengthen quarantine; 3. Chemical control: use pesticide with low toxicity and high efficiency and low residues.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Quercus maritima, Quercus variabilis, Quercus splendens	1. Silvicultural measures: mixed forests, improved site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: Trichogramma; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Elaeocarpus	Leaf blight and quenching disease	1. Silvicultural measures: mixed forests, improved site conditions, cleaning leaves; 2. Strengthen quarantine; 3. Chemical control: use pesticide with low toxicity and high efficiency and low residues.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
	Anomala corpulenta Motschulsky, Ceroplastes rubens (Maskell) Geometridae	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: parasitic fly; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Manglietia	Wilt, root rot and anthracnose	1. Silvicultural measures: mixed forests, improved site conditions, cleaning leaves; 2. Strengthen quarantine; 3. Chemical control: use pesticide with low toxicity and high efficiency and low residues.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Black cutworm, grub	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: parasitic fly; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Indo-Cambodian Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Betula luminifera H. Winkl	Phassus nodus Chu et Wang	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: Trichogramma, BT; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Hackberry	Psyllidae, red spider	1. Silvicultural measures: mixed forests, improve site conditions;	Matrine Azadirachtin	Chlorbenzuron Triflumuron.	Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Chemical control: timely spraying of pollution-free chemicals.	Nicotine BT	Diflubenzuron Fenoxycarb	Ⅲ Ⅲ U
	Powdery mildew, sooty blotch, leaf spot	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Clear Thiophanate Triadimefon	U U Ⅲ
Sapium discolor	Philosamia cynthia Walker et Felder, thorn moth, Plagiodera versicolora, Clania variegata Snellen	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Chemical control: timely spraying of pollution-free chemicals.	Matrine Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Hybrid Liriodendron chinense	Philosamia cynthia Walker et Felder	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Chemical control: timely spraying of pollution-free chemicals.	Matrine Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Toona sinensis	Batocera horsfieldi, Cossidae	1. Silvicultural measures: improved site conditions, clearing of diseased foliage;	Matrine Azadirachtin	Chlorbenzuron Triflumuron.	Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Nicotine BT SNPV	Fenoxycarb Sendebao	Ⅲ U U
Toona ciliata Roem. var. pubescens (Franch.) Hand.-Mazz.	Blight and stem rot disease	1. Silvicultural measures: mixed forests, improve site conditions, cleaning leaves, soil disinfection; 2. Strengthen quarantine; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Clear Thiophanate Triadimefon	U U Ⅲ
	Grub, thorn moth	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: parasitic fly; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Ginkgo	Stem rot, leaf blight, dry disease	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Clear Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
	Moth, borer	1. Silvicultural measures: improved site conditions, clearing of diseased foliage; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Matrine Azadirachtin Nicotine BT SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao	Ⅲ Ⅲ U U
Vernicia montana	Root rot, black spot	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Thosea sinensis (Walker), Batocera davidis deyrolle	1. Silvicultural measures: improved site conditions; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Matrine Nicotine BT	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao	Ⅲ Ⅲ U U
Choerospondias	Blight, root rot, anthracnose	1. Silvicultural measures: mixed forests, improve site conditions, cleaning leaves, soil disinfection; 2. Strengthen quarantine; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
	Cutworm, grub	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: parasitic fly; 4. Chemical control: timely spraying of pollution-free chemicals.	Matrine Azadirachtin Nicotine BT	Chlorbenzuron Triflumuron. Diflubenzuron Fenoxycarb	Ⅲ Ⅲ Ⅲ U
Michelia fuscata (Andr.) Blume	Leaf blight, anthracnose, algae spot disease, stooty blotch	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Scale bug	1. Silvicultural measures: improved site conditions; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Matrine Azadirachtin Nicotine BT SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao.	Ⅲ Ⅲ U U
Koelreuteria (Huangshan Koelreuteria)	Leading disease	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased	Carbendazim	Chlorothalonil Methyl Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.			
	Aphids, six-star black-dot leopard, beetle	1. Silvicultural measures: mixed forests, improve site conditions, clearing of diseased foliage; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc. 3. Biological control: parasitic fly, BT; 4. Chemical control: timely spraying of pollution-free chemicals.	Nicotine of Matrine Bt SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao	Ⅲ Ⅲ U U
Bayberry	Red Bayberry canker, brown spot, dry disease, root rot	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Moth, beetle	1. Silvicultural measures: mixed forests, improve site conditions; 2. Mechanical and physical prevention: digging egg, sex attractant, insecticide lamps, etc.	Matrine Indo-Cambodian Nicotine Bt SNPV	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao.	Ⅲ Ⅲ U U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		3. Biological control: release parasitic fly; 4. Chemical control: timely spraying of pollution-free chemicals.			
Castanopsis	Powdery mildew and leaf blight	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
Sweet Oachestnut	Brown rot disease, decay, blooming disease	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
Ormosia	Tar spot disease, anthracnose	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead		Chlorothalonil Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.			
	Aristobia hispida, locust, beetle,	1. Silvicultural measures: improved site conditions; 2. Mechanical and physical prevention: digging egg, insecticidal lamps, etc. 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Matrine Azadirachtin Nicotine Bt	Triflumuron. Fenoxycarb Sendebao.	Ⅲ U U
Red magnolia and white magnolia	Yellows, root rot, anthracnose	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate	U U
	Aphids, scale worms	1. Silvicultural measures: mixed forests, improve site conditions, cleaning leaves, soil disinfection; 2. Strengthen quarantine; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao.	Ⅲ U U
Saucer Magnolia	Wilt, root rot and grub	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree	Carbendazim	Chlorothalonil Thiophanate Fenoxycarb	U U U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.		Sendebao.	U
Cercis gigantea	Angular spot disease, wilt disease, leaf blight	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate	U U
	Clania variegata Snellen, Latoia consocia Walker, aphid	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: release parasitic fly; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Oleander	Black spots, brown spots, anthracnose, leaf spot, stooty blotch	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		high efficiency and low residues variety.			
	Aphids, red spiders, scale insects, moths	1. Silvicultural measures: mixed forests, improve site conditions; 2. Chemical control: use of low toxicity and high efficiency and low residues variety.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Fruticosa	Basically no pests				
Cryptomeria	Red blight	1. Silvicultural measures: mixed forests, improve site conditions; 2. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Megastigmus, Dendrolimus houi Lajonquier, Homona issiki	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: protection of natural enemies; 3. Physical control: use of fire or black booby traps; 4. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Camellia	Anthrax, soft rot, crown gall, sooty mould	1. Breed disease resistant species; strengthen management; and improve disease resistance. 2. Silvicultural measures: planting of bait trees removal of diseased leaves, diseased branches, dead branches and replace old trees 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Tussock moths,	1. Silvicultural measures: mixed forests,	Azadirachtin	Triflumuron.	Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
	weevil, white beetle, tea beetle	improve site conditions; 2. Biological control: use of natural or artificial breeding of ladybugs, grass flies, spiders, frogs and other predatory predators, parasitic bees, parasites, nematodes and other parasitic predators; 3. Physical prevention and control: artificial control, trap lighting; 4. Chemical control: timely spraying of pollution-free chemicals.	BT SNPV	Fenoxycarb Sendebao	U U
Pseudolarix	Damping off, stem rot, leaf blight	1. Silvicultural measures: mixed forests, improve site conditions, clearing of diseased foliage; 2. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Moth	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: protection of natural enemies; 3. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao.	Ⅲ U U
Torreya	Brown rot disease, soft rot disease, stem rot disease, root rot disease	1. Silvicultural measures: mixed forests, improve site conditions, clearing of diseased foliage; 2. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Moths, beetles, termites, cutworm	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: protection of natural enemies; 3. Chemical control: timely spraying of	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		pollution-free chemicals.			
Sapindus Mukorossi	Wilt, canker, stooty blotch	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate	U U
	Beetle, Spodoptera litura, Hepialidae, Psyllidae	1. Silvicultural measures: mixed forests, improve site conditions; 2. Strengthen quarantine; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Nicotine Azadirachtin Bt	Chlorbenzuron Triflumuron. Fenoxycarb Sendebao	Ⅲ Ⅲ U U
Pistacia chinensis	Blight	1. Strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Month, seed wasp	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: Trichogramma, chicken; 3. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
Maire Yew	Wilt, stem rot, blight, phytophthora disease	1. Silvicultural measures: mixed forests, improve site conditions, clearing of diseased foliage; 2. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Clear Thiophanate Triadimefon	U U Ⅲ
	Scale shell worms, aphids	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: protection of natural enemies; 3. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Fire Spike	Brown spot and powdery mildew	1. Strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate	U U
	Wood borer	1. Silvicultural measures: mixed forests, improve site conditions; 2. Chemical control: the timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Litsea auriculata	Root rot disease	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, fruit, diseased branches, dead branches and scraped bark, centrally buried and burnt;	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		3. Strengthen quarantine; 4. Chemical control: use of low toxicity and high efficiency and low residues variety.			
Keteleeria cyclolepis	Stem rot disease, leaf blight	1. Silvicultural measures: mixed forests, improve site conditions, clearing of diseased foliage; 2. Chemical control: timely spraying of pollution-free chemicals.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Moth	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: protection of natural enemies; 3. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Alder	Sooty blotch	1. Breed disease resistant species; strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate Triadimefon	U U Ⅲ
	Monema flavescens, Anomala corpulenta Motsch, flea beetle	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: use of natural or artificial breeding of ladybugs, grass flies, spiders, frogs and other predatory predators, parasitic bees, parasites, nematodes and other parasitic predators; 3. Physical prevention and control: artificial	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U

Table 3.5-1 Recommended Pest Control Measures and Pesticides

Species	Pest types	Prevention and control measures	Biological Pesticide	Recommended Chemical pesticides	Pesticide Classification (WHO)
		control, trap lighting; 4. Chemical control: timely spraying of pollution-free chemicals.			
Dalbergia	Aphids, Olethreutidae, Monema flavescens	1. Silvicultural measures: mixed forests, improve site conditions; 2. Biological control: use of natural or artificial breeding of ladybugs, grass flies, spiders, frogs and other predatory predators, parasitic bees, parasites, nematodes and other parasitic predators; 3. Physical prevention and control: artificial control, trap lighting; 4. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U
Indigofera pseudotinctoria	Brown spot, powdery mildew	1. Strengthen management; increase the application of organic fertilizer; enhance tree potential; and improve disease resistance. 2. Silvicultural measures: removal of diseased leaves, diseased branches, dead branches and scraped bark, centrally buried and burnt; 3. Chemical control: use of low toxicity and high efficiency and low residues variety.	Carbendazim	Chlorothalonil Thiophanate	U U
	Wood borer	1. Silvicultural measures: mixed forests, improve site conditions; 2. Chemical control: timely spraying of pollution-free chemicals.	Azadirachtin BT SNPV	Triflumuron. Fenoxycarb Sendebao	Ⅲ U U

4. Use and Management of Pesticides in Project Area

4.1 RECOMMENDED TYPES OF PESTICIDES

4.1.1 Recommended Pesticides

During the implementation of the project, the use of pesticides shall be economic, safe and effective. Table 3.5-1 gives the recommended pesticide list in accordance with relevant laws and regulations, the approach of IPM and principles of integrated management.

If any pests and diseases are not covered in Table 3.5-1 or any other pesticides not included in the table are to be selected,, pesticides not recommended in Table 3.5-1 may also be used to control pests and diseases. However, such new pesticide to be applied need to be proposed by experts from forest protection agency at or above the provincial level and approved by the Provincial PMO and reported to the World Bank for record before use. All pesticides used must comply with the requirements of the World Bank and policies and regulations of PRC.

4.1.2 Pesticides prohibited and restricted in China

BHC, DDT, toxaphene, DBCP, Chlordimeform, 2-dibromoethane, nitrofen, aldrin, dieldrin, mercury, arsenic and lead preparation, dexon, Fluoroacetamide, gliftor, tetramine, Silatranes, sodium fluoroacetate, methyl parathion, parathion, monocrotophos, phosphorus amine, fenamiphos, fonofos, methyl sulfide, calcium phosphate, magnesium phosphide, zinc phosphide, Cadusafos, coumaphos, sulfotep, Terbufos, methamidophos, paraquat, three dicofol, sodium pentachlorophenate, 2, 4-butylate and Metsulfuron methyl, Ehtametsulfuron, asomate, Monzet, chlorsulfuron, octachlorodipropyl ether, etc.

Pesticides including phorate, methyl isofenphos, G Budweiser, Isocarbophos, Do-win, endosulfan, Omethoate, methidathion, aldicarb and Ethoprophos, demeton, Sulfur phosphorus, Isazofos are prohibited for vegetables, fruit trees, tea and herbs.

Registration of chlorpyrifos and triazophos on vegetables was cancelled as of Dec. 31, 2016; application of chlorpyrifos and triazophos on vegetables is prohibited as of Dec. 31, 2016.

Registration of carbofuran, phorate and isofenphos-methyl on sugarcane crops is cancelled as of Sept. 7, 2016 and application of carbofuran, phorate and isofenphos-methyl on sugarcane crops is prohibited as of Oct. 1, 2018.

Application of fipronil is prohibited in areas other than for health purposes or as seed dressing for corn and other dry field crops.

Pesticide registration of florfenicol amide on rice is cancelled as of Sept. 7, 2016 and application of florfenicol amide on rice is prohibited as of Oct. 1, 2018. Application of daminozide on peanuts is prohibited.

The scope of registration and application and method of application of Methyl bromide and Trichloronitromethane are changed to soil fumigation and other registrations than soil fumigation are cancelled as of Oct. 1, 2015. Application of Methyl bromide and Trichloronitromethane should be carried out under professional guidance.

Pesticide registration certificate of products containing endosulfan is cancelled as of

July 1, 2018 and application of products containing endosulfan is prohibited on agriculture.

The scope of registration and application of products containing Methyl bromide are changed to quarantine fumigation treatment and as of January 1, 2019. Application of product containing Methyl bromide is prohibited in agriculture.

As of August 1, 2017, pesticide registration of acephate, carbosulfan and dimethoate (including single agents and compound preparations containing effective ingredients of the aforesaid 3 types of pesticides, hereinafter the same) in vegetables, fruits and melons, tea, fungus and herbs is cancelled and request for registration of acephate, carbosulfan and dimethoate in vegetables, fruits and melons, tea, fungus and herbs is no longer accepted and approved. As of August 1, 2019, use of acephate, carbosulfan and dimethoate in vegetables, fruits and melons, tea, fungus and herbs is prohibited.

All pesticide products should be used within the scope of usage approved upon pesticide registration and are prohibited to use outside the approved scope.

4.2. Procurement, Transportation and Storage of Pesticides

4.2.1 Procurement of Pesticides

The procurement of pesticides should be based on the recommended list using counterpart funds. The pesticide type and amount to be purchased should be determined according to the pest forecast and reported to the county PMO. The county and province PMOs will prepare the procurement list jointly.

The requirements included in the WHO Guidelines to Pesticide Classification (2009) shall be strictly executed in pest management; Class I pesticides are prohibited; Class III and Class U are recommended with priority.Pesticides used in the Project are Class III and Class U pesticides complying with the WHO requirements.

4.2.2 Transportation of Pesticides

For pesticides purchased in bulk, a technician should be commissioned to escort pesticides to ensure timely and safe delivery. Once containers containing pesticides are damaged, effective remedial measures must be taken to prevent environmental pollution. The county PMO will keep the original records of transportation and delivery.

4.2.3 Storage of Pesticides

The local forestry bureau where the project is located shall use special facilities to store the pesticides. Units and retail stores that provide services to afforestation entities shall maintain their storage facilities on a regular basis. The remaining pesticides shall be returned to the designated pesticide storage depot. According to the relevant laws and regulations, empty pesticide containers shall be returned to the designated warehouse for reuse or disposal.

4.3 Environmental, Occupational/Health Risks

4.3.1 Environmental Risks

(1) The main environmental risks in the process of using pesticides in the project area include:

- Pesticide residues will cause deterioration of water quality and potential decrease of aquatic organisms (such as fish and aquatic insects).
- Spraying pesticides or chemicals near the drinking water sources will cause pollution to water sources.
- Highly toxic pesticides will affect the non-target species (especially the bees, birds, livestock and natural enemies of pests, etc.)
- Long-term and excessive use of some pesticides will lead to increased resitance of pests and rats to pesticides.
- Pesticide residues in the soil will cause soil contamination.
- Pesticide packaging waste may cause non-point source pollution.

(2) Measures to mitigate the above risks include:

- Provide trainings to the pesticide users on environmental impact, and recommend better spraying equipment and methods.
- Cooperate with the local government and forestry department to regulate pesticide spraying behavior and carry out supervision and monitoring to protect the water sources.
- Recommend spraying equipment with national quality certification.
- Choose the pesticides with high efficiency, low toxicity and low pesticide residues.
- Promote biological control measures to minimize the use of chemical pesticides; use a series of non-pollution measures (physical, biological and low toxic chemicals) to ensure that the pests' resistance will not increase.
- Set up centralized collection and recycling station for packaging waste.

4.3.2 OCCUPATIONAL/HEALTH RISKS

(1) Occupational or health risks of pesticide application mainly include:

- Harms caused by inhalation of pesticide gas when preparing and spraying pesticide in the absence of protective equipment.
- Skin burns due to pesticide spraying or spilling without protective clothing.
- Pollution to the drinking water source due to applying pesticides or spills near the water source.

(2) Measures to mitigate the risks above include:

- Provide trainings on pesticide transportation, storage, safe use and waste management. The main contents include: possible occupation/health impacts of certain pesticides; recommended handling and spraying methods; approved spraying equipment and how to use these equipment; wearings for safety (long-sleeved clothes, mask, hat, glove, trousers and footwear); best weather condition for pesticide application; how to store chemical pesticides safely; how to handle the pesticide waste properly.
- The execution status of the aforesaid measures should be monitored and

evaluated and, if not properly executed, further education and training should be conducted.

5. Training Plan

5.1 Training Methods and Participants

The provincial PMO shall develop technical training programs at all levels in accordance with the concept of integrated pest management. The trainings will be conducted at three levels, i.e. provincial level, city level and township level. The provincial training courses will be organized by the provincial PMO and the trainees are management and technical staff of the county PMOs. The county level training courses will be organized by the county PMO and the participants include township forestry technical persons and technicians of forest farms. The county PMO will organize township training courses for the village cadres, farmer associations, and farmer representatives. The agencies responsible for organizing trainings shall carefully prepare appropriate training materials and use different formats of training, such as training workshop and on-site training.

5.2 Training Contents

The training should include the following major aspects:

- ✓ National and local laws and regulations;
- ✓ Pest management plan of the Project and the key contents of implementation;
- ✓ Technologies of identification, prevention and integrated management of the key pests and diseases in the project area;
- ✓ Morphological characteristics and identification of pests and diseases;
- ✓ Characteristics and losses of different pests and diseases;
- ✓ Law of occurrence of major pests and diseases;
- ✓ Identification of natural enemy insects;
- ✓ Technologies for selection and safe use of pesticides;
- ✓ Knowledge and operating skills in purchase, transportation, safe use and storage of pesticides;
- ✓ Safe storage and disposal of agricultural chemicals and their packaging wastes.

5.3 Training Plan and Budget

The training work plan should include two parts, i.e. the trainer training plan and the farmers field school work plan. Here described as follows is the training plan

Table 5.6-1 Training Plan and Cost

Training Contents	Participants	Project Area	Persons	Times	Cost	Implementing Agencies
Provincial						
1. Laws and regulations; pest management plan; 2. Forest pest control technology; 3. Pesticide procurement, management and safe use.	County PMO, technicians of county forestry pest control station.	Chun'an, Jiande	20	First year and third year during project implementation	200 CNY/person day, 8000 CNY in total	Provincial PMO
County						
1. Laws and regulations; pest management plan; 2. Forest pest control technology; 3. Pesticide procurement, management and safe use.	Technicians of township and forest farm	Chun'an, Jiande	40	First year and third year during project implementation	200 CNY/person day, 16,000 CNY in total	County PMO
Township						
Field demonstration on pest control and safe use of pesticides	Village cadres, farmer representatives	Chun'an, Jiande	100	Once a year, in the high season of pests and diseases	50 CNY/person day, 25,000 CNY in total	County PMO
Others						
Expert consulting services (experts of domestic and international forestry institutes on plant protection, pesticide and ecology)	Provincial PMO, county PMO and relevant technicians	Chun'an, Jiande	/	Invite relevant experts in high season to conduct on-site tour or training each year, 7-10 days each time.	30,000 CNY each time*5 years, 150,000 CNY in total	County PMO
Pests and diseases monitoring, survey and evaluation and pesticide management	Permeant monitoring staff of plant protection agency in the project area	Chun'an, Jiande	/	90 times monitoring annually according to the monitoring plan.	10,000 CNY*90*6 year, 5.4 million CNY in total	County PMO

6. Monitoring and Evaluation

6.1 Monitoring and Evaluation of Pest Occurrence and Damages

The monitoring work shall include both positioned monitoring and routine monitoring. Under the guidance of provincial forestry pest control station, the forest protection stations of the project counties and cities are responsible for carrying out positioned monitoring 2 or 3 times each year, usually during the periods of high incidence. In addition, the participating entities should conduct routine daily observation under the guidance of forestry technicians of county and township and report to the county PMO in time if pests and diseases occur.

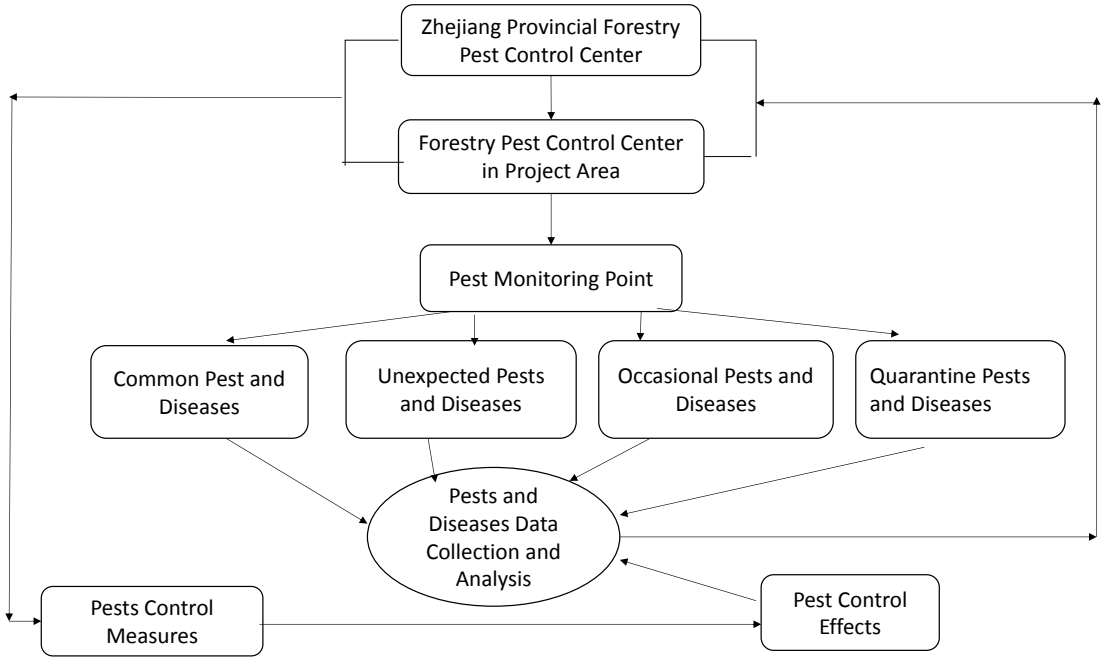


Figure 6-1 Pest and Disease Monitoring in the Project Area

6.1.1 Selection and Arrangement of Positioned Monitoring Site

One representative will be selected for each forest eco-restoration technology model based on their contents and distribution for positioned monitoring of pest types, rate of occurrence and degree of damages. 10 monitoring sites will be set up in Chun'an County 3 in Jiande City to conduct 3 monitoring each year.

6.1.2 Monitoring Methods

The fixed monitoring sites will be set up in selected project forest by sampling to identify 20 to 30 standard trees. These trees will be marked as fixed standard trees for monitoring. The pest occurrence of the standard trees are regularly surveyed each year, including the types of pests and diseases, the incidence rate and the degree of damage. The mitigation measures taken and frequency will be recorded.

6.2 Monitoring and Evaluation of Pest Management Quality

Under the guidance of the provincial PMO, the county PMO shall conduct regular inspections and random checks to monitor and evaluate the quality of integrated pest

management of the project forest. The provincial PMO shall supervise and inspect the monitoring and evaluation of integrated pest management in project counties.

The major contents of monitoring and evaluation include:

1. Monitoring of the types and areas of pests occurred in the project forest and measures taken and effects in each year and evaluation of the compliance with IMP requirements;
2. Monitoring of the types and quantities of pesticides purchased in batches and purchased by the participating entities and evaluation of the compliance with the WHO recommended pesticides of and above Class II or list of pesticides recommended for the Project.
3. Monitoring of the contents and person-days of pest management and technical training conducted for the county and township level technicians and participating entities and evaluation of the progress and effects of implementation of training plan.
4. Monitoring of the use of pesticides by the participating entities, including correctness of pesticide usage, spraying methods, protective measures taken in the use of pesticides, disposal of waste pesticides and packaging, etc., and evaluation of safe use of pesticides by the participating entities and farmers.

6.3 REPORTING

The PMOs at all levels and county-level forestry pest control station should report to the World Bank on the project implementation semi-annually and twice in a year. The content of the report should include the forest area, occurrence and control of pests, usage of pesticides, cost of pest management and utilization of project funds in project area.

Annex 6: ECOP for Road Construction

Environmental Codes of Practice

Road Construction

Contents

1. General

1.1 Project background

Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project is classified as Category B through environmental screening of the category, location, sensitivity and scale of the Project as well as the characteristics and scale of potential environmental impacts based on the requirements of environmental screening and categorization specified in the World Bank safeguard policies on environmental assessment (OP4.01) and requires the development of Environmental Codes of Practice (ECOP). This report is the Environmental Codes of Practice for Road Construction developed with reference to the EHS Guidelines, Operation Policies and Safeguard Policies of the World Bank and is applicable to the forest fire emergency access roads to be constructed in Jiande City. The key contents of the ECOP include project introduction, establishment of environment management body, implementation plan of environment protection measures, construction supervision plan and reporting mechanism and file management.

1.2 Relevant laws and regulations and World Bank safeguard policies

1.2.1 Relevant laws and regulations of China

(1) Environmental Protection Law of the People's Republic of China (amended in Year 2014);

(2) Law of the People's Republic of China on Environmental Impact Assessment (amended in Year 2016);

(3) Law of the People's Republic of China on Prevention and Control of Air Pollution (amended in Year 2015)

(4) Law of the People's Republic of China on Prevention and Control of Water Pollution (amended in Year 2008)

(5) Law of the People's Republic of China on Prevention and Control of Noise Pollution (amended in Year 1997)

(6) Law of the People's Republic of China on Prevention and Control of Environmental Pollution of Solid Wastes (amended in Year 2013);

(7) Water and Soil Conservation Law of the People's Republic of China (amended in Year 2011)

(8) Flood Control Law of the People's Republic of China (amended in Year 2015);

(9) Law of the People's Republic of China on Protection of Cultural Relics (4th amendment on April 24, 2015)

(10) Law of the People's Republic of China on Wildlife Protection (Nov. 8, 1988);

(11) Regulations of the People's Republic of China on Protection of Wild Plants (2nd amendment on July 2, 2016);

(12) Interim Methods for Public Participation in Environmental Impact Assessment (SEPA Huanfa Circular No. 2006[28], Feb. 14, 2006);

(13) Methods for Public Participation in Environmental Protection (MoEP Decree No. (2015)35);

(14) Notice on Strengthening Management of Environmental Impact Assessment on Construction Projects Utilizing Loans from International Financial Institutions (Huanjian Circular No. [1993]324);

(15) Management Catalogue of Environmental Impact Assessment Categories of Construction Projects (Sept. 1, 2017);

1.2.2 World Bank safeguard policies and the Environment, Health and Safety Guidelines of international financial institutions

This ECOP is developed in accordance with the Operational Policies on Environmental Assessment as a part of the World Bank safeguard policies (OP4.01) which requires environmental assessment of Category B projects, and the Environment, Health and Safety Guidelines of the World Bank Group, which requires the development of an environment management plan before and during the construction stage as well as the implementation of such environment management plan and monitoring of the mitigation measures implemented during the construction stage.

1.3 Key Project Components

1. Forest fire emergency access road: section from Xin'anjiang Street Office to Yangxi Street Office

   This emergency access road, with a total length of approximately 12km,

extends from Zhengfa Road of Xin'anjiang Street Office to Fangcun Village, a natural village of Gaoling administered by Yangxi Street Office and then further extends from Shibahu Village to Tongguan Forest Area (the Lover's Valley attraction). Including drainage ditches with a length of 10km, retaining walls with a volume of 8800m3 and 40 drainage culverts and 4 public toilets along the road, this road construction component will benefit a total forest area of 29km2 and will be constructed according to the Class III forest area road standards with a design speed of 20km/h, a roadbed width of 4.5m (0.5m wide earth shoulder + 3.5m wide carriageway + 0.5m wide earth shoulder) and a pavement structure of asphalt concrete.

2. Mountain-climbing Path: Bailingkeng Reservoir section in Hangtou Town

   This mountain-climbing path to be constructed under the Project starts at Wulongxi Village of Hangtou Town and extends along the mountain ridge for a total length of approximately 9km. As a new road with a subgrade width of 2.5m, the road will be constructed in three sections with a length of 5.331km, 2.756km and 0.852km respectively.

1.4 Objectives of ECOP

The ECOP is developed to present a set of detailed, technically feasible, and financially sustainable and operable environmental measures regarding to the inevitable and potential negative environmental impacts involved in the road construction works, identify the measures and arrangements of environmental pollution mitigation, environment management and institutional building to be implemented by the project construction contractors, supervision engineers, operators and environment management bodies in the construction and operation stages of the Project so as to eliminate or remedy and reduce the adverse environmental and social impacts to an acceptable level. The specific objectives of the ECOP include:

（1） Identifying the obligations of environment management of the construction contractors and operators

The project management unit, the project owner, the design unit and the EIA agency should carry out a detailed on-site review and verification of the environmental protection objectives involved in the project area and develop, in association with the local environmental characteristics and project features, and include practical and feasible environmental protection and pollution prevention and mitigation measures into the project design. In the tendering stage of the Project, it should be explicitly specified that it is an obligation of the bid winner to

implement the requirements included in the ECOP, which should be incorporated into the actual activities of engineering design and construction of the Project.

（2） Serving as the operational guidelines of environment management

The construction supervision plan proposed in the ECOP for the pre-construction stage and the construction stage as well as the reporting mechanism and the file management procedure can assure the effective implementation of the environmental pollution mitigation measures. To be provided as environmental protection documents to the construction supervision unit, the environmental monitoring unit and other relevant agencies, these documents will specify the responsibilities and roles of the relevant functional departments and management bodies as well as the channels and means of communication between these departments and bodies to effectively assure the smooth implementation of the environmental pollution mitigation measures.

1.5 Applicability

This ECOP is applicable to forest fire emergency access roads to be constructed in Jiande City and aims to provide the environment management agencies, construction supervision agencies and construction contractors with guidelines on the various measures for mitigation and monitoring of adverse environmental impacts in the process of project implementation and operation.

2. General requirements of the ECOP

In the construction process of the Project, the contractor of the road construction works will play a critical role in implementing the environment management, pollution control and prevention measures. In order to assure the execution of the ECOP, the contents included in this Section are general requirements and measures applicable to the major agencies involved in the construction process of the Project and the construction contractor should enforce the environment management measures proposed in the ECOP under the coordination and supervisory management of the various management agencies.

2.1 Implementation of environmental measures during construction drawing design and tendering document preparation

As the Project enters the implementation stage, relevant procurement activities will be implemented according to the Procurement Guidelines of the World Bank.

The tendering document preparation unit and the construction design unit are required to include the mitigation measures proposed in the ECOP against any potential adverse environmental impacts into the technical specifications of the tendering documents and the construction design of different stages under the coordination, guidance and supervision of the municipal PMO. The tendering documents need to require the tenderer to make commitments on the following environment management requirement in the bid document and incorporate such contents into the construction contract.

（1） The construction design unit should propose measures to mitigate potential adverse environmental impacts in the construction design of different stages. In the feasibility study stage, the environmental impacts should be analyzed and assessed and ECOP should be developed; in the preliminary design stage, the environmental protection measures proposed in the EIA and ECOP should be implemented; in the construction design stage, environmental protection engineering design should be produced based on the comments of ratification of the preliminary design.

（2） The contractor of the road construction works is required to provide 1 to 2 site environment engineers on each construction site responsible for implementing the environmental protection measures throughout the construction stage to assure that the construction activities of the contractor and its subcontractors (if any) satisfy the various

requirements of this ECOP and necessary environmental protection measures are taken in the construction process.

（3） The contractor of the road construction works must include the “Site Environment Management Plan” in its construction program after the contract is signed and before the commencement of the construction works.

（4） The contractor of the road construction works must respect the local construction safety and civilization requirements.

（5） The contractor of the road construction works and the construction supervision unit must receive training on environmental protection and environment management before the commencement of the construction works.

The following design elements should be taken into account as a priority in the various stages of design based on the general requirements of the ECOP and in association with the characteristics of the road infrastructure works:

Road design requirements:

（1） During the route and site selection stage of the construction drawing design of the temporary land occupation of the Project (construction sites, construction camps and access roads), full consideration should be given to avoidance of sensitive sites to mitigate impacts on residential areas in the neighborhood by temporary land occupation, minimize occupation of arable land and reduce damages to existing landscape and vegetation.

（2） In the design of earthworks and stonework, earthworks and stonework balance should be optimized and deep excavation should be avoided to achieve best possible balance between excavation and fill.

（3） Subgrade design should consider characteristics of local climate and rain season and construction of channels crossing roads should be planned and arranged ahead of time. Subgrade storm water interception and drainage measures should be reinforced and side ditches and gutters and other roadside water diversion measures should be provided to increase the function of soil and water conservation.

（4） The slope protection design should cater for the specific features of the Project and the reality of the local natural environment and also take protection of embankment slope as the top goal and extend concurrent consideration to the needs of production activities.

（5） In the process of development of the construction program, the characteristics of local climate should be considered to develop a reasonable construction schedule and assure proper implementation of the flood prevention and storm water drainage activities in the rain season. In addition, preventive measures should be taken to prevent and control erosion of exposed subgrade after excavation and fill caused by storm water scouring.

（6） The construction organization plan of the road construction works should give prior consideration to the protection of local residents and other sensitive objects and practical and feasible pollution prevention measures should be proposed in the design process to minimize disturbances to sensitive objects.

（7） The landscaping design should be developed in association with the noise control and dust control measures. Appropriate tree species should be selected to minimize repetitive investment in water and soil conservation, greenbelt beautification and dust prevention and noise insulation.

2.2 Preparations before construction

After the contract award and before commencement of the road construction works, the ECOP document should be provided by the Municipal PMO to the road construction contractor and the construction supervision unit should be determined.

After the tendering process is ended and a contract is signed with the civil works contractor, the contractor should conduct a visit to the construction site to identify environmental restriction factors in the project area. Prior to the commencement of the road construction works, a construction site checklist should be prepared and completed to inspect the sensitivity of the various environmental elements on site to provide an important basis for environmental protection of the road construction works in the future.

The purpose of the construction site checklist is to identify the relevant issues of environmental safety and identify and screen environmentally sensitive issues needing special protection measures.

Based on the results of construction site inspection, the civil works contractor should prepare the “Site Environment Management Plan”, which should incorporate the requirements of the ECOP and get approval by the construction supervision unit.

2.3 Environment management in the construction stage

During the construction of the road construction works, the civil works contractor should accept the supervision by the construction supervision unit commissioned by the project owner.

The contractor of the road construction works should implement the various environmental protection measures based on the requirements of environment management in the construction contract and the “Site Environment Management Plan” approved by the construction supervision unit. The construction supervision unit should carry out direct full-process supervision over the implementation of the environmental protection measures taken by the contractors while the local environmental protection administrative authority and its environmental surveillance unit and the public stakeholders in the project area should conduct external environment management monitoring.

Throughout the construction stage, the contractor of the road construction works should actively coordinate with the construction supervision unit and the environmental monitoring unit to perform their duties as detailed in “2.2 Responsibilities and Staffing of Agencies involved in the Environment Management System”.

The construction contractor should coordinate closely with the local government departments and other authorities to assure full compliance with the requirements of the laws and regulations of China.

2.3.1 Full-process construction supervision

The key assignments of the construction supervision unit include:

(1) Mainly responsible for supervising the construction activities of the contractor and other relevant activities, e.g. land occupation and compensation, etc. to assure that the aforesaid activities comply with the requirements, investment and objectives of environmental protection; responsible for coordinating the relationship between the land administration authority and the environmental monitoring authority on the construction site;

(2) Responsible for supervising and guiding on a regular basis the contractor’s environmental behaviors and assuring that the requirements of ECOP are satisfied;

(3) Responsible for review and approval of the “Site Environment Management Plan” of the contractor;

(4) Following up with and monitoring the implementation status of measures taken by the contractor in environmental protection and avoiding and mitigation of adverse environmental impacts;

(5) Monitoring and checking whether the construction behaviors of the contractor comply with the requirements of this ECOP;

(6) Making sure that an investigation should be immediately conducted and a report submitted to the municipal PMO or local environmental protection administration authority for a solution in case of any non-compliance with the environmental protection requirements or any adverse environmental impacts or any complaints from local residents on environmental protection in the project area; issuing simultaneously to the contractor an Instruction on Environmental Protection Corrections (Table 4 as attached) and making sure the corrective measures are taken by the contractor under supervision.

(7) Stopping any activities or behaviors by the contractor violating the environmental protection requirements;

(8) Providing on-the-job training to the contractor to avoid and abate possible adverse impacts on the local environment;

(9) Conducting site environment inspections on a weekly basis and preparing, archiving and incorporating the Environmental Protection Checklist in the Construction Stage (Table 3 as attached) into the “Site Inspection Report” for monthly submission to the municipal PMO;

(10) Conducting a further site environment inspection prior to the environmental protection acceptance upon the completion of the construction works and preparing and putting into archives the Environmental Protection Acceptance Checklist (Table 5 as attached).

2.3.2 Environmental Protection Unit Supervision and Public Opinion

The construction contractors should coordinate closely with the local governments and other authorities throughout the construction stage to assure full compliance with this ECOP and provide adequate information to the affected public, in particular information on construction behaviors affecting public safety, matters infringing upon public interests and sensitive areas and temporary stockpiling sites, etc. The local EPB should carry out sample inspections over the environmental protection measures taken by the construction contractors, receive site inspection reports submitted by the project owner and the municipal PMO and carry out its administrative duties based on the reported information and make arrangements for emergency responses to any abnormal environmental conditions arising in the

construction process.

The contractors will assure that information to be disclosed to the public is posted at sites in the vicinity of local residential buildings in the project area, including name of contractor, name and telephone number of environment management coordinators, environmental impacts likely to arise in the construction process and preventive measures to be taken as well as the estimated duration of such impacts. In the meanwhile, the contractor needs to provide an open and transparent way of public participation and hotline telephone number and complaint handling office to receive public consultation and advices. Environmental issues reflected in the public feedback should be immediately investigated and addressed within the shortest possible time.

2.4 Corrective measures to non-conformities to the ECOP requirements

The contractor and subcontractors (if any) of the road construction works must respect the requirements included in the ECOP and upon the occurrence of any pollution accidents (or events) due to failure in respecting the environmental protection measures specified in the ECOP:

(1) The Contractor of the road construction works should take immediate measures and trigger the emergency response plan of environmental pollution accidents to eliminate the pollution sources and control the resulted environmental pollution.

(2) The contractor of the road construction works should immediately notify the construction supervision unit and the project management unit while the construction supervision unit and the project management unit should provide assistance and guidance to the construction contractor to take remedial measures to reduce or eliminate environmental impacts. A report should be delivered within 24 hours to the local environmental protection administration authority (or local environment monitoring authority) for inspection and guidance to minimize the impact.

(3) The contractor of the road construction works should keep record of the implementation status of the pollution control measures and propose and submit corrective measures to the construction supervision unit and the project owner. Such records should be put into archives and registration by the construction supervision unit and the municipal PMO and the implementation status of such remedial measures will be reported by the project owner to the municipal PMO.

(4) The contractor of the road construction works should conduct an in-depth analysis of the causes of environmental pollution and develop preventive

measures and improve the construction design proposal to prevent recurrence of similar accidents. The preventive measures developed by the contractor should be approved, archived and registered by the construction supervision unit and the municipal PMO.

(5) The project owner should take disciplinary and punishment actions to the contractor of the road construction works according to the stipulations in the contract based on the nature, scope and degree of impact of the pollution accident and the implementation status of the contractor's remedial measures and report the results of such actions to the local environmental protection administration authority.

3. ECOP in the stage of construction site preparation

The construction sites of the road construction works mainly include the main works construction areas, the construction and production areas, the construction camps and the access roads as well as the stockpiling sites of related construction materials.

(1) Main works construction areas include land within the boundary of the right-of-way of roads.

(2) Construction and production areas generally include the concrete mixing plants, lime soil mixing plants, precast yards and construction material stockpiling sites.

(3) Construction camps are temporary places of centralized residence for construction workers participating in a construction project.

(4) Access roads are temporary roads constructed for the convenience of the construction activities.

(5) Construction material stockpiling sites generally include the sand and stone quarries, borrowing sites and soil-spoiling and waste disposal sites.

Construction site preparation mainly includes the formalities of land acquisition and resettlement to be fulfilled in advance. The construction areas of the main works are areas of permanent land occupation while the construction and production areas, construction camps, access roads and construction material stockpiling sites are generally areas of temporary land occupation.

Both permanent and temporary land occupation involve the following environmental and social impacts:

(1) Change of land use;

(2) Damages to surface vegetation;

(3) Aggravation of soil erosion among a series of environmental problems;

(4) Negative impacts caused by land acquisition and resettlement on the daily life of local residents.

Therefore, in order to save land resources and avoid unnecessary environmental impacts from land occupation, the scope of permanent and temporary land occupation (construction and production areas, construction camps and construction access roads) for the road construction works should be determined and the relevant formalities of land use for the Project should be fulfilled in the construction preparation stage prior to construction mobilization and commencement.

The following principles should be followed in terms of temporary land occupation:

(1) Where resettlement is involved in the process of land acquisition for the construction area of the main works of road construction under the Project, the relocation program included in the resettlement plan of the Project should be strictly implemented so that any problems of production and livelihood of the affected residents in the future are solved effectively and reasonable compensation are provided.

(2) The construction and production areas mainly include the concrete mixing plants, lime soil mixing plants and should be located in a centralized way. Prior investigations should be carried out to identify any reliable and available concrete mixing plants. Where possible, commodity concrete should be selected as a priority and in-situ asphalt mixing on the construction sites (the construction areas of main works) should be banned; in case of any operation difficulties, the construction and production areas should be selected in accordance with the requirements in Table 3-1.

Table 3-1 Requirements on selection of construction and production areas

Non-selectable	Selectable
• Land parcels located upwind of sensitive sites such as residential buildings, schools, etc. • Land parcels located within a distance of 200m downwind of sensitive sites such as residential buildings, schools, etc. • Basic farmland • Homestead • Forest land • Land parcels within a distance of 200m from the land territory of a river way • Land parcels located within a distance of 1000m at the upper reaches and 500m at the lower reaches of the drinking water sources and inside the protection area of drinking water sources • Low-lying land or paddy fields • Land with excellent vegetation cover • Land of special usages	• Land parcel within the scope of permanent land use • Wasteland • Abandoned farmland • Land parcels with relatively high terrain • Other low-quality land parcels

(3) Existing buildings and infrastructures should be utilized as a priority as construction camps to reduce soil and water conservation and environmental impacts caused by construction of construction camps; in case of any operation difficulties, the construction camps should be selected in accordance with the requirements in Table 3-2.

Table 3-2 Requirements on siting of construction camps

Non-selectable	Selectable
• Land parcels near residential buildings • Basic farmland • Homestead • Forest land • Land parcels within a distance of 200m from the land territory of a river way • Land parcels located within a distance of 1000m at the upper reaches and 500m at the lower reaches of the drinking water sources and inside the protection area of drinking water sources • Low-lying land or paddy fields • Land with excellent vegetation cover • Areas with hazards of collapses and landslides • Areas prone to mud slides • Land of special usages	• Wasteland • Abandoned farmland • Land parcels with relatively high terrain • Other low-quality land parcels

(4) Existing roads should be utilized to the best possibility as access roads for road construction and such access roads should be located far away from sensitive sites such as residential buildings, schools and hospitals.

New access road should be paved based on their usages. Site pavement should be handled based on the usage of the respective sites. For example, roads allowing the passage of heavy-duty vehicles should be paved with recyclable load-bearing bricks (structures) while ordinary sidewalks should be paved with recyclable seepage bricks. Dust along road sections prone to dust generation should be suppressed by water spraying.

(5) Construction material stockpiling sites generally include sand and aggregate stockpiling sites, borrowing sites and soil-spoiling and waste disposal sites.

Quarries: Aggregates needed for construction of the Project should unexceptionally be purchased locally.

Soil-spoiling and waste disposal sites: In the process of construction, a certain volume of construction wastes and debris will likely be generated,

mainly including waste soil from excavation, waste materials of road construction and waste rocks and mud from clearing and grubbing. In the construction site preparation stage, the destination of such wastes should be selected in a reasonable way based on the results of calculation of earthwork and stonework balance in the design stage and local recycling or borrowing site vegetation restoration should be selected as a top priority. In case of any operational difficulty, the siting of soil-spoiling and waste disposal sites should satisfy the requirements in Table3-3.

Table 3-3 Requirements on siting of soil-spoiling and waste disposal sites

Non-selectable	Selectable
• Basic farmland or other farm land, paddy field and cash crop fields • Homestead • Forest land • Land parcels within a distance of 200m from the land territory of a river way • Low-lying land or paddy fields • Land with excellent vegetation cover • Areas with hazards of collapses and landslides • Areas prone to mud slides • Land of special usages	• Wasteland • Abandoned farmland • Other low-quality land parcels • Mountain plain or low-lying areas

(6) Prior to the commencement of the construction works, the supervision engineer should carry out a strict review of the land use plan for temporary facilities to assure minimized occupation of farmland (in particular paddy field) and forest land.

Prior to road excavation and pipeline excavation, a survey of the existing pipelines should be properly carried out to avoid damages to existing pipelines during construction.

The construction contractors should identify suitable public water sources and municipal tap water or existing drinking water sources in the nearby villages should be selected. Drilling of new wells is strictly banned.

4. Management of construction sites and facilities

4.1 Management of construction sites

The construction sites mainly include the construction areas of the main works, the construction and production areas and the construction access roads.

4.1.1 Construction areas of main works

The construction sites mainly include the construction areas of the main works, the construction and production areas and the construction access roads.

5.1.1.1 Pollution source analysis for the construction areas of main works

Construction activities of the main works cover a number of construction stages including clearing and grubbing, subgrade construction, supporting infrastructure construction, side slope trimming and ecological restoration. The environmental impacts generated in the construction of the main works under the Project mainly include the following aspects:

(1) Clearing and grubbing: Loose soil, construction wastes, crushed stone and other debris may be generated in this process, which, if not properly treated, will cause dust and solid waste pollution and thus soil erosion.

(2) Subgrade construction: Vegetation will be damaged and surface will be exposed to result in certain changes of the local ecological structure; In the meanwhile, waste soil will be generated from earthwork excavation and dust pollution and soil erosion from direct excavation or delayed fencing or temporary waterproofing during earthwork fill; dust may also arise during material transportation.

(3) Slope trimming: Failure in timely slope trimming will lead to impacts of soil erosion and dust pollution.

(4) Ecological restoration: Construction behaviors such as temporary stockpiling of earth materials and compacting of construction plants will inevitably cause damages to vegetation on land around the boundaries of the right of way of roads and lead to aggravated soil erosion around the project area.

(5) Construction noises: All the aforesaid construction stages will require the use of many construction plants and transportation vehicles, which will radiate strong noises. Some equipment even generates vibration influencing the local residents and schools. The main construction plants include pile drivers, excavators, bulldozers, loaders and rollers while the transportation vehicles mainly include various trucks and dump trucks.

4.1.1.2 Pollution control measures in the construction areas of the main works

（1） The following pollution control measures should be taken during

clearing and grubbing:

Serious attention should be paid to dust suppression through water spraying so as to abate dust pollution.

Construction wastes and debris as generated should be cleared out of site in a timely manner and enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes, which should be subject to reasonable disposal according to the requirements of “Section VII ECOP of Construction Material Stockpiling Sites”.

In order to prevent soil erosion, the respective water and soil conservation measures should be taken according to the requirements in “Section VIII Water and Soil Conservation Management”.

（2） The following pollution control measures should be taken in subgrade construction:

Strict control should be implemented on the subgrade to avoid damages from over-excavation to surrounding vegetation and any felling of trees outside the construction areas is prohibited.

Construction wastes and debris as generated should be cleared out of site in a timely manner and enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes, which should be subject to reasonable disposal according to the requirements of “Section VII ECOP of Construction Material Stockpiling Sites”

Water should be sprayed on construction site to reduce dust pollution.

In order to prevent soil erosion, the respective water and soil conservation measures should be taken according to the requirements in “Section VIII Water and Soil Conservation Management”

（3） The following pollution control measures should be taken upon slope trimming:

Exposed slopes should be trimmed in time to reduce time of exposure.

Exposed slopes should be covered with dust prevention nets or sprayed with water for dust suppression to avoid dust pollution.

Respective water and soil conservation measures should be taken according to the requirement of Section VIII --- Management of Water and Soil Conservation.

（4） The following pollution control measures should be taken upon ecological restoration:

Ecological restoration of damaged land should be carried out prior to the completion of the construction works and such damaged land should at least be restored to the status prior to construction.

Arable top soil stripped during the construction should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities.

（5） Pollution control measures for construction noises:

The construction time should be subject to strict control. Construction activities using plants and equipment generating strong noises on construction sites within a distance of less than 150m from the residential areas must be suspended at night (from 22:00 pm to 06:00 am). On construction sites where the construction activities must be implemented in a continuous way, the contractor should contact in a timely manner, depending on the specific cases, the local environmental protection departments and obtain a nighttime construction permit according to the respective provisions and issue a public announcement to obtain maximum public support.

Mobile or temporary sound barriers and other noise prevention measures should be used on sensitive sites in the vicinity of the construction site (with a distance of less than 50m).

The construction site should be located far away from schools and hospitals where possible. The construction time for construction sites in the neighborhood of schools involving the use of strong-noise machinery should be negotiated and agreed with the schools and no construction activities should be arranged during the exam hours of the schools where possible.

（6） Others: Burning of wastes is prohibited on construction sites.

4.1.2 Construction and production areas

4.1.2.1 Pollution source analysis for construction and production areas

Construction and production areas mainly include concrete mixing plants and lime soil mixing plants and the key sources of pollution are:

（1） Loose soil, construction wastes, crushed stone and other debris generated in the process of clearing and grubbing, which, if not properly

treated, will cause dust and solid waste pollution and soil erosion.

（2） Dust generated in the process of concrete mixing;

（3） Dust generated in the process of lime soil mixing;

（4） Dust generated in the process of material loading and unloading and storage;

（5） Dust generated by construction and transportation vehicles;

（6） Noises and vibration generated in the process of equipment operation and transportation.

4.1.2.2 Pollution control measures for the construction and production areas

（1） The following pollution control measures should be taken in the process of clearing and grubbing:

Serious attention should be paid to dust suppression through water spraying so as to abate dust pollution. Construction wastes and debris as generated should be cleared out of site in a timely manner.
In order to prevent soil erosion, respective water and soil conservation measures should be taken according to the requirement of Section VIII --- Management of Water and Soil Conservation.

（2） Pollution control measures that should be taken in the process of concrete mixing include:

Commodity concrete should be selected as the top priority.
Wet mixing should be selected as the method of concrete mixing and the mixing process should be carried out in an enclosed state.

（3） Pollution control measures to be taken in the process of lime soil mixing include:

Wet mixing should be selected for the lime soil mixing plant, which should be operated in a fenced enclosure.

（4） Material loading and unloading and stockpiling process

Windproof and covering measures or dust suppression measures should be taken in the process of transportation, temporary storage and loading and unloading of earth, cement and lime among other bulk materials.
The material stockpiling site should be flat and solid.
Fencing measures should be taken for stockpiling sites of construction materials, such as cement, lime and sand and stone, which should covered with tarpaulins to reduce pollution from storm water scouring.

（5） Pollution control measures to be taken for dust pollution generated by construction and transportation vehicles include:

Vehicle washing facilities should be provided at the entrances and exits of the construction sites so that vehicles are washed and cleaned upon departure. Roads connecting the vehicle washing equipment and the exit of the construction site should be paved with concrete, asphalt or crushed brick to avoid possible take-away of mud and debris out of the site.

Enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes.

（6） Pollution control measures to be taken for construction noises should include:

Shock absorbers should be provided on the bases of fixed mechanical equipment with strong vibration (e.g. mixers). Fixed strong noise sources should be provided with sound insulators (e.g. the power-generation trucks) or positioned and operated indoors. The construction time should be subject to strict control. Construction activities using plants and equipment generating strong noises on construction sites within a distance of less than 150m from the residential areas must be suspended at night (from 22:00 pm to 06:00 am).

（7） Others:

Damaged land should be ecologically restored to at least the pre-construction state after the construction works is completed.

Arable top soil stripped during the construction should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities.

Burning of wastes is prohibited on construction sites.

4.1.3 Construction access roads

4.1.3.1 Pollution source analysis for the construction access roads

Environmental impacts generated from opening and construction of access road are mainly reflected in the following aspects:

（1） Dust pollution from road surfaces during operation of trucks and equipment;
（2） Noise pollution generated in the process of vehicle operation;
（3） Damages to surface vegetation and soil erosion resulting from

temporary land occupation.

4.1.3.2 Analysis of pollution control measures for access roads

（1） Pollution control measures against dust generated from road surfaces:

Pavement of new access roads and hardening of sites should be handled based on the design usage. For example, reusable load-bearing bricks (components) may be used for access roads allowing heavy-duty vehicles while reusable seepage bricks may be used for pavement of ordinary footpaths.
The access roads should be maintained and cleaned every day and dust-prone sections should be sprayed with water for dust suppression.

（2） Noise pollution control measures:

Transportation vehicles should be maintained according to Section 5.2 Construction equipment management.
Requirements in Section XVIII Construction Traffic Management should be followed.

（3） Ecological impact control measures:

Newly constructed access roads should be ecologically restored to at least the pre-construction state after the construction works is completed.
In order to prevent soil erosion, respective water and soil conservation measures should be taken according to the requirement of Section VIII --- Management of Water and Soil Conservation
Arable top soil stripped during the construction should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities.
Occupied or damaged local roads should be relocated or subject to protective treatment such as pavement rehabilitation and landscaping. In addition, compensation of a certain amount should be paid to local governments to safeguard the righteous interests of local governments and residents.

4.2 Construction equipment management

4.2.1 Pollution source analysis for construction equipment

In the construction process of road construction works, the operation of

construction plants will bring a number of adverse impacts on the surrounding environment and sensitive sites, which are mainly reflected in the following aspects:

（1） Oil leakage from equipment results in contamination of soil and water.
（2） Noise generated from equipment operation;
（3） Waste gas and tail gas emitted by fuel-powered machinery and vehicles.
（4） Waste engine oil, waste cotton yarns and other solid wastes generated in the process of equipment maintenance and repair.

It is therefore of great significance to strengthen the equipment management and maintenance.

4.2.2 Pollution control for construction equipment

In order to strengthen management of construction equipment, the following pollution control measures are proposed:

（1） Pollution control measures through reduction of oil leakage

State-of-the-art equipment and machinery should be selected, if possible, to effectively reduce the number of oil leakage and machinery repair and thus the generation of oily wastewater.

In the process of inevitable oil leakage, solid oil-absorbing materials (e.g. cotton yarns, wood chips, oil-absorbing paper) should be used, if possible, and the waste oil should be collected and transformed into the solid substances to avoid excessive generation of oily wastewater.

Maintenance and servicing of machinery, equipment and transportation vehicles should be carried out at centralized maintenance sites along each road section, if possible, for the sake of easy collection of oily wastewater.

Horizontal sedimentation tanks should be provided in the machinery maintenance sites and the oily wastewater will be collected in the sedimentation tanks for simple treatment such as acid-alkaline neutralization, sedimentation, oil separation and debris removal before discharge. The sedimentation tanks should be backfilled with soil for landscaping upon completion of the construction works.

The ground surface of the equipment maintenance sites should be paved and subject to anti-seepage treatment to avoid possible contamination of soil caused by oil leakage.

Records of equipment repair and maintenance should be developed to enable periodical maintenance based on the operation status of equipment.

（2） Pollution control measures against equipment operation noises:

The construction contractor must select construction equipment and machinery and transportation vehicles conforming to the relevant national standards and select, if possible, low-noise construction plants.

Shock absorbers should be provided on the bases of fixed mechanical equipment with strong vibration. Fixed strong noise sources (e.g. the power-generation trucks) should be provided with sound insulators or positioned and operated indoors.

Maintenance and servicing of the various construction equipment should be strengthened to keep them in fine operation to fundamentally reduce the intensity of noise and vibration sources.

（3） Pollution control measures against tail gas and exhaust gas from equipment:

The construction contractor must select construction equipment and machinery and transportation vehicles conforming to the relevant national health protection standards and assure that the exhaust gas emission of such equipment and vehicles conforms to the relevant national standards.

（4） Pollution control measures against solid wastes:

Waste oil and chemical solvents are hazardous wastes and should be separately stored based on their nature. Sites for temporary storage of hazardous wastes should be provided with obvious signs and constructed in accordance with the "Pollution control standards for storage of hazardous wastes" (GB18597-2001). Such hazardous wastes should be treated and disposed by a qualified unit and must not be dumped in a random way.

Toxic and hazardous wastes requiring recovery (e.g. oil buckets) should be recovered by material suppliers in principle and such responsibilities should be defined in the material procurement contract.

Recovery and disposal of hazardous wastes generated in a decentralized way (e.g. oil gloves, oil yarn heads) should be carried out by qualified agencies authorized by the PMO.

Oil and grease leaked into the soil should be collected in a timely manner with scrapping devices and sealed up and transported to a qualified treatment plant for centralized treatment.

When it is unlikely to carry out the maintenance and servicing of machinery, equipment and transportation vehicles at a designated maintenance site for each road section, containers or solid

oil-absorbing materials should be used to collect the oily wastewater generated from such equipment, which should be sealed up and transported to an external site for further treatment. A nearby disposal plant with the required qualifications for disposal of such wastes should be selected.

5. ECOP for construction camps

5.1 Pollution source analysis of construction camps

Pollution sources in the construction camps mainly comprise of pollutants generated in the domestic activities of the construction workers, including:

（1） Loose soil, construction wastes, crushed stone and other debris generated in the process of site leveling for the construction camps, which, if not properly treated, will cause dust and solid waste pollution and soil erosion.

（2） Domestic wastewater, including washing wastewater, bathing wastewater and food and beverage wastewater.

（3） Domestic exhaust gas, including exhaust gas and smoke from cooking gas combustion.

（4） Solid wastes, mainly comprising of domestic wastes of workers and sludge from septic tanks.

（5） Ecological environment impacts: Land occupation by the construction camps belongs to temporary occupation and the following environmental impacts will be generated during the land occupation period:

a) change of land use;

b) damages to surface vegetation;

c) aggravated soil erosion.

5.2 Pollution control for construction camps

（1） With regard to the various pollution sources in the construction and operation processes of the construction camps, the construction contractor should take the following pollution control measures:

Construction wastes and debris as generated should be cleared out of site in a timely manner and enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes, which should be subject to reasonable disposal according to the requirements of “Section VII ECOP of Construction Material Stockpiling Sites”.

Serious attention should be paid to dust suppression through water

spraying so as to abate dust pollution.

In order to prevent soil erosion, respective water and soil conservation measures should be taken according to the requirement of Section VIII --- Management of Water and Soil Conservation

（2） The following pollution control measures should be taken against domestic sewage of the construction camps:

Oil or grease traps should be provided in the canteen and a qualified unit with the waste digestion qualification certificate and business license approved by the competent authority should be employed to assure timely removal of wastes.

Temporary toilets and septic tanks should be provided on the construction camps and should be subject to anti-seepage treatment.

Drainage gutters and sedimentation tanks should be provided on the construction camps. Filters should be installed on sewer pipes of canteen, washrooms and shower rooms. Construction wastewater should not be discharged into the municipal sewage pipeline or natural rivers until properly settled. In the meanwhile, the drainage ditches should be kept tidy and free of obstacles to assure smooth drainage.

The construction camps should be kept in a smooth drainage condition and free of ponding of black and odor wastewater and unregulated urination and defecation.

Uncontrolled dump and discharge of domestic wastewater into agricultural irrigation canals is prohibited. No domestic solid wastes and construction wastes should be stockpiled around the aforesaid areas.

（3） Domestic exhaust gas control measures:

Clean energy, such as natural gas, electricity, should be used for cooking on the construction camps according to the requirements of local EP authorities.

（4） Solid waste treatment measures:

Recoverable wastes (e.g. waste paper, etc.) should be recovered and disposed by an authorized unit.

Enclosed garbage stations should be provided in the construction camps for timely collection, removal and digestion of domestic solid wastes of staff according to the respective requirements.

Enclosed slop pails should be provided outside the canteen and be emptied and cleaned in a timely manner.

The septic tanks should be emptied and cleaned by the authorized unit and should be backfilled upon the completion of the construction works.

（5） Control measures for ecological impacts:

All temporary facilities should be demolished and the occupied site restored to the pre-construction state within one month as of the completion of the construction works.

Arable top soil stripped during the construction should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities.

（6） Other environmental protection requirements:

The civil works contractor should strictly abide by the following bans in the construction process of the construction camps:

Use of clay bricks in construction of temporary facilities in the construction camp is prohibited and the safety and fire protection requirements and relevant national regulations should be respected.

The construction camps should be clearly distinguished from the construction areas and separation measures should be taken to assure that the construction camps remain in a tidy and orderly condition.

Burning of wastes is prohibited in the construction camps.

6. ECOP for construction material stockpiling sites

The key materials of road construction are aggregate and cement.

6.1 Sand and stone quarries

The construction sites of the road construction works of the Project do not have the conditions for setting up dedicated quarries. Site survey reveals that the subproject areas have rich reserves of sand and stone materials. Rich reserves of rubbles, (block) stone, aggregates and gravels needed for construction of pavement and structures are present in the vicinity of the project area. The quarries are uniformly distributed and capable of producing materials to a certain scale and conforming to the quality standard of construction materials. With convenient transportation condition from the quarries to the construction sites, it is unnecessary to set up new quarries.

6.2 Soil-spoiling and waste disposal sites

6.2.1 Analysis of environmental impact factors for the soil-spoiling and waste disposal sites

A certain volume of construction wastes and debris may be generated in the construction process of the road construction works, mainly including waste

soil from excavation, waste road construction materials, waste rock and mud from site clearing, which, if not disposed in a reasonable way, may bring the following environmental impacts:

（1） Exposed surface of the soil-spoiling and waste disposal sites may incur relatively serious dust pollution if no action is taken.

（2） Soil erosion may arise if no fencing or temporary waterproofing actions are taken in a timely manner at the soil-spoiling and waste disposal sites.

（3） Damages to surface vegetation may bring adverse impacts on ecological environment.

（4） Surface vegetation damages and surface exposure caused by earthwork excavation may bring adverse impacts on local landscape.

6.2.2 Control of environmental impacts from soil-spoiling and waste disposal sites

In order to avoid adverse environmental impacts from the establishment of the soil-spoiling and waste disposal sites, this ECOP proposes the following environmental protection measures:

(1) General requirements:

If any waste soil is generated, the top choice is to have such waste soil reused on the same construction site or other construction sites or reused for vegetation restoration in the borrowing sites so as to avoid setting up new waste soil disposal sites and fundamentally eliminate environmental impacts in this regard.

If reuse of waste soil is unlikely, a local survey should be carried out to find out if any designated digestion sites exist locally for construction wastes and debris. If any, the required formalities of removal and transportation should be fulfilled and the construction wastes should be delivered to the designated places for digestion.

(2) Dust control measures:

Layered compaction may effectively suppress dust on the soil-spoiling and waste disposal sites.

Dust suppression should be carried out through water spraying to reduce dust pollution caused by exposed surface.

(3) Soil erosion control:

In order to prevent soil erosion, respective water and soil conservation measures should be taken according to the requirement of Section VIII --- Management of Water and Soil Conservation.

(4) Control of ecological impacts:

Before the soil-spoiling and waste disposal site is mobilized, the top soil should be excavated and used for land rehabilitation. The top soil should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration of the soil-spoiling and waste disposal sites upon completion of the construction activities.

Vegetation restoration should be carried out upon the completion of the borrow fill operation according to the requirements in Section XII --- Ecological Protection Management.

7. Management of water and soil conservation

Water and soil conservation in the road construction works should be implemented following the principle where “the water and soil conservation activities are integrated with the main works of road construction and equal emphasis is laid on the main works, the ancillary works and the temporary works so that both the fundamental and indicative causes of soil erosion are eliminated through integrated efforts of prevention and control focusing on prevention. In addition, the water and soil conservation facilities should be distributed and arranged in a reasonable way to not only cater for the local circumstances and pursue effectiveness, but also highlight the importance of water and soil conservation in the construction stage. Serious attention should be paid to landscaping and reclamation of borrowing sites and waste soil disposal sites involved in the road construction works and fences should be erected around the soil-spoiling and waste disposal sites before any disposal operation commences.

7.1 Distribution of water and soil conservation facilities and construction arrangement

(1) Distribution of preventive and control measures

Soil erosion likely to arise in the construction of the Project mainly occurs in the subgrade zones and the waste soil disposal sites. The roadbed excavation involves the longest duration and the focus of soil erosion prevention should be the treatment of side slope and distribution of drainage facilities. The focus of soil erosion prevention in the soil-spoiling and waste disposal sites include temporary fencing, drainage facilities and vegetation restoration.

(2) Construction progress scheduling

Soil erosion likely to arise in the construction of the Project mainly occurs in

the construction stage of the Project. The key erosion type is hydraulic erosion and the focus of erosion prevention is storm water diversion. Since a relatively sound storm water system is included in the design of the main works, a part of the storm water system should be implemented in advance and connected with the natural ditches and existing drainage facilities to perform its function of water and soil conservation at the earliest possible date.

7.2 Prevention and control zone of the main works

(1) Top soil stockpiling is not permitted in catchment areas of surface runoffs, in sensitive zones such as roads or river ways in the vicinity of the Project, in areas affecting construction or road traffic. In order to reduce the quantity of protection measures, top soil should be stockpiled at unoccupied low-lying land parcels where possible. If the top soil is temporarily stockpiled on both sides of the right-of-way of the subgrade, a cofferdam of bagged earth should be built up around the stockpile to avoid possible slides; temporarily stockpiled top soil should be used as topping soil for future side slope landscaping.

(2) Slope protection should be carried out in a timely manner. Since roads included under the Project are urban roads, the subgrade slope protection should, in principle, take ecological protection as the main solution and lightweight supports as the secondary solution, with land development on both sides taken into account. Based on the geological and hydrological condition of the project area, geotextile net grass protection slope should be used along the filled embankment and retaining walls at certain individual sections.

(3) Temporary retaining ditches should be provided outside the boundary of low-lying areas in the project area to prevent storm water scours in rain season.

(4) Sand sedimentation tanks should be provided at the outlet of the subgrade drainage gutters.

7.3 Prevention and control zone for the construction and production areas

The construction and production areas mainly include concrete mixing plant and lime soil mixing plant, etc.

（1） On-site soil erosion is the focus of prevention and control in the construction and production areas. To accommodate frequent passage of vehicles and need of material stockpiling, the entire site should be hardened and paved with cement concrete.

（2） Temporary retaining ditches should be provided outside the boundary

of low-lying areas in the project area to prevent storm water scours in rain season.

（3） Top soil and material stockpiles should be covered with dust prevention nets to prevent storm water scours and pollution to surrounding environment.

（4） A reasonable construction schedule should be developed to shorten the time of temporary land occupation and vegetation restoration or land rehabilitation should be immediately implemented for the temporarily occupied land parcels upon completion of the Project.

（5） The key tasks of land rehabilitation in the late stage of the Project include demolition of construction facilities, removing aggregates, sand and other construction materials spilled in the course of concrete mixing and landscaping or rehabilitation of land parcel where the construction site is located to restore the land parcel to its original state to the best possibility.

7.4 Prevention and control zone for the construction access roads

The access roads to be constructed for the road construction works of the Project are roads for transportation of construction materials and waste soil (and debris). If it is truly necessary to build new access roads under the Project, waste and dry land should be selected in terms of land occupation. In addition, the scope of access roads should be minimized to reduce damages to vegetation and soil due to temporary land occupation by the access roads.

（1） Construction requirements

a) If possible, an existing road should be selected and financed after negotiation with local authorities and developed on a win-win basis into an access road through widening and hardening.

b) Newly developed access roads should be routed in such a way that large-scale excavation and riverside land parcels are avoided.

c) Water should be sprayed periodically in clear and windy days for dust suppression.

（2） Design of prevention and control measures

Drainage gutters will be excavated on one side and connected to the drainage gutters of the temporary soil-spoiling and waste disposal site and subgrade in order to minimize land occupation.

7.5 Prevention and control zone of the construction camps

（1） Grass and shrubs should be planted in areas except the camps and the

hardened areas as a measure of temporary landscaping and beautification of the construction camps.

（2） Brick masonry drainage gutters should be constructed for fast discharge of ponded water on site.

（3） At the end of the Project, the camps and the hardened areas should be demolished for land rehabilitation and vegetation restoration.

7.6 Prevention and control zone for the soil-spoiling and waste disposal sites

（9） In case of any implementation difficulty, soil-spoiling and waste disposal sites need to be set up in preferably mountain plain or low-lying areas.

（10） Based on the topographical features of the soil-spoiling and waste disposal site, retaining wall should be constructed at the bottom part of the soil-spoiling and waste disposal site prior to disposal operation. Such retaining wall should be constructed in such a way that the location and topographical features of the waste disposal stockpiles are taken into account and the retaining walls are safe, cost-effective and reasonable.

（11） Interception ditches should be constructed at the upper slope of the soil-spoiling and waste disposal site to intercept slope runoffs and sedimentation tanks should be built on both ends. Energy digestion facilities should be provided if the interception ditch has a big end slope.

（12） The disposed wastes should be rolled and compacted in time. A 1-2m wide terrace should be provided at a spacing of 5-6m along the elevation of the disposed waste and drainage gutters should be provided on the terrace.

（13） Upon the completion of the construction works, ecological restoration should be immediately implemented to the soil-spoiling and waste disposal sites.

8. Ambient air quality management

Pollutants generating impacts on the ambient air quality in the construction stage of the Project mainly include construction dust and vehicle tail gas.

8.1 Construction dust

（1） The construction access roads are simple gravel roads and water will be sprayed periodically to reduce dust.

（2） Fine particle bulky materials stockpiled on construction sites should be enclosed or covered and water should be sprayed over the stockpiles,

based on the nature of the material, to effectively suppress dust.

（3） Road fences should be set up for environmentally sensitive sites (zones) along the road sections under construction.

（4） Removal of construction wastes should be carried out with a closed container and aerial casting is prohibited. The construction wastes should be stored by type in accordance with the relevant classification management requirements of municipal wastes and should be cleared and digested in a timely manner. Water should be sprayed to an appropriate extent ahead of the clearing operation.

（5） Management of transportation vehicles should be strengthened and those transporting dust-prone materials should be covered with tarpaulins.

（6） Water spraying should be carried out during demolition for the sake of dust suppression. The construction wastes should be cleared out of site within 3 days as of the completion of the demolition activity and the relevant requirements on demolition management should be respected.

（7） Dust-prone areas on the construction sites should be enclosed with fences or sprayed with water for dust suppression.

（8） Earthwork materials on construction sites should be stockpiled at a centralized place and properly covered; vehicles should not be overloaded to avoid spillage en route due to vibration.

（9） Vehicle washing facilities should be provided at the entrance and exit of construction sites and surface mud and earth should be cleaned before vehicles leave the site.

（10） The storage sites of materials and formworks on site should be flat and solid;

（11） The construction sites should be cleaned and sprayed with water in a timely manner;

（12） On account of the dominant wind direction and the objects of environmental protection in the vicinity, stockpiling sites of fine-particle bulky materials and other key dust sources should be located more than 300m away at the downwind side of objects of environmental protection.

（13） Burning of wastes is prohibited.

8.2 Automobile tail gas

（1） Construction machinery and vehicles in excellent operating condition should be selected;

（2） Fuel-powered construction machinery and vehicles must be utilized in

normal state to assure compliant emission of tail gas.

（3） The equipment should be utilized in a reasonable way and equipment maintenance and repair should be strengthened.

9. Acoustic environment quality management

Noise sources at different stages of the construction stage will produce impacts of different degrees on the acoustic environment quality of the project area. Stronger efforts of management should be made and respective environment control measures should be taken to minimize such impacts.

（1） State-of-the-art and reliable low-noise equipment should be selected upon type selection;

（2） The construction period in a day lasts from 8:00am to 20:00pm and construction activities should be banned in the noon nap hours from 12:00am to 14:00pm. Nighttime construction is restricted, but if continuous nighttime construction is truly necessary, a certificate should be obtained from local construction administration authority, an approval granted by local EP authority and a public announcement made to local residents.

（3） The construction progress should be reasonably scheduled to avoid simultaneous operation of multiple high-noise mechanical plants on the same construction site and at the same time. During construction, efforts should be made to speed up the progress and shorten the duration of noise impacts so as to minimize the impacts of construction noises on the operators.

（4） Noises of transportation vehicles may produce certain impacts on the sensitive sites of acoustic environment along the route. Therefore, the construction contractor needs to strengthen the construction workers' awareness of environmental protection, learn local customs and habits and reasonably schedule the transportation time and take self-conscious measures to limit speed and prohibit honking for vehicles and other construction plants operating in high-density residential areas and other environmentally-sensitive areas so as to effectively prevent and reduce noise impacts.

（5） Mechanical equipment generating relatively high noise should be located on the far side of the residential area and noise-reducing fences should be erected around construction sites with a distance of less than 5m from residences, schools and similar buildings.

（6） Advices should be given to the construction contractor to reasonably arrange and allocate the construction workers to reduce the operation

time of high-noise machinery operators. Earmuffs may be provided to reduce noise impacts on the construction workers.

（7） All the mechanical equipment should be effectively maintained and serviced on a periodical basis to keep such equipment in an excellent condition for the purpose of reducing noise and extending equipment service life.

（8） Strict management requirements should be implemented on construction intensity, machinery and vehicle operators and code of operation.

10. Water environment quality management

（1） Wastewater from site washing, vehicle washing, construction material washing, concrete curing and aggregate washing on the construction sites should be collected via the sluice and then mixed and diluted before entering the temporary sedimentation tank for treatment. The temporary sedimentation tank should be appropriately sized to assure a standard wastewater retention time of more than 12 hours. Treated wastewater will be reused in site washing, construction material washing, concrete curing and aggregate washing on the construction sites.

（2） Stronger efforts should be made in construction management to strictly control oil leakages of the construction plants; drainage system and water and soil conservation measures should be properly implemented for the temporary stockpiling areas to prevent possible impacts on the water environment by soil erosion at the waste soil stockpiling sites.

（3） The construction units must carry out the treatment measures for construction and production wastewater and domestic sewage to assure that such wastewater is properly treated and disposed.

（4） Environmental protection education for construction workers should be strengthened to enhance their environmental awareness and prevent and stop any random dumping of wastes and wastewater by construction workers.

（5） Waste oil and other solid wastes involved in the construction process must neither be dumped or cast into nor placed around the water systems and should, instead, be transported to designated sites or treated according to the relevant requirements in a timely manner.

（6） Actions should be taken to prevent constructional impacts on Bailingkeng Reservoir.

The 9km long mountain-climbing path around Bailingkeng Reservoir in Hangtou Town extends from Wulongxi Village of Hangtou Town

along the mountain ridge. According to the Water Function Zone and Water Environment Function Zone Plan of Zhejiang Province, areas within the watershed with a longitudinal depth of 200m or less than 200m along the coast above the normal water level belong to Class I drinking water source protection zone while the land areas outside the Class I protection zone are Class II drinking water source protection zone. The mountain-climbing path involves no Class I drinking water source protection zone and only a part of the path involves Class II drinking water source protection zone.

It is stipulated in the Provisions on Management of Pollution Control in Drinking Water Source Protection Zones and the Regulations of Zhejiang Province on Protection of Drinking Water Sources that construction, reconstruction and expansion projects with no connections with water supply facilities and water source protection are prohibited in the Class I drinking water source protection zones and pollutant discharge outlets and construction, reconstruction or expansion projects involving discharge of pollutants are prohibited in Class II drinking water source protection zones. In order to mitigate the impact on Bailingkeng Reservoir, the following measures should be implemented:

1) It is prohibited to locate any construction camps and discharge any wastewater in the catchment area of Bailingkeng Reservoir;
2) The construction contractors shall set up sedimentation tanks and other wastewater treatment facilities on the construction sites in the construction stage to make sure that the construction wastewater is collected, sedimented and treated and the supernatant shall be used for dust suppression on construction sites instead of directly discharged into the nearby water bodies.
3) Fencing facilities should be constructed on the side of the reservoir to reduce soil erosion.
4) Sites for stockpiling of toxic and hazardous substances are prohibited in the water source protection zones.

11. Ecological protection management

（1） The layout of the construction sites should be reasonably optimized to minimize the scope of construction activities and reduce the level of damages to vegetation from implementation of the construction works.

（2） Construction materials outsourced for the construction works, such as stone, sand, cement, etc., should be transported on a demand-driven basis to minimize land occupation and vegetation damage. Upon completion of the construction works, the construction sites should be

cleaned and landscaped in time to restore damaged vegetation to the maximum extent.

（3） Temporary protective fences should be erected before the commencement of the construction works to protect trees left undisturbed on the construction sites based on the site visit results.

（4） No signs other than the identification label should be attached to the trees. Stockpiling of construction materials or parking of mechanical equipment around the tree protection zones is neither permitted.

（5） Temporary interception ditches should be constructed on the construction site to provide a flood diversion canal for the surface runoff passage damaged by the Project so as to divert flood formed in rain season and avoid runoff scours.

（6） The construction contractor should minimize the duration of temporary land occupation and control the earthwork construction time provided that the construction quality is assured and a stable excavation and fill slope should be maintained to reduce impacts on areas outside the construction area of the Project.

（7） Ecological restoration of the construction sites should be carried out prior to the final acceptance of the Project.

12. Social environment management

In order to mitigate the impacts on the livelihood of local residents due to construction of the road construction works, the following environmental impact control measures should be taken:

（1） The various LAR subsidies should be allocated to the concerned village groups and individuals based on the compensation standards of Zhejiang Province, the local circumstances and the agreements signed with the LAR affected households. The various compensations should be reasonably allocated and utilized through full promotion of democracy and respect of the basic citizen rights; the arable land and labor force should be reasonably adjusted through full enforcement of the relevant policies.

（2） Local roads occupied or damaged in the construction of the proposed road constructions should be relocated or subject to protective treatment such as pavement rehabilitation and landscaping. In addition, compensation of a certain amount should be paid to local governments to safeguard the righteous interests of local governments and residents.

（3） Construction and transportation vehicles should avoid the peak hours of local roads to prevent traffic congestion and accidents.

（4） Connection with the relevant roads and installation of safety signs

should be implemented before the construction works is completed and put into operation.

13. Solid waste treatment management

According to the requirements of the relevant laws and regulations, solid wastes such as construction wastes, waste soil (debris) and domestic solid wastes must be properly collected and reasonably treated.

（1） Arrangements should be made to achieve comprehensive use of construction wastes in the road construction works simultaneously implemented, with the remnants stockpiled at a designed stockpiling place on the construction site and transported in a timely manner based on the construction progress to the solid waste landfills of each project town for disposal.

（2） Removal of construction wastes should be carried out with a closed container and aerial casting is prohibited. The construction wastes should be stored by type in accordance with the relevant classification management requirements of municipal wastes and should be cleared and digested in a timely manner.

（3） Water should be sprayed to an appropriate extent ahead of the clearing operation.

（4） Domestic wastes should be collected in the garbage bins and bags provided on the construction sites and then transported to the Domestic Waste Landfill for further treatment and disposal;

（5） The waste soil contains a certain portion of mellow soil, which should be used in wasteland reclamation and forestation of the project area. The remaining soil may be used as subgrade fill of the road works and bedding fill on both sides of channels in the vicinity.

（6） Burning of toxic and hazardous substances is not permitted on construction sites. Toxic and hazardous substances should be disposed according to the relevant requirements and stipulations.

14. Hazardous wastes and flammables and explosives

14.1 Management measures for hazardous wastes, flammables and explosives

Some hazardous wastes (e.g. waste diesel, waste engine oil, waste lubricants, and waste paint) and flammables and explosives (e.g. diesel, engine oil) are involved in the construction process of the road construction works. If not properly handled upon storage and transportation, significant environmental

impacts may arise.

（1） Management measures for storage of hazardous wastes and flammables and explosives:

a) Upon delivery of diesel, engine oil, lubricants and paints into the construction site, the inspectors should carefully check the package and confirm if there are any leakages. The delivered goods should be rejected if any leakages are identified;

b) A special storage space should be provided for hazardous wastes and flammables and explosives stored in the construction and production areas. Warning signs should be erected; floor should be subject to anti-seepage treatment and absorbing bags, sand and chips among other emergency response materials should be prepared.

c) Labels should be attached to hazardous wastes and flammables and explosives;

d) Storage of diesel, engine oil, lubricants and paints should comply with the requirements of storage type and data specified in the storage certificate.

（2） Fire prevention management measures

a) Laws, bylaws and regulations on fire safety management promulgated by the national and local governments should be enforced and the enterprise work standards should be followed.

b) Fire operation approval procedure should be strictly followed and unapproved fire operation should be prohibited.

c) Strict management methods should be developed for flammables and explosives and effective measures should be taken for safety assurance;

d) Greater efforts should be made in electricity safety education and unapproved connection of electric cables is prohibited.

e) On-site rescue measures for fire incidents and accidents

A：In the event of a fire accident, rescue activities should be organized on site based on the fire accident emergency response plan. Rescue personnel entering the scene must carry protective devices and unrelated persons should not be allowed to enter the accident scene.

B：Fire causes should be identified and suitable fire extinguishers should be selected;

C：Once the fire is extinguished, a special monitoring personnel should be assigned to prevent possible resurgence. The rescue time may be extended when

necessary;

D：The fire accident scene should be cleaned in time and burned materials and articles properly disposed.

f) Fire extinguishers of the corresponding types should be provided in the storage places of diesel, engine oil, lubricants and paints.

15. Public participation

The construction contractors should provide adequate information to the public in the affected area, in particular, local residents likely to be directly affected by the construction activities in the project area. Key measures to be taken include:

（1） Setting up a bulletin board at the entrance of the construction site to disclose information such as project name, key construction works, construction time as well as the contact person and contact information for complaints and advices;

（2） Making arrangements for site environment engineer to answer questions from the public on environmental protection;

（3） Fulfilling the relevant formalities for and disclose to the local residents information on any nighttime construction required for the sake of construction technology and workmanship. Information to be disclosed in such cases include beginning and ending time of as well as the permit granted by the environmental protection authority on nighttime construction.

（4） A public announcement should be posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, and telephone and bus service) needed for the implementation of the construction works.

（5） All feedbacks, comments and questions from the public should be recorded and archived. Questions raised by the public should be answered and responded in a timely manner, with the results of answers and responses recorded and archived for future inspection by the supervision unit.

16. Construction traffic management

Temporary increase of traffic caused by the road construction will bring noise impacts and daily life inconvenience for local residents along the transportation routes. Therefore, the following construction traffic management measures are proposed in this ECOP.

（1） A reasonable construction schedule should be developed to shorten the time of temporary land occupation.

（2） Enclosed transportation vehicles must be used for transportation of earth, debris and construction wastes.

（3） Transportation of construction materials at night time should be prohibited on any construction access road with a centralized area of residence in a distance of less than 50m.

（4） Construction and transportation vehicles should avoid the peak hours of local roads to prevent traffic congestion and accidents.

（5） Construction vehicles should travel along designated routes and unauthorized change of routes is prohibited to avoid possible damages to farmland and forest land;

（6） Construction nameplates should be installed at obvious positions to indicate the name of project, scope of construction site, names of EA, contractor, supervision company and monitoring unit as well as the name of project responsible person, date of commencement and completion and supervision and complaint hotline as well as the specific environmental protection measures;

（7） The construction contractor should post commencement notices around the construction site 7 days prior to the scheduled date of commencement of the respective construction works to disclose information including project overview, construction plan, name of responsible construction units and name of project manager and complaint and appeal telephone numbers.

（8） Nighttime construction should be restricted. If nighttime construction is needed in any special circumstances, the impacts by nighttime construction on the neighborhood should be controlled and a prior notice should be sent to obtain the understanding of the local residents;

（9） The height of construction fences should not be smaller than 1.8m for ordinary road sections and 2.5m for key road sections in the urban area. The advertisement slogans should be attached in a standardized way; the walls should have blue color as the base color and be kept clean all year long and free of scribbling and spraying.

17. Supervision plan

Responsibilities of construction supervision should be incorporated into the environment supervision of the road construction works to implement total quality management of the Project following the requirements of both construction quality and environment quality.

17.1 Scope of construction supervision

Areas of and along the road construction works, mainly construction sites, soil-spoiling and waste disposal sites, and areas causing environmental pollution to the surrounding environment due to production and construction.

17.2 Contents of construction supervision

（1） Reviewing and verifying whether the environmental protection measures proposed in this ECOP are incorporated in the design proposal and the construction drawing design;

（2） Assisting the construction unit in organizing environmental protection training for construction and management staff;

（3） Reviewing clauses on environmental protection in the project contract;

（4） Carrying out the supervision of water, sound and air environment quality in the construction process, the environmental impact mitigation measures and the environmental protection works and organizing staged acceptance based on the respective standards;

（5） Keeping systematic records of the environmental impacts of the construction activities, effects of the environmental protection measures and the implementation status of the environmental protection activities;

（6） Giving timely feedbacks to the construction supervision team on the relevant environmental protection measures and any unanticipated issues arising in the construction process and recommending solutions;

（7） Responsible for preparing the construction supervision plans and summary reports.

17.3 Terms of reference for construction supervision

（1） A sound and robust safeguard system should be set up for construction supervision.

It is required that a full-time environmental protection personnel should be assigned in the construction supervision team to conduct total quality management in accordance with the construction quality and environmental quality requirements. The environmental protection and construction supervision work of the Project will be supervised by the Municipal PMO, environmental specialist and the environmental protection bureau.

（2） Environmental protection management methods as well as their detailed rules of implementation should be developed.

Environmental protection regulations, such as environmental protection management methods and the detailed rules of implementation of the environmental protection work should be

developed based on the specific characteristics of the Project.

（3） A sound work procedure for construction supervision should be established.

a) Work record system, i.e. the “Supervision Diary”, which describes the results of inspection, environmental problems and cause analysis and responsible units as well as the preliminary solution, etc.

b) The various environmental protection checklists specified in the ECOP annexes should be prepared on a periodical basis.

c) Corrective measures should be proposed to any environmental problems existing in the construction activities of the construction contractor and their implementation status should be followed up with, including issuing notices of corrective actions, checklists and archiving of inspection documents.

d) Reports on the implementation status of the Project should be submitted to the Municipal PMO on a weekly basis.

18. Construction safety and health

The construction contractor is obliged to respect all the national and local safety requirements and take any other measures for accident avoidance to assure the safety and health of construction workers.

（1） The construction contractor should ensure that qualified first aid is available. Appropriate first aid devices should be provided at the construction sites and documented emergency handling procedure should be developed for remote sites so that the patient can be transferred to a suitable medical institution;

（2） Occupational health and safety training should be provided all newly recruited construction workers to introduce to them basic work rules on the construction site, rules of personal protection and how to prevent the other staff members from being injured;

（3） Warning signs should be attached on all powered electric devices and wires; all electricity wires, cables and electric tools on hand should be checked for any damaged or exposed wires and the maximum permissible operating voltage of tools on hand should be determined in accordance with the manufacturer's recommendations. All electrical equipment operating in humid (or possibly humid) environment should be double-insulation / grounded;

（4） Appropriate eye protection devices (such as welding goggles and / or masks) should be provided for all operators participating or assisting in the welding operations.

（5） Guardrails (with middle and peripheral baffles) should be installed at the edge of all vulnerable and dangerous areas. In addition, the construction workers should be provided with fall prevention devices (including safety belts and distance limiting ropes).

（6） The construction contractor should determine and provide the construction workers with appropriate personal protective devices that can adequately protect the workers themselves, other workers and occasional visitors and should not bring unnecessary inconvenience to the user.

（7） Health education should be provided to construction workers, e.g. implementing information communication strategies, enhancing face-to-face counseling, addressing systemic problems that affect individual behavior and encouraging individuals to take protective measures; in addition, the construction workers should be encouraged to use insect repellent, clothing, mosquito nets and other blocking methods to avoid disease spreading via mosquito bites.

（8） Prior to the commencement of the construction works, the Contractor should develop a Health & Safety Management Plan (HSMP), which should include analysis of occupational hazards and be subject to the approval and consent of the Supervision Engineer.

（9） Separate access roads should be provided for pedestrians and vehicles inside and outside the buildings and such access roads should be easy to use, safe and reliable and meet the respective needs;

（10） The employer should ensure that satisfactory first aid is available at all times. Efforts should be made in the entire workplace to provide an easily accessible first aid station equipped with appropriate first aid devices; if the first aid measures at the workstation should include immediate flushing of eyes with fresh water as recommended, an eyewash station and / or emergency shower equipment should be provided in the vicinity of all such workstations; documented emergency procedures should be avaid at remote locations to deal with traumatic or critically ill patients until it is likely to transfer the patient to an appropriate medical facility.

（11） During the work hours, the work places, the boilets and the other amenities should be maintained at a temperature within the range of temperature complying with the usage of the respective space.

（12） Occupational health and safety training should be provided all newly hired staff to give them a briefing on the basic rules of work and personal protection and how to prevent injuries to other employees.

Such training should include basic knowledge of hazards, specific hazards at the workplace, codes of conduct of work safety, fire emergency response procedures, evacuation procedures, and natural disaster management procedures. Such training should introduce in detail the specific hazards in the workplace and the color codes used.

（13） Basic vocational training courses and special courses should be provided, as needed, to ensure that employees are aware of the specific hazards involved each job assignment. Training should be provided to all managers, supervisors, employees, and occasional visitors allowed to enter areas involving risks and hazards; employees with rescue and first aid responsibilities should receive special training to prevent themselves or other employees from unintended exposure to more significant impacts and health hazards. Such training should include contents on how to prevent infection of pathogen in blood due to contact with body fluids and human tissue.

（14） Correct signs should be provided to indicate hazardous areas (e.g. power distribution rooms, compressor rooms, etc.), fixtures, materials, safety precautions, emergency exits, etc. Such signs should conform to international standards and be familiar and easy to understand for staff, visitors, the general public (as the case may be).

（15） Personal Protective Equipment (PPE) is designed to protect workers from possible harms from hazards at the workplace. Table 3.8-1 lists the various occupational hazards and the personal protective equipment provided for all purposes. The personal protective equipment should be used in the workplace in the following manners：

a) Personal Protective Equipment (PPE) should be used in an active manner if it is unlikely to eliminate or adequately reduce the degree of hazard or exposure using the other methods, work plans or operation procedures;

b) Suitable personal protective equipment should be identified and provided so that the respective worker, the other workers and occasional visitors are fully protected without causing unnecessary inconvenience to users.

c) The personal protective equipment should be correctly maintained, including cleaning contaminated appliances, replacing damaged or worn appliances. Proper use of personal protective equipment should be included as a content in the routine staff training;

d) Personal protective equipment should be selected according to the hazards existing on site and the classification methods mentioned earlier in this chapter and with reference to the

performance and test standards determined by the recognized authorities.

19. Traffic safety

Traffic accidents have become one of the most common causes of public injury and death in the world. All project staff must maintain traffic safety while traveling and leaving the workplace and operating the project equipment on free roads or public roads. The security measures to prevent and control the injury and death of traffic accidents should be designed to protect project workers and road users and victims of road traffic accidents. Based on the size and nature of the project activities, the following safety actions should be taken:

（1） Safety education and training should be organized on a periodical basis to particularly make the drivers aware of the importance of safe driving.

（2） To avoid fatigue driving, actions should be taken to limit driving time and make sure drivers drive in turns. To minimize traffic accidents, driving on dangerous roads and time periods should be avoided.

（3） Vehicles should be regularly maintained using manufacturer-approved spare parts, which should be purchased in a timely manner to prevent possible serious accidents due to equipment faults or premature failure of spare parts.

（4） Separation of pedestrian and motor vehicles should be realized.

（5） Traffic safety control measures should be taken and road signs and signal should be used to warn pedestrians and vehicles of any traffic dangers; road signs may be improved through cooperation with the local community and the competent authorities improve visibility of road signs and enhance traffic safety in an all-around way.

（6） Traffic safety and pedestrian safety education should be conducted in the communities in the vicinity of the project area and schools.

（7） To assure that appropriate first aid is provided in case of any accidents, communications should be kept with the emergency response workers.

（8） Locally purchased materials should be used where possible to minimize transportation distance;

（9） Driving techniques should be improved and it must be regarded as a mandatory requirement that drivers must hold licenses.

（10） Prior to the commencement of the construction works, the Contractor should develop a Health & Safety Management Plan (HSMP), which should include analysis of occupational hazards and be subject to the approval and consent of the Supervision Engineer.

20. Physical and cultural resources

Results of relevant surveys show that no cultural relics and ancient buildings are involved in the construction area of the road construction works.

In accordance with Article 32 of the Law of the People's Republic of China on Cultural Relics Protection (Oct. 28, 2002), "in the course of construction of a project or agricultural production, all units and individuals that discover cultural relics shall keep the scene intact and immediately report to the local administrative department for cultural relics; after receiving the report, the department shall, except under special circumstances, rush to the scene within 24 hours and put forth its proposals on the handling of the matter within seven days. The administrative department for cultural relics may report to and request the local people's government to inform the public security organ of the matter and to seek its assistance in keeping the scene intact; and where important cultural relics are discovered, the matter shall immediately be reported to the administrative department for cultural relics under the State Council, which shall put forth its proposal on the handling of the matter within 15 days after receiving the report. The cultural relics discovered in such a manner as mentioned in the preceding paragraph belong to the State, and no unit or individual may plunder, privately divide or conceal them." Based on the aforesaid legal and regulatory requirements, this ECOP proposes the following management requirements on cultural relics discovered during construction:

If any cultural relics are discovered during construction, the construction works should be immediately suspended to protect the scene and a report should be immediately delivered to the local cultural relics administration department. No further action taken should be taken without authorization. Upon receipt of the opinion of the cultural relics administration department on further action, the construction contractor should develop its construction program for the concerned section based on the opinion of the cultural relics administration department and should not resume the construction until a consent is obtained from the cultural relics administration department. No unit and individuals should continue the construction or carry out any production activities in the archaeological excavation area until such excavation is completed. No unit or individual should plunder, privately divide or conceal any cultural relics discovered during construction.

21. Environmental protection training and education

Training and education on environmental protection should include the following contents:

（1） Prior to the commencement of the Project, the Municipal PMO should assign an environmental specialist to provide environmental protection

training for the contractors and construction supervision agencies of the road construction works;

（2） Prior to the commencement of the construction works, the contractor of the road construction works should organize training and examinations for the operators on the construction sites on laws and regulations on environmental protection and health and sanitation;

（3） The contractor of the road construction works should organize staff training on the risk emergency response plan as well as emergency response rehearsals on a yearly basis.

（4） The contractor of the road construction works should organize occupational health training and physical examination on a half-year basis for operators handling toxic and hazardous substances and provide guidance to such operators on correct use of occupational disease prevention devices and personal labor protection devices.

（5） The civil works contractor oshould prepare a training plan to provide appropriate site briefing, dialogue toolkits, safety guidance to all employees and visitors. The training plan should also include details on training time and frequency.

Annex Table 1: Construction Site Checklist Prior to Mobilization

Name of subproject: Contract No. and Subproject Location:

Name of construction site: Weather condition:

Checked by: Date of construction site check:

S.N	Environmental issues	Yes	No	N/A	Note / Recommended actions
1	Is the Project located in a national / provincial/ county-level nature reserve? (If yes, the Project should be cancelled.)				
2	Is the Project located in an experimental zone of a national / provincial / county-level nature reserve? (If yes, the Project is eligible for construction, but permits from the concerned authorities are mandatory.)				
3	Will land acquisition for the Project cause significant deterioration or changes of the natural environment of a protection area, a recommended protection area or an area with unique ecological significance?				
4	Will the Project cause temporary or permanent relocation of or impacts of any other forms on the national / provincial or recommended national / provincial physical and cultural resources or physical and cultural resources identified through discussions with the APs?				
5	Does the Project involve any physical and cultural resources that are extremely sensitive for local residents (e.g. tombs)?				

6	Are there any known archaeological, historical or cultural relics (including ancient tombs, mausoleums) in the project area?				
7	Are there any endangered species (aquatic or terrestrial) in the project area?				
8	Are there any natural habitats in the project area?				
9	Are there any wetlands or saturated soil zones (permanent or temporary) in the project area?				
10	Will the construction of the Project cause any short-term impacts on the villagers' rights of use of the infrastructures, services and relevant resources?				
11	Are there a large number of objects of environmental protection (hospitals, schools, residential areas, villages, etc.) in the project-affected area?				
12	Is transplanting needed for the sidewalk trees involved in the Project?				
13	Are there any existing power supply facilities (cables, poles, and transformers), telecommunication facilities, water supply and drainage facilities and heating facilities in the construction site of the Project?				
14	Are there any conflicts with local traffic due to use of access roads (urban roads) for constructional purposes?				
15	Others (Please specify)				

Annex Table 2: Checklist for Environment Protection Inspection on Construction Sites

Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project

Serial No.:

Date:

Instructions:
This table is the checklist for environmental protection inspections in the construction stage of the road construction component of Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project and includes the environmental protection measures tailored to the specific subprojects and the local environmental conditions, which may be added or adjusted if necessary.

Name of subproject:

Contract No. and Subproject Location:

Name of construction site:

Weather condition:

Current construction stage:

Date of environmental protection inspection:

Specific time:

Weather condition:

Checked by:

Inspection Item		Implementation Status			Note
		Yes	No	N/A	
ECOP for the construction site	（1） Whether the relevant formalities are fulfilled for the project sites （construction and production areas, construction camps, construction access roads and construction material stockpiling sites）?				
	（2） Whether a survey of the existing pipelines has been properly carried out to avoid				

Inspection Item				Implementation Status			Note
				Yes	No	N/A	
			damages to existing pipelines during construction?				
			（3） Whether the construction contractors have, through consulting the town project organization, identified suitable public water sources and selected municipal tap water or existing drinking water sources in the nearby villages? Whether drilling of new wells is strictly banned?				
			（4） Others (Please specify)				
Construction site management	Control of environmental impacts in the construction areas of the main works	Clearing and grubbing	（1） Whether serious attention is paid to dust suppression through water spraying so as to abate dust pollution?				
			（2） Whether construction wastes and debris as generated are cleared out of site in a timely manner and enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
		Subgrade construction	（1） Whether strict control is implemented on the subgrade and pipeline excavation to avoid damages from over-excavation to surrounding vegetation? Whether any felling of trees outside the construction areas is prohibited?				
			（2） Whether waste soil as generated is cleared out of site in a timely manner and enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
			（3） Whether water is sprayed on construction site for dust suppression so as to abate dust pollution?				
		Slope trimming	（1） Whether exposed slopes are trimmed in time to reduce time of exposure?				
			（2） Whether exposed slopes are covered with dust prevention nets or sprayed with water for dust suppression to avoid dust pollution?				
		Ecological restoration	（1） Whether ecological restoration of damaged land is carried out prior to the completion of the construction works and such damaged land is at least restored to the status prior to construction?				
			（2） Whether arable top soil stripped during the construction is stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam? Whether temporary gutters and sand sedimentation measures are provided around the stockpiles? Whether the stockpiled top soil is covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities?				
		Bridge and culvert constructi	（1） Whether bridge and culvert construction is implemented in low-water season and the construction time is shortened where possible to reduce disturbance of the				

Inspection Item				Implementation Status			Note
				Yes	No	N/A	
			water systems?				
			（2） Whether maintenance and servicing of equipment is strengthened to reduce the frequency of oil leakage?				
			（3） Whether storage of asphalt, oils and chemicals and similar construction materials is prohibited in the vicinity of water systems?				
		Construction noise	（1） Whether the construction time is subject to strict control? Whether construction activities using plants and equipment generating strong noises on construction sites within a distance of less than 150m from the residential areas are suspended at night (from 22:00 pm to 06:00 am)? Whether the construction contractor contact the local EP authority and apply for permits for nighttime construction and disclose such information to obtain maximum public support?				
			（2） Whether mobile or temporary sound barriers and other noise prevention measures are used on sensitive sites in the vicinity of the construction site (with a distance of less than 50m)?				
			（3） Whether the construction site are located far away from schools and hospitals where possible? Whether the construction time for construction sites in the neighborhood of schools involving the use of strong-noise machinery is negotiated and agreed with the schools and no construction activities are arranged during the exam hours of the schools where possible?				
		Others	（1） Whether burning of wastes is prohibited on construction sites?				
	Control of environmental impacts in the construction and production areas	Clearing and grubbing	（1） Whether serious attention is paid to dust suppression through water spraying so as to abate dust pollution?				
			（2） Whether construction wastes and debris as generated are cleared out of site in a timely manner?				
		Concrete mixing	（1） Whether commodity concrete is selected as the top priority?				
			（2） Whether wet mixing is selected as the method of concrete mixing and the mixing process is carried out in an enclosed state?				
		Lime soil mixing	（1） Whether wet mixing is selected for the lime soil mixing plant, which is operated in a fenced enclosure?				
		loading and unloading and	（1） Whether windproof and covering measures or dust suppression measures are taken in the process of transportation, temporary storage and loading and unloading of earth, cement and lime among other bulk				

Inspection Item				Implementation Status			Note
				Yes	No	N/A	
			materials?				
			（2） Whether the material stockpiling site is flat and solid?				
			（3） Whether fencing measures are taken for stockpiling sites of construction materials, such as cement, lime and sand and stone, which are covered with tarpaulins to reduce pollution from storm water scouring?				
		Construction and transportation vehicles	（1） Whether vehicle washing facilities are provided at the entrances and exits of the construction sites so that vehicles are washed and cleaned upon departure? Whether roads connecting the vehicle washing equipment and the exit of the construction site are paved with concrete, asphalt or crushed brick to avoid possible take-away of mud and debris out of the site?				
			（2） Whether enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
		Precast yard	（1） Whether wastewater from concrete mixing are collected and treated in the sedimentation tank and reused for dust suppression on the construction sites? Whether the sedimentation tanks are backfilled for ecological restoration upon the completion of the construction works?				
		Construction noises	（1） Whether shock absorbers are provided on the bases of fixed mechanical equipment with strong vibration (e.g. mixers)?				
			（2） Whether fixed strong noise sources are provided with sound insulators (e.g. the power-generation trucks) or positioned and operated indoors?				
			（3） Whether the construction time is subject to strict control and construction activities using plants and equipment generating strong noises on construction sites within a distance of less than 150m from the residential areas are suspended at night (from 22:00 pm to 06:00 am)?				
		Others	（1） Whether damaged land is ecologically restored to at least the pre-construction state after the construction works is completed?				
			（2） Whether arable top soil stripped during the construction is stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam? Whether temporary gutters and sand sedimentation measures are provided around the stockpiles? Whether the stockpiled top soil is covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities?				
			（3） Whether burning of wastes is prohibited on construction sites?				
	Impacts of construction dust	Road dust	（1） Whether pavement of new access roads and hardening of sites are handled				

Inspection Item				Implementation Status			Note
				Yes	No	N/A	
			based on the design usage?				
			（2） Whether the access roads are maintained and cleaned every day and dust-prone sections sprayed with water for dust suppression?				
		Noise control	（1） Whether transportation vehicles are maintained according to the requirements in “Construction equipment management”?				
			（2） Whether the requirements in “Construction Traffic Management” are followed?				
		Control of ecological impacts	（1） Whether newly constructed access roads are ecologically restored to at least the pre-construction state after the construction works is completed?				
			（2） Whether arable top soil stripped during the construction is stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam? Whether temporary gutters and sand sedimentation measures are provided around the stockpiles? Whether the stockpiled top soil is covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities?				
			（3） Whether occupied or damaged local roads are relocated or subject to protective treatment such as pavement rehabilitation and landscaping upon the completion of the construction works? Whether compensation of a certain amount is paid to local governments to safeguard the righteous interests of local governments and residents?				
	Others (Please specify)						
Construction equipment management	Pollution control measures through reduction of oil leakage		（1） Whether state-of-the-art equipment and machinery are selected, if possible, to effectively reduce the number of oil leakage and machinery repair and thus the generation of oily wastewater?				
			（2） Whether solid oil-absorbing materials (e.g. cotton yarns, wood chips, oil-absorbing paper) are used in the process of inevitable oil leakage, where possible, and whether the waste oil is collected and transformed into the solid substances to avoid excessive generation of oily wastewater?				
			（3） Whether maintenance and servicing of machinery, equipment and transportation vehicles is carried out at centralized maintenance sites along each road section, if possible, for the sake of easy collection of oily wastewater?				
			（4） Whether horizontal sedimentation tanks are provided in the machinery maintenance sites and the oily wastewater is collected in the sedimentation tanks for simple treatment such as acid-alkaline neutralization, sedimentation, oil separation and debris removal before discharge? Whether the				

Inspection Item			Implementation Status			Note
			Yes	No	N/A	
		sedimentation tanks are backfilled with soil for landscaping upon completion of the construction works?				
		（5） Whether the ground surface of the equipment maintenance sites is paved and subject to anti-seepage treatment to avoid possible contamination of soil caused by oil leakage?				
		（6） Whether records of equipment repair and maintenance are developed to enable periodical maintenance based on the operation status of equipment?				
	Control of equipment noises	（1） Whether the construction contractor selects construction equipment and machinery and transportation vehicles conforming to the relevant national standards and select, if possible, low-noise construction plants?				
		（2） Whether shock absorbers are provided on the bases of fixed mechanical equipment with strong vibration and whether fixed strong noise sources (e.g. the power-generation trucks) should be provided with sound insulators or positioned and operated indoors?				
		（3） Whether maintenance and servicing of the various construction equipment are strengthened to keep them in fine operation (to fundamentally reduce the intensity of noise and vibration sources)?				
	Pollution control of equipment tail gas and exhaust gas	（1） Whether the construction contractor selects construction equipment and machinery and transportation vehicles conforming to the relevant national health protection standards and assures that the exhaust gas emission of such equipment and vehicles conforms to the relevant national standards?				
	Pollution control of solid wastes	（1） Whether waste oil and chemical solvents and other hazardous wastes are separately stored based on their nature? Whether such hazardous wastes are treated and disposed by a qualified unit？ Whether sites for temporary storage of hazardous wastes are provided with obvious signs and constructed in accordance with the "Pollution control standards for storage of hazardous wastes" (GB18597-2001)?				
		（2） Whether toxic and hazardous wastes requiring recovery (e.g. oil buckets) are recovered by material suppliers in principle and whether such responsibilities are defined in the material procurement contract?				
		（3） Whether recovery and disposal of hazardous wastes generated in a decentralized way (e.g. oil gloves, oil yarn heads) is carried out by qualified agencies authorized by the PMO?				
		（4） Whether oil and grease leaked into the soil is collected in a timely manner with scrapping devices and sealed up and				

Inspection Item			Implementation Status			Note
			Yes	No	N/A	
		transported to a qualified treatment plant for centralized treatment?				
		（5） Whether containers or solid oil-absorbing materials are used to collect the oily wastewater generated from such equipment when it is unlikely to carry out the maintenance and servicing of machinery, equipment and transportation vehicles at a designated maintenance site for each road section and whether the collected wastewater is sealed up and transported to an external site for further treatment? Whether a nearby disposal plant with the required qualifications for disposal of such wastes is selected?				
	Others (Please specify)					
	Storage requirements of chemicals	（1） Whether the inspectors carefully check the package and confirm if there are any leakages upon delivery of paints, diesel and gasoline into the construction site? Whether the delivered goods are rejected if any leakages are identified?				
		（2） Whether a special storage space is provided for storage of oils and chemical solvents and warning signs are erected; whether the floor is subject to anti-seepage treatment and absorbing bags, sand and chips among other emergency response materials are prepared?				
		（3） Whether accident emergency response plans are developed and workers are trained before mobilized on the construction sites?				
		（4） Others (Please specify)				
ECOP for construction camps	Site leveling	（1） Whether construction wastes and debris as generated are cleared out of site in a timely manner and enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
		（2） Whether water is sprayed for dust suppression so as to abate dust pollution?				
	Domestic sewage control	（1） Oil or grease traps should be provided in the canteen and a qualified unit with the waste digestion qualification certificate and business license approved by the competent authority should be employed to assure timely removal of wastes.				
		（2） Temporary toilets and septic tanks should be provided on the construction camps and should be subject to anti-seepage treatment.				

Inspection Item			Implementation Status			Note
			Yes	No	N/A	
		（3） Drainage gutters and sedimentation tanks should be provided on the construction camps. Filters should be installed on sewer pipes of canteen, washrooms and shower rooms. Construction wastewater should not be discharged into the municipal sewage pipeline or natural rivers until properly settled. In the meanwhile, the drainage ditches should be kept tidy and free of obstacles to assure smooth drainage.				
		（4） The construction camps should be kept in a smooth drainage condition and free of ponding of black and odor wastewater and unregulated urination and defecation				
		（5） Uncontrolled dump and discharge of domestic wastewater into agricultural irrigation canals is prohibited. No domestic solid wastes and construction wastes should be stockpiled around the aforesaid areas				
	Domestic exhaust gas control	（1） Clean energy, such as natural gas, electricity, should be used for cooking on the construction camps according to the requirements of local EP authorities				
	Solid waste control	（1） Recoverable wastes (e.g. waste paper, etc.) should be recovered and disposed by an authorized unit.				
		（2） Enclosed garbage stations should be provided in the construction camps for timely collection, removal and digestion of domestic solid wastes of staff according to the respective requirements				
		（3） Enclosed slop pails should be provided outside the canteen and be emptied and cleaned in a timely manner.				
		（4） The septic tanks should be emptied and cleaned by the authorized unit and should be backfilled upon the completion of the construction works.				
	Ecological impact control	（1） All temporary facilities should be demolished and the occupied site restored to the pre-construction state within one month as of the completion of the construction works				
		（2） Whether arable top soil stripped during the construction is stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam? Whether temporary gutters and sand sedimentation measures are provided around the stockpiles? Whether the stockpiled top soil is covered with dust prevention nets and reused for ecological restoration upon completion of the construction activities?				

Inspection Item				Implementation Status			Note
				Yes	No	N/A	
	Other requirements		（1） Use of clay bricks in construction of temporary facilities in the construction camp is prohibited and the safety and fire protection requirements and relevant national regulations should be respected				
			（2） The construction camps should be clearly distinguished from the construction areas and separation measures should be taken to assure that the construction camps remain in a tidy and orderly condition.				
			（3） Burning of wastes is prohibited in the construction camps.				
	Others (Please specify)						
ECOP of construction material stockpiling sites	Control of environmental impacts of borrowing sites	General requirements	（1） Deep excavation should be avoided in the construction process and all efforts should be made to achieve balance between excavation and earthwork fill. If borrow fill is needed, the prior choice is to purchase commodity soil or seeking waste soil from urban construction projects so as to avoid setting up new borrowing sites and thus fundamentally eliminate the environmental impacts of borrowing sites.				
			（2） Centralized borrow fill should be selected for the Project to reduce the number of borrowing sites				
		Dust control	（1） Attention should be paid to dust suppression through water spraying in the course of borrow fill operation to reduce dust pollution resulting from earthwork excavation.				
		Control of ecological impacts	（1） During excavation, the top soil should be preserved for land rehabilitation. The top soil should be stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam. Temporary gutters and sand sedimentation measures should be provided around the stockpiles. The stockpiled top soil should be covered with dust prevention nets and reused for ecological restoration of the borrowing sites upon completion of the construction activities.				
		Landscape control	（1） Respective environmental protection measures should be taken according to the requirements of Section XVII --- Control of Landscape Impacts				
	Control of impacts of soil-spoiling and waste disposal sites	General requirements	（1） If any waste soil is generated, the top choice is to have such waste soil reused on the same construction site or other construction sites or reused for vegetation restoration in the borrowing sites so as to avoid setting up new waste soil disposal sites and fundamentally eliminate environmental impacts in this regard.				
			（2） Whether a local survey is carried out				

Inspection Item				Implementation Status			Note
				Yes	No	N/A	
			to find out if any designated digestion sites exist locally for reasonable disposal of construction wastes and debris?				
		Dust control	（1） Layered compaction may effectively suppress dust on the soil-spoiling and waste disposal sites。				
			（2） Dust suppression should be carried out through water spraying to reduce dust pollution caused by exposed surface				
		Ecological impact control	（1） Whether the excavated top soil is used for land rehabilitation? Whether the top soil is stockpiled temporarily on a relatively flat area on the construction site and fenced up with bagged earth cofferdam? Whether temporary gutters and sand sedimentation measures are provided around the stockpiles and the stockpiled top soil is covered with dust prevention nets?				
		Landscape control	（1） Whether respective environmental protection measures are taken upon the completion of the construction works according to the requirements of “Control of Landscape Impacts”?				
	Others (Please specify)						
Soil erosion control plan	Construction area of the main works		（1） Whether the top soil is temporarily stockpiled on both sides of the right-of-way of the subgrade; whether a cofferdam of bagged earth is built up around the stockpile to avoid possible slides?				
			（2） Whether slope protection is carried out in a timely manner according to the principles of subgrade slope protection? Whether geotextile net grass protection slope is used along the filled embankment and retaining walls at certain individual sections?				
			（3） Sand sedimentation tanks should be provided at the outlet of the subgrade drainage gutters.				
	Prevention and control zone for the construction and production areas		（1） Whether the sites in the construction and production areas are paved with cement concrete?				
			（2） Whether temporary retaining ditches are provided outside the boundary of low-lying areas in the project area to prevent storm water scours in rain season?				
			（3） Whether top soil and material stockpiles are covered with dust prevention nets to prevent storm water scours and pollution to surrounding environment?				
			（4） Whether a reasonable construction schedule should be developed to shorten the time of temporary land occupation and vegetation restoration or land rehabilitation should be immediately implemented for the temporarily occupied land parcels upon completion of the Project.				
	Control zone for the construction		（1） Whether proper engineering protection and drainage facilities are				

Inspection Item			Implementation Status			Note
			Yes	No	N/A	
		constructed for newly developed access roads?				
		（2） Whether a reasonable construction schedule is developed to shorten the time of temporary land occupation?				
	Prevention and control zone for the construction camps	（1） Whether grass and shrubs are planted in areas except the camps and the hardened areas as a measure of temporary landscaping and beautification of the construction camps?				
		（2） Whether brick masonry drainage gutters are constructed for fast discharge of ponded water on site?				
		（3） Whether the camps and the hardened areas are demolished for land rehabilitation and vegetation restoration at the end of the Project?				
	Prevention and control zone for the soil-spoiling and waste disposal sites	（1） Whether the soil-spoiling and waste disposal site is selected in a reasonable way?				
		（2） Whether a retaining wall is constructed at the bottom part of the soil-spoiling and waste disposal site based on the topographical features of the soil-spoiling and waste disposal site prior to disposal operation? Whether such retaining wall is constructed in a safe, cost-effective and reasonable manner?				
		（3） Whether interception ditches are constructed at the upper slope of the soil-spoiling and waste disposal site to intercept slope runoffs? Whether sedimentation tanks are built on both ends and whether energy digestion facilities are provided?				
		（4） Whether the disposed wastes are rolled and compacted in time? Whether a 1-2m wide terrace is provided at a spacing of 5-6m along the elevation of the disposed waste?				
		（5） Whether ecological restoration is immediately implemented to the soil-spoiling and waste disposal sites upon the completion of the construction works?				
	Others (Please specify)					
Ecological restoration		（1） Whether ecological restoration is carried out, where possible, utilizing top soil stored in the process of clearing and grubbing?				
		（2） Whether landscaping is implemented through combination of trees, shrubs and grass? Whether extensive landscaping is achieved and no unoccupied space is left to prevent invasion by alien species?				
		（3） Whether alien species are not be selected as landscaping plants?				
		（4） Others (Please specify)				
Cultural relics protection		（1） Whether the construction works are immediately suspended to protect the scene				

Inspection Item		Implementation Status			Note
		Yes	No	N/A	
	under the supervision of the construction supervision engineer when any unmovable cultural relics (including ancient ruins, ancient tombs, etc.) are discovered during construction?				
	（2） Whether the EA develops its construction program for the concerned section after the appraisal or clearing is taken by the cultural relics administration department and resumes the construction after a consent is obtained from the cultural relics administration department?				
	（3） Whether any moveable cultural relics (including substances of daily life or production activities of different ages) discovered during construction are handed over to the cultural relics administration department?				
	（4） Others (Please specify)				
Construction traffic management	（1） Whether a reasonable construction schedule is developed to shorten the time of temporary land occupation?				
	（2） Whether enclosed transportation vehicles are used for transportation of earth, debris and construction wastes?				
	（3） Whether transportation of construction materials at night time is prohibited on any construction access road with a centralized area of residence in a distance of less than 50m?				
	（4） Whether construction and transportation vehicles avoid the peak hours of local roads to prevent traffic congestion and accidents?				
	（5） Whether construction vehicles travel along designated routes and unauthorized change of routes is prohibited to avoid possible damages to farmland and forest land?				
	（6） Others (Please specify)				
Public participation	（1） Whether a bulletin board is set up at the entrance of the construction site to disclose information of construction works and contact information for complaints and advices?				
	（2） Whether arrangements are made for environmental protection technicians to answer questions from the public on environmental protection?				
	（3） Whether the relevant formalities are fulfilled for and information is disclose to the local residents on any nighttime construction?				
	（4） Whether a public announcement is posted at least five days in advance at the construction site as well as the premises of affected households and enterprises to notify the public of the beginning and ending time of any possible suspension of municipal services (including water supply, power supply, and telephone and bus service) needed for the implementation of the construction works?				

Inspection Item		Implementation Status			Note
		Yes	No	N/A	
	（5） Whether all feedbacks, comments and questions from the public are recorded and archived and subject to inspection by the supervision unit?				
	（6） Others (Please specify)				
Social and environmental impact control	（1） Whether the various LAR subsidies are allocated to the concerned village groups and individuals based on the compensation standards of the national government and Zhejiang Province? Whether the arable land and labor force are reasonably adjusted through full enforcement of the relevant policies?				
	（2） Whether construction and transportation vehicles avoid the peak hours of local roads to prevent traffic congestion and accidents?				
	（3） Whether local roads occupied or damaged in the construction of the proposed road constructions are relocated or subject to protective treatment such as pavement rehabilitation and landscaping at the end of the construction works? Whether compensation of a certain amount is paid to local governments to safeguard the righteous interests of local governments and residents?				
	（4） Others (Please specify)				
Occupational health	（1） Whether warning signs or instructions are provided at operation positions, equipment and sites prone to occupational hazards on the construction sites?				
	（2） Whether occupational health training and physical examination are organized on a periodical basis for staff handling toxic and hazardous substances and guidance provided on correct use of occupational disease prevention devices and personal labor protection devices?				
	（3） Whether the construction contractor provides the construction workers with personal labor protection devices?				
	（4） Whether low-noise equipment is selected on construction sites and operators wear ear plugs for hearing protection?				
	（5） Whether forced ventilation facilities are provided in operation areas where good natural ventilation is not guaranteed and whether operators working in sites involving toxic and hazardous gases are properly protected?				
	（6） Whether operators wear dust masks in dusty operation sites?				
	（7） Whether operators in welding operations wear protective masks, goggles and gloves and other personal protective equipment?				
	（8） Whether summer cooling supplies				

Inspection Item		Implementation Status			Note
		Yes	No	N/A	
	are provided on construction sites where high-temperature operations are involved and reasonable arrangements are made for work and rest timetable?				
	（9） Others (Please specify)				
Health and epidemic prevention	（1） Whether respective health standards are satisfied in terms of meals, drinking water, rest places provided for staff on the construction sites (and health certificates are available)?				
	（2） Whether dormitories, canteens, bathrooms and toilets are properly ventilated and illuminated, with full-time personnel assigned and responsible for routine maintenance?				
	（3） Whether openable windows are provided for dormitories on construction sites as required? Whether beds in staff dormitories are not more than 2 tiers and large multi-person bed is prohibited?				
	（4） Whether valid health permits issued by the relevant departments are available at canteens and all cooks hold valid health certificates?				
	（5） Whether the canteens are located away from toilets, garbage stations, toxic and hazardous places and other pollution sources as required?				
	（6） Whether independent preparation rooms and storage room are provided in the canteens and mouse guards of no less than 0.2m high are provided at the bottom of the doors?				
	（7） Whether toilets, sanitary facilities, drainage gutters and dark and humid areas are sterilized on a periodical basis (and respective records are maintained)?				
	（8） Whether enclosed containers are provided in the living areas and flies are periodically killed and containers emptied in a timely manner?				
	（9） Whether clinics are provided on construction sites and equipped with health kits, frequently used drugs and bandages, tourniquets, neck care, stretchers and other first aid devices?				
	（10） Whether any incidents of infectious diseases, food poisoning, acute occupational poisoning of the construction workers are promptly reported to the local health and epidemic prevention authorities and construction administration authorities and corresponding actions are taken in accordance with the relevant provisions of the health and				

Inspection Item		Implementation Status			Note
		Yes	No	N/A	
	epidemic prevention authorities?				
	（11） Others (Please specify)				
Environmental protection training and education	（1） Whether environmental protection training is provided for the contractors and construction supervision agencies of the road construction works?				
	（2） Whether training and examinations are organized for the operators on the construction sites on laws and regulations on environmental protection and health and sanitation?				
	（3） Whether training on the risk emergency response plan as well as emergency response rehearsals are organized for staff?				
	（4） Whether occupational health training and physical examination are organized for operators handling toxic and hazardous substances?				
Others (Please specify)					

Checked by: (signature)_____ Time:_____

Supervision Engineer: (signature)_____ Time:_____

Notes:

(1) Information to be noted may include problems observed on site, remarks on non-conforming situations and recommended corrective or preventive actions.

(2) In the event of any unacceptable measures or situations requiring further improvement identified during site inspection, the Supervision Engineer may immediately issue an “Instruction on Environmental Protection Corrections” to the contractor and indicate the serial number of the Instruction herein. Details of corrective actions taken by the contractor need to be recorded separately.

(3) This table is the checklist for environmental protection inspections in the construction stage of the road construction works and is applicable to the specific subprojects and specific environmental problems. This table may be adjusted and corresponding measures of environmental protection may be taken, where appropriate, based on local environmental conditions and construction components.

Annex Table 3: Instruction on Environmental Protection Corrections

When the Supervision Engineer discovers, during site inspection, any non-conforming environmental protection measures or situations requiring improvement or violating the contract clauses, the Supervision Engineer shall immediately issue an “Instruction on Environmental Protection Corrections” to the Contractor and note the serial number of the “Instruction on Environmental Protection Corrections” in the Remarks column.

Instruction on Environmental Protection Corrections
S. N.：_____ Contract Number and Description: _____ Name of Subproject:_____ _____ Name of Construction Site: _____ Current Construction Stage: _____
Problems existing during site inspection: Checked by:_____ Date:_____
Contractor’s cause analysis and corrective actions: Contractor: _____ Date:_____
Comments by Supervision Engineer: Supervision engineer:_____Date:_____
Opinions by Environmental Protection Authority (when necessary): Contact person:_____ Date:_____
Deadline of correction: To be corrected by (Date): _____ Contractor:_____Date: _____

Supervision Engineer:_____Date:_____
Conclusion of review: Reviewed by: _____Date:_____

Annex Table 4: Checklist of Environmental Protection Inspection Prior to Project Completion and Hand-over

Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Environment Protection Project

Serial No.:

Date:

Instructions:
This table is the checklist for environmental protection inspections in the construction stage of the road construction component of the Project and includes the environmental protection measures tailored to the specific subprojects and the local environmental conditions, which may be added or adjusted if necessary.

Name of subproject:

Contract No. and Subproject Location:

Name of construction site:

Current construction stage:

Date of environmental protection inspection:

Specific time:

Weather condition:

Checked by:

Item of inspection	Status of implementation		N/A	Note (e.g. problems or non-conformities observed, recommended corrective or preventive actions)
	Implemented	Not implemented		
1. Are all the construction wastes on the construction sites removed and transported to the municipal solid waste landfill site?				
2. Are actions taken against the acoustic environment protection objects along the road?				
3. Are ecological protection measures taken for the temporary waste (debris) disposal sites?				
4. Have the traffic conditions of the existing rural roads used as access roads deteriorated or improved?				
5. Have the hardened concrete mixing sites been demolished?				
6. Are land rehabilitation, restoration or landscaping				

Item of inspection	Status of implementation		N/A	Note (e.g. problems or non-conformities observed, recommended corrective or preventive actions)
	Implemented	Not implemented		
measures taken for land parcels temporarily occupied by the concrete mixing plants?				
7. Are the temporary sedimentation tanks and sand sedimentation tanks demolished?				
8. Are land rehabilitation, restoration or landscaping measures taken for land parcels temporarily occupied by the sedimentation tanks and sand sedimentation tanks?				
9. Are the temporary road shoulder water retaining curbs and temporary chutes and drainage gutters demolished and corresponding measures of ecological restoration taken?				
10. Are the subgrade slopes landscaped?				
11. Is the road drainage system in a sound condition?				
12. Have the project owners of the subprojects carried out training and education activities?				
13. Are the local public satisfied with the road works constructed under the Project?				

* Any local and existing item recorded as “not implemented” might indicate any condition that is non-conforming or needs further improvement. In such an event, the Supervision Engineer shall immediately issue to the Contractor an “Instruction on Environmental Protection Corrections” and note the serial number. Details of corrective actions taken by the contractor need to be recorded separately.